VOICE CNPN 5G PROJECTS
Covering Various Verticals
&
CNPN SPECTRUM WHITE PAPER

(January 2024)

ITI and TCIL can act as System Integrator for the projects.

VOICE WHITEPAPER ON SPECTRUM ISSUES OF CNPN NETWORKs

VOICE CNPN Projects covering 5G End to End Solutions

1. TETRA Substitution in METRO Networks

2. NWR Test Bed Project

3. Mobile Mesh Network with Network in Box

4. Power Grid

5. Mining 1

6. Mining 2

7. Rural ecosystem Enablement

8. Drone based Network Radio Frequency exposure

9. Enabling Innovation in IOT M2M

10. Enabling Smart Farming

11. Smart Refinery

12. Smart Villages

13. Ocean Floating Telecom Tower

14. Gram Panchayat

15. Captive Network for PSUs & Enterprises

16. Wireless Access Network & Network Manager

17. Oil & Gas

18. Multiple Vertical Use Cases through Niral 5G Core

19. Bank on Wheel

20. Major Dam & Irrigation

21. Coal Mines

22. Solution for Ports

23. Smart City

24. Solution for Railways and Mining

25. Lab Proposal

26. Model Village

27. Captive non-public Network with E-Band

28. Strategic & Disaster Management

VOICE WHITE PAPER

CNPN and SPECTRUM ALLOCATION

Case in favour of administrative approval of spectrum directly to Enterprises and/or CNPN service providers for Setting Up Enterprise Mobile Networks.

VoICE WHITE PAPER
Case in favour of administrative approval of spectrum directly to Enterprises and/or CNPN service providers for Setting Up Enterprise Mobile Networks.

Reference: The Telecom Act Schedule 1

At this stage, we are on the right track for global adoption of India's 4G/ 5G stack and the Government's intent to ensure that the country becomes an export engine of products, of technologies, aligning with Hon'ble Prime Minister very clear vision of Indian Global leadership, needs appreciation.

In India, deployment of Captive Non-public Network by Enterprise is at nascent stage. The ecosystem for CNPN use cases in Government (Railways, Armed Forces, Power/ Mining/ Smart City etc) , PSUs, Industrial Infrastructure projects etc are dependent upon the availability of wireless spectrum to Enterprises in an affordable manner instead of relying on just Fiber connectivity. There are advantages of private networks working on dedicated spectrum over fixed line network / fiber such as it would be less expensive to modify existing deployed networks and there would not be any limit of number of devices which can be connected and even minimal downtime during network modifications can be ensured.

There is a large market for Captive Non-Public Networks (CNPN), for enterprise & in-building / in- campus customer segment. **The Telecommunications Act 2023 envisages regulatory support to innovation and technology development.** Domestic telecom industry including MSMEs have tremendous strength in the mobile technology domain including 2G, 4G and is rapidly evolving in 5G also. The CNPN licensing framework has been defined but deployment of CNPN by Enterprises has not taken off. Access service providers have not found it commercially viable so far. Other players are not able to obtain spectrum for the limited purpose of the CNPN networking at a reasonable cost or on lease basis from the spectrum holders.

Additionally, there is a requirement to enhance the scope of services of CNPN licensee by allowing to deploy CNPN for Enterprises using the assigned spectrum. Since Spectrum is expected to be allocated for specific campus/ localised area, CNPN licensee will be able to re-use same spectrum for multiple enterprises or Industry verticals at different locations to achieve optimal spectrum efficiency. Moreover, same channel can be licensed to multiple companies located at different geographies to ensure optimal spectrum utilization.

Additionally, Spectrum leasing should also be allowed for deployment of CNPN in line with the provisions made in the Telecommunications Act 2023. These measures will be a significant contribution in the overall growth of the GDP due to productivity enhancement across Industries and a major boost to Make In India initiative. It is also pertinent to highlight that Industry 4.0 is one of the key drivers for Private networks. It is an automation and data exchange solution based on IoT, AI, cloud computing and robotics to make industrial operations efficient and affordable. Accelerating Industry
4.1 is one of the key missions specified by DoT in NDCP policy 2018. In order to achieve that, there is an immense need to focus on specific network requirements of industry 4.0.

Therefore, for the success of CNPN, it is important that these Enterprise solution providers get domestic market access and handholding to initial commercialization in domestic market with direct spectrum assignment to Enterprises and/or CNPN service providers for deployment of their captive private networks to meet their digital transformation requirements.

a. Further, it is pertinent to mention that the organisations/ Enterprises deploying their own captive networks, would be amongst the largest buyers of domestic telecom equipment and technical know-how. CNPN/ Enterprise Service Providers would act as enabler for Enterprises and/or CNPN service providers in deployment and maintenance of their private networks.

b. To support the domestic industry adoption of Captive Non-Public Network (CNPN) solutions designed by domestic and MSME companies must be encouraged, a small chunk of spectrum may be allocated in line with TRAI recommendations. Spectrum in suitable IMT bands (like mid-band - 3.3 GHz) may be assigned directly to Enterprise and/ or CNPN Service provider administratively as per TRAI recommendations and in spirit of New Telecommunication bill. The same will reduce the dependence on TSPs (Mobile Network Operators) and consequent influence on decision by MNC players. This will help domestic product companies come out with innovative products and solutions to support such in building applications effectively for CNPN related use cases thereby benefitting the Enterprises and contribute significantly in the success of Industry 4.0 Government initiative.

c. Additionally transformative potential of IoT for economies and societies is vast, yet the technologies and ecosystem are still in early development. Proactive regulatory measures are essential to foster competition and support a dynamic IoT market. World-wide IOT devices as well as other M2M devices which require very low bandwidth to operate but need great penetration inside the buildings work efficiently on 2G technology. Billions of such modems/ devices are already in use by MSMEs and other small enterprises. To replace all every 2-3 years with launch of new technology which is data centric does not make any business case. Accordingly, a small chunk of spectrum in 2G preferably in 800/ 900 Band should be made available free of cost to cater to these IOT / in building and M2M devices only. This should not be used for any other commercial purpose.

d. Some of the regulatory measures can be considered by the Government including allocating specific frequencies in GSM and LTE bands (i.e., 850, 900, 1800 & 1900 MHz bands, may be about 2 MHz in GSM bands and about 5+5 MHz in 1900 bands may be allocated. This will enable the domestic industry to design & develop IOT systems in these frequency bands and conduct trials of equipment developed in-house. This will help the country to become an export engine of products and technologies.

e. In this regard, it may be kindly recall that in the NFAP 2011 released April 2011 had provisions under IND-50 and IND-55. However, these provisions were somehow removed in the revised NFAP 2022.

Private mobile networks provide dedicated and customized connectivity solutions tailored to the unique needs of enterprises across various sectors. While telco networks are standardized products

more tilted towards retail services in contrast Enterprise networks are more customised requiring handholding and software customisation, where India scores above others. Enterprise networks would be greenfield deployments without legacy handicaps. There are several possible use cases which can be deployed in the CNPN by Enterprises and/or CNPN service providers. Some of them are listed below –

Industry Agnostic
- Video Surveillance
- Environmental monitoring
- Edge based analytics
- Smart warehousing
- Employee Safety
- Predictive maintenance

Manufacturing and Mining
- Industrial IoT based automation
- Predictive maintenance
- Automated inspection & quality control
- Industrial Robotics & Cobots
- Remote operations

Stadiums and Venues
- Fan engagement
- Crowd management & safety
- Immersive experience
- Remote production
- Personalized consumption

Ports
- Connected GSEs
- Smart cargo and material handling
- AGVs and robotics
- Asset tracking
- Preventive maintenance

Horizontal Technology
- AR/VR based applications
- Drone applications
- Mobility related applications
- Autonomous vehicles
- Asset tracking

Campus Mobility and Logistics
- Smart yard management
- Passenger management & safety
- Smart cargo and material handling
- Remote operations
- Predictive and preventive maintenance

Agriculture
- Massive sensor network
- Irrigation and water management
- Optimized & targeted feed
- Localized treatment for weeds
- Geo fencing and safety

Hospitals
- Smart wards
- Remote surgical training
- Asset tracking - eHealth devices
- Video surveillance
- Push-to-talk communication

However, to effectively establish and operate private mobile networks, the allocation of dedicated spectrum is crucial to Enterprises and/or CNPN service providers and any restrictions and control will be an impediment to growth innovation and experimentation.

- Unless spectrum allocation is freely available to Enterprises and/or CNPN service providers dependence on TSPs will act as an inertia for adoption of solutions developed by domestic design companies.
- TSPs have significant dependence on existing equipment vendors who would influence decision making so it's important that CNPN deployments should be free from TSP's interference which can only be made possible with the direct assignment of spectrum to Enterprises and/or CNPN service providers
- SLA signed between TSPs and existing equipment vendor would be cited as reasons for insistence on products of MNC equipment vendors or insistence on protocols not supported by MSME may be made the basis for eliminating domestic products.
- Legacy protocols not required in private greenfield deployments. Feature set required in CNPN is a subset of the telco grade deployment and reduced feature sets should be allowed for TEC certification of CNPN.
- Creativity and experimentation will be sacrificed in favour of legacy protection and cost of deployment will be high.
- TSPs are known to add up to 40% of the cost for providing spectrum. Since same spectrum can be re-used hence direct allocation of spectrum to Enterprises and/or CNPN service providers will substantially reduce the cost burden.

Need recognized in past

NFAP 2000, provided for 30 MHz (1880 -1900 & 1900–1910 MHz vide India notes 49 & 50) for indigenously developed technologies.

NFAP 2008 diluted it by allowing spectrum band 1900–1910 paired with 1980 - 1990 for Cellular operation but clause for indigenous technologies was dropped in India notes 54.

NFAP 2011 (Footnotes 50 & 55) earmark small chunks of GSM band frequency for setting up private / captive networks based on indigenously developed technology. These provisions were made, on forceful requests of three Indian design companies, despite tremendous resistance by the telecom operators.

However, these provisions were somehow removed in the revised NFAP 2022.

"IND 50"   Requirements for Micro cellular low powered, telecommunication systems with maximum EIRP up to 4 Watts, FDD access techniques may be considered at specific locations for indigenously developed systems and technology, in a small chunk, in the frequency band 900 MHz presently used by existing wireless users of captive systems subject to co-ordination on case-by-case basis".

"IND 55"   Requirements for Micro cellular low powered telecommunication systems with maximum EIRP up to 4 Watts, FDD access techniques may be considered at specific locations for indigenously developed systems and technology, in a small chunk, in the frequency band 1800 MHz presently used by existing wireless users of captive systems subject to co-ordination on case-by-case basis"

Size of Opportunity

The market for private mobile networks is witnessing significant growth on a global scale, driven by the increasing demand for secure and dedicated communication solutions across various industries. According to market research reports, the global market for private LTE and 5G networks is projected to exceed 16 billion by 2026 and market in India is expected to exceed Rs 24000 Crore growing at a CAGR of around 40% over the next few years.

Drivers for CNPN Who are the buyers
  ➢ Every Office, every campus, every building & housing society needs it and they are all shifting to IP based communication. Sectors such as manufacturing, energy, transportation, healthcare, and public safety will increasingly leveraging private mobile networks to enhance operational efficiency, improve safety standards apart from the above industries, Railways, Defense, CPWD, Metro, MHA, would also be significantly benefited with CNPN deployments.

  ➢ Enhanced Network Control and Security sensitive campuses of ISRO, BARC & other Government campuses would need private networks that would offer greater control over their communication infrastructure.

  ➢ Government offices looking for secured private solutions for security not dependent on Telco networks. e.g : ISRO / BARC

  ➢ Large campuses that require mobility e.g. Oil rigs, Ship, Submarine, Island resort, Accident sites.

  ➢ Industry 4.0 for High-speed low latency network. Increased adoption of Industry 4.0

technologies, the push for digital transformation, needs reliable, secure high speed, low latency network in the campus to address the need low-latency connections for real-time monitoring and control systems. Internet of Things (IoT) devices, robotics, and automation for machine-to-machine communication need robust connectivity.

➢ Smart cities for similar technical requirements as above would further fuel the demand for private mobile networks. To fully leverage the potential of these transformative technologies, fostering innovation and growth in various sectors they would need CNPN.

➢ Disaster Relief operations with vehicle mounted systems. NDMA

➢ Healthcare for Realtime data exchange that 5G networks will support for telemedicine and remote patient monitoring

➢ Utility companies Airports, Ports, Stadiums, Police for wireless private emergency communication.

➢ Police control systems substitutes for Tetra based imported communication.

Private networks with dedicated spectrum will allow Enterprises and/or CNPN service providers to establish their own networks, that prioritize bandwidth allocation, optimize coverage, and ensure network security. Unlike public networks, private mobile networks can be designed with specific security protocols and encryption standards, safeguarding sensitive data and providing a more reliable and secure environment for critical operations.

How will Open spectrum allocation help Voice members & end customers

The open spectrum allocation policy can significantly benefit the design development of 4G or 5G technology by fostering innovation, encouraging competition, and promoting a level playing field for various stakeholders.
➢ **Encouraging Innovation**: Open spectrum allocation allows a wider range unrestricted by licence holders, for active participants, including design companies, startups, and research institutions, to access and utilize spectrum resources for their innovative solutions.
➢ **Greater competition** will benefits end-users with more choices hence better price discovery
➢ **Supporting Collaboration and Ecosystem Development**: Open spectrum allocation encourages collaboration and partnerships among different stakeholders, including design companies, equipment manufacturers, service providers, and academia. By fostering an open and collaborative environment, it promotes knowledge sharing, technology exchange, and joint initiatives. This collaborative approach facilitates the development of a robust ecosystem around 4G or 5G technology, accelerating the pace of design innovation, and driving the overall advancement of the technology landscape
➢ **Opportunity to experiment, test, and validate their 4G or 5G designs** in real-world. This iterative process is crucial for driving design development and technological advancements
➢ This **promotes a more diverse and competitive market environment**, stimulating increased research and development efforts in 4G or 5G technology. With more players actively engaged, the potential for breakthrough design developments and novel applications of the technology is amplified.

The moment deployment of CNPN is controlled by TSPs there would be restrictions imposed because of legacy mindset and control systems and also the same would not be commercially viable for Enterprises and/or CNPN service providers to allow TSPs to deploy and maintain their CNPNs.

Key Challenges for CNPN deployment through TSPs (Mobile Network Operators):

Under Industry4.0 Enterprise connectivity would require utmost customer centric approach where network's reliability, speed, latency, efficiency, density each need to be defined by the Enterprises and can vary for each Enterprises depending on their operational requirement. For example, 5G captive network for a manufacturing plant with large assembly line would be completely different from the Airports or Mines.

There are multiple options enabled by the Department of Telecommunications for mobile network operators through the recent guidelines released for CNPN (Captive Non-public Networks).

1. Spectrum leasing is one such option where there is underutilized spectrum available with them from their auction acquired spectrum bands. MNOs could lease the spectrum to potential enterprises for building captive private networks for their respective locations. However, given the current mobile services industry scenario in India, IMT spectrums for public networks has been a scarcity as the available spectrum and its utilisation is significantly high across all the mobile services providers. Hence, spectrum leasing to enterprises is not being followed as a viable option by the mobile network providers. There is also a possibility of interference of public network coverage with the captive private networks due to proximity.

2. The other option is that TSPs could use their existing public network infrastructure to provide the CNPN to an enterprise by creating a virtual slice of capacity in the public network. There are significant technical challenges in this scenario as the traffic and performance needs of the public networks and private networks are completely different. Public networks have dynamic & significantly varying utilisation of the capacity through the day in line with busy hour traffic trends, while captive private networks need uniform and stringent SLAs as CNPNs are deployed to manage their mission critical applications. Also, public networks generally downlink centric with over 75-80% of downlink utilisation while private networks would be more uplink centric due to industrial applications and use cases. This poses a major challenge to the frame structures & synchronization being used for the slice. Since the same spectrum & capacity is being shared by both public and private networks, managing quality of services due to varied utilisation between both, is a significant issue.

 Global development around captive networks:

Global developments are corroborating the fact that private cellular networks would be the founding stones for the industrial revolution. To realize the full potential of this 5G-based revolution, spectrum access should be available to large enterprises as well as SMEs to ensure mass adoption. Hence, spectrum allocation and governance framework need to be such that even a small enterprise should be able to avail and use it.

There are a few incentives which will ensure SMEs adopt for private networks –
  - ➢ **Affordability** – Spectrum should be available either free of costs or alternatively at nominal (annual or one time) fees to ensure fair opportunity to SMEs.
  - ➢ **Ease of governance** – Application process needs to be simple allowing easy use of spectrum across the geographies including rural areas.
  - ➢ **Flexible period** – Spectrum allocation period is needed to use the spectrum according to need of SMEs.

To fulfill all these criteria, we suggest light touch registration framework for the Enterprises to be allocated spectrum for private networks with following conditions:

➢ **Light touch regulation for spectrum allocation** – Spectrum should be allocated directly to enterprises and/or CNPN Service provider in an administrative allocation under registration mechanism with geographic allocation for captive use.

➢ **Affordable** – Licenses need to be allocated at nominal (annual or one time) fees, based on pro-rata costing factoring in the private use aspect to ensure fair opportunity to all the sizes of enterprises and Industry verticals in India. Like Germany, India can set license fee based on various parameters like coverage area, frequency, bandwidth, rural or urban location, license duration etc.

➢ **Ease of governance** – Allocation process needs to be simple registration based allowing easy use of spectrum across the geographies including rural areas.

➢ **Flexible period** – Licensing period for private networks needs to be flexible where a companies can acquire license as per their needs. This is necessary to ensure need-based spectrum allocation and optimal spectrum utilization.

➢ **Reuse of Spectrum** – Since Spectrum is expected to be allocated for specific campus/ localised area, hence it suggested to allocate same spectrum to multiple enterprises or Industry verticals at different locations to achieve optimal spectrum efficiency.

Direct allocation of spectrum at reasonable price would provide multiple benefits to the enterprise / industry verticals.

Few of these benefits are:

➢ **Control:** It will provide complete control to them on their private network without any dependency on telco operator or others and full freedom to unleash the potential for Industry 4.0 transformation.

➢ **Innovation**: It will enable significant opportunity to innovate and create prudent use cases relevant to their industry and business.

➢ **Flexibility**: It will provide flexibility to create relevant network topology and architecture needed for their business within their campuses.

Captive network spectrum charging proposed methodology:

➢ Typical frequency spectrums for 5G private networks are popular in mid-band and mmWave category. TRAI has already recommended few such frequency bands for direct allocation to enterprises and industry verticals for captive non-public networks in India.

➢ In the recently concluded spectrum auctions, Department of Telecom has already achieved the market determined price for both mid-band as well as mmWave spectrum bands which was bought by incumbent Mobile network operators as well as one new operator for their 5G rollouts.

➢ Block size 10MHz for mid-band and 50MHz for Wave 50MHz of block size is already formulated.

➢ The license of these operators permits them to cover any of the licensed service area (LSA) with the respective spectrum for public networks and provide services as stipulated in the licensing

conditions.

➢ If we exclude the forest and unproductive lands in different LSAs, nearly 70% of the geographical area is a potential for any public mobile network operator for which the operator deploys his network coverage with respective spectrums. However, for CNPN there is no need to cover the entire geography and what is needed for an enterprise, or an industry vertical is to cover just their campus, factories, ports, mines, plants, etc which is just a fraction of the total LSA geography.

➢ Department of Telecommunications (DoT) can leverage the existing pricing methodology, by calculating the cost of per square meter of deployable area.

➢ Proposed CNPN Spectrum License duration – 10 Years

Global references:
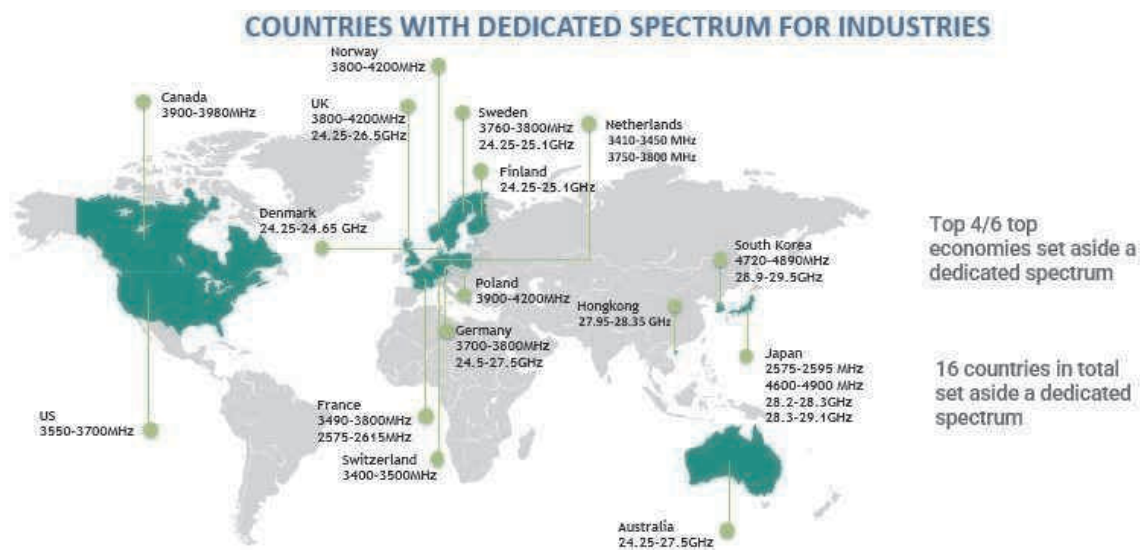
Conclusion

A liberalized policy on setting up Captive Private Mobile Networks can be the game changer that can resurrect the domestic design and manufacturing ecosystem. It will open up opportunities for innovative solutions for not only Mining, Defense, remote locations, refineries, utility companies but also for providing "in building solutions" to address coverage and spectrum availability issues. VOICE demands a liberal and open mechanism for administrative allocation of spectrum and reserving CNPN domain for deployment of domestic design products only.

VOICE CNPN PROJECT 1
5G TETRA SUBSTITUTION in METRO Networks

5G Deployment at NAVI MUMBAI METRO Phase 1 from CBD BELAPUR to PENDHAR
Mission Critical Services for Public Safety

Objective

The Project shall support building a TETRA substitution solution that can be delivered rather quickly with some support from the concerned authorities. Conventional solutions have a ready well- established market and now many countries are replacing TETRA based public safety networks with 4G technology and will eventually shift to 5G. Objective of the proposed project is to set up a live pilot using domestic designed 4G / 5G products to set up a network that meets and exceeds all TETRA functionalities used in Metro train communication. This project will seamlessly work with Unified communication systems of Metro trains and will be combining mission-critical voice features with multi-media services, to enable unprecedented use cases such as multimedia talk groups, collaboration tools and integrated command and control. These new capabilities will in turn transform the way agencies respond to incidents, improve their efi ciency through streamlined workflows, and enhance the safety of frontline personnel because of better \ awareness.

Category

Import substitution & development of Indian solution with domestic specifications.

Project

Build a live 5G set up at Navi Mumbai Metro Stations that will be used to test & interop with various subsystems in Metro Network. Test bed would be set up at Navi Mumbai Metro CBD Belapur Station and CIDCO Science Park Metro Station connected over IP MPLS backbone for test & experimentation that can be carried out with various equipment.

Objective

Define specifications & API required for setting up a converged 5G communication network for Navi Mumbai Metro. It would be used to define Navi Mumbai Metro network specifications while conforming to overarching global 3GPP architecture to meet Indian requirements and provide seamless inter-operability with legacy time-tested devices.

Navi Mumbai Metro live test bed will ensure that essential controls and algorithms driving the system are initiated and remain in control of Navi Mumbai Metro. Navi Mumbai Metro test bed would be specifically used to ensure and build a roadmap for the following: -

Vendor Inter-operability

Navi Mumbai Metro has to follow a multi-vendor approach hence defining protocols for inter

working would be cardinally important while insistence on 3GPP to ensure overall compliance to global standards and availability of global supply chain for critical components of the network. It is essential that each component of the network i.e. Core, IMS, Radio, MCX, IP PABX, PA system, Voice loggers & devices comply with basic technical specifications of 3GPP. Proposed network would use each sub systems from at least two vendors of Indian design. In exceptional cases, design with foreign origin can also be used say for reference purpose.

Navi Mumbai Metro Specific API

Each OEM would also ensure seamless interoperability with APIs decided by Navi Mumbai Metro for its custom operations & seamless functioning with IPPABX, PA system, Free space mic, Voice recording system etc. while complying to overarching 3GPP specifications.

Building AI (!rtificial intelligence)

Artificial Intelligence is the natural normal roadmap at present. Intelligent and "usage aware" network would have significantly lower operational cost, since devices which are not in use upto now, will hibernate saving energy and resources. This will significantly reduce the Return on Investments compared to legacy networks. Testing and trial on some of the following would be initiated.

   i. **Provide 5G coverage in Navi Mumbai Metro Stations** in one line for seamless working over IP MPLS.

  ii. Seamless Integration of all stations of Navi Mumbai Metro Project communications systems like IPPABX, PA system, Free space mic, Voice recording system, Security agencies with 5G network.

  iii. **Mission Critical Services (MCX)** with Multicast & Broadcast services, eMBMS, Floor Control services, MCPTT for Communication between Control Room, Station Manager and Security Staffs.

  iv. **Demonstration of IoT services** over 5G including Camera surveillance, Help Desks and various sensors used in Navi Mumbai Metro.

  v. **5 QCI bearers:** Multiple bearers for priority and assured quality for each category of calls.

  vi. **Non 3GPP IOT integration:** Seamless working with non 5GPP IOT applications on Lora or WiFi.

  vii. **Network Management & Control of entire network at a centralized Command Control System.**

Deployment at Mumbai Metro Project

Navi Mumbai Metro Station – seamless with High Availability IMS as well as Core

Challenges

a) Concept acceptability with Metros because of inertia and incumbent (MNC) pressure.
b) Spectrum Availability.
c) Inter-operability with existing equipment's and sub systems

Expectations from DOT

a) Strong endorsement of the project by credible authority well connected in Metro and Indian Railways
b) DOT to champion the cause and ensure support.
c) SRI division to orchestrate with each individual design company the way it was done for TCIL labs.
d) Involve DCIS / TTDF who have funded development projects in this space to push for clearance of next instalment with UAT under these projects.

The following domestic Vendors product and services can be used to implement Mission Critical services for Public Safety. This is not an exhaustive list of VoICE stakeholders but many more would be available for complete end to end solution delivery: -

S. No.	Items Name	OEMs
1	Core, EPC	VVDN, Signaltron, Niral, Resonous, Coral, WiSig
2	Radio	Signaltron, VVDN, Lekha, Resonous, C-DOT, BigCat Wireless, HFCL, Sooktha, Galore, Tidal Wave, Tejas, WiSig
3	IMS / IP PABX / PA / Voice logger	C-DOT, Niral, Dyotis, Cientra, Rebacca, Coral, Echelon Edge
4	Antenna	Kenstel, Astrome

5	Despatcher Console	Coral, Sanchar Tele, CDOT, IIT Mubai Startup
6	MCX handsets	Sanchar Tele, CDOT, Coral, IIT Mumbai Startup, Optimus Logic
7	24 port Switch	Nivetti, Tejas, Indio Networks
8	NMS	Dyotis, Amantya, Coral, Galore, C-DOT, Rebacca
9	High-end Router	Nivetti, Infinity Labs, CosGrid, Inventum, Tejas, HFCL
10	Artificial Intelligence	LivNSense
11	IOT sensors	Coral, Cosgrid

PROVISIONAL Estimated Cost:

Sl No.	Item	Qty.	Unit Cost	GST in %	Unit cost including tax	Total Cost Without Tax	Total Cost with Tax
1	5G gNode-B, 2 sector, 4x4 MIMO, 40W per port, Installation Material etc.	12	30,00,000	18	35,40,000	3,60,00,000	4,24,80,000
2	Antenna and erecting for Radio network	2	7,00,000	18	8,26,000	14,00,000	16,52,000
3	Duplicated HA Core, SW License, EPC, IMS, PA system, Voice logger & NMS including HW server for 500 subscribers.	2	1,50,00,000	18	1,77,00,000	3,00,00,000	3,54,00,000
4	Despatcher	5	4,01,200	18	4,73,416	20,06,000	23,67,080
5	MCX handsets	80	47,790	18	56,392	38,23,200	45,11,376
6	StaFon Radio	5	3,54,000	18	4,17,720	17,70,000	20,88,600
7	24 port Switch	12	250000	18	2,95,000	30,00,000	35,40,000
8	High-end Router	2	2500000	18	29,50,000	50,00,000	59,00,000
9	IOT sensors & integration	1	10,00,000	18	11,80,000	10,00,000	11,80,000
10	Installation commissioning support for 5 years	1	75,00,000	18	88,50,000	75,00,000	88,50,000
	Total Cost		3,07,52,99		3,62,88,528	9,14,99,200	10,79,69,056

Rounded Off to Rs. 12 Crores with balance towards Administrative Expenses, other activities/ works and equipment that may be needed to added as per dynamic requirements.

Lead Implementor

Coral Telecom has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VOICE CNPN PROJECT 2
5G NWR Test Bed

As the train speeds increase and IoT applications get added, latency needs will become increasingly relevant. Functions like V2V communication, axle counters and collision avoidance systems, at train speed of 200+ Kmph would be extremely latency sensitive and a Project on 5G network is being proposed for setting up a test bed for North Western Railways

Project

It is proposed to build a live 5G set up that can seamlessly work with pre-existing communication infrastructure at NWR that will be used to test & interop with various subsystems in Indian railways. Test bed would be set up between HQ building and DRM office connected over IP MPLS backbone, for test without involving actual train traffic. Objective is to carry out that testing, trial & experimentation with various pre-existing communication equipment by implementing only additional 5G elements required for such networks.

Category

Import substitution & development of Indian solution with domestic specifications.

Objective

Define specifications & API required for setting up a converged 5G communication network for Indian railways. It would be used to define IR network specifications while conforming to overarching global 3GPP architecture so as to meet Indian requirements and provide seamless inter-operability with legacy time-tested devices.

NWR live test bed will ensure that essential controls and algorithms driving the system are initiated that remain in control of Indian Railways and IR does not get locked in with specific vendors. Overall control and architecture would be an Indian IPR that will facilitate application of !rtificial Intelligence and self-learning models in times to come.

NWR test bed would be specifically used to ensure and build a roadmap for the following

Vendor Inter-operability

IR has to follow a multi-vendor approach hence defining protocols for inter-working would be cardinally important while insistence on 3GPP to ensure overall compliance to global standards and availability of global supply chain for critical components of the network. It is essential that each component of the network i.e. Core, IMS, Radio, MCX & devices comply with basic technical specifica2ons of 3GPP. Proposed network would use each sub systems from at least two vendors, at least one of which would be an Indian
design.

Indian Railways Specific API

Each OEM would also ensure seamless interoperability with APIs decided by Indian Railways for its custom operations & legacy systems while complying to overarching 3GPP specifications. Systems like TCCS, Kawatch, IP PABX, Emergency communication and Walkie Talkie are time tested and proven hence they should seamlessly plug into the radio networks.

Legacy Asset Integration

Protecting and providing seamless interface with legacy assets of the Large Indian Railway network is very important since they cannot be replaced overnight and must not be replaced since it involves skilling of work force and learning new work patterns.

High availability & Distributed network with edge compute capabilities

IMS, MCX, Stand Alone Core & gNodeB would be in high availability N+1 mode to work in load sharing ac2ve-ac2ve mode. This would not only provide resilience to the network but would also test edge compute for latency sensi2ve decision making.

Security Measures

These would be added as per requirements

Vandal proof

Vandal proof solution to mitigate instances of Jamming by using markers on valid carriers combined with carrier hopping techniques. Techniques like MULEPRO (Multi-channel Exfiltration Protocol) would be tested for enhanced robustness.

<u>Building AI (!rtificial intelligence</u>)

Artificial Intelligence is the natural roadmap coming up in the projects. Intelligent and "usage aware" network would have significantly lower operational cost, since those devices, which are not in use, will hibernate saving energy and resources. This will significantly reduce the ROI compared to legacy networks. Testing and trial on some of the following would be initiated.

Beam forming direction, Remote Electrical Tilt to allocate more resources in the desired direction, Hibernation when resources are idle. Beamforming and Ability to Channelize Energy in the direction of the Receiver could make the systems energy eficient & deliver greater throughput.
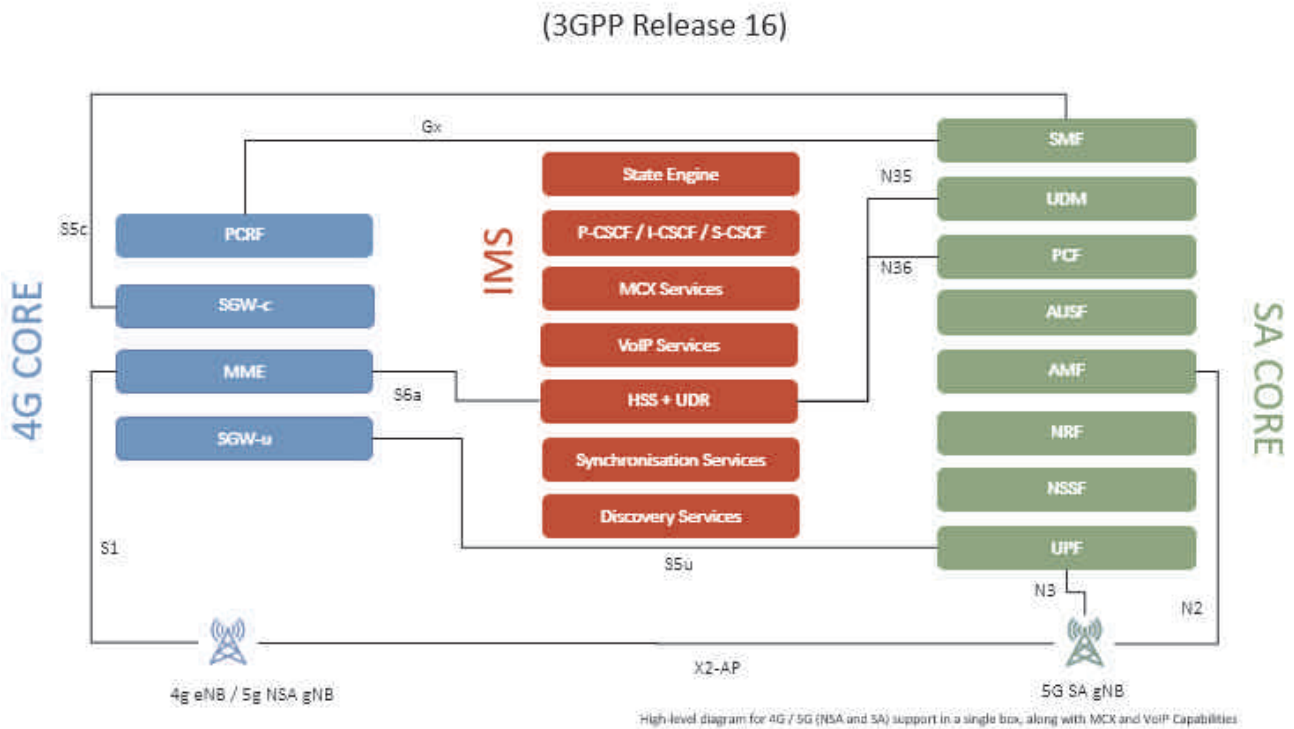
As additional AI inputs are built on the networks, significant advantages would be observed on edge computation / V2V communication and "shortest path" planning.

AI will help create self-learning models based on trafﬁc patterns and computational requirements for decision making to auto-configure network topology considering the dynamic workload characteristics. AI orchestration layer, for instance, running consensus algorithms across trains for automated and informed route discovery and avoiding wait times or to shift in a containerized

/ virtual compute environment to allocate additional resources to specific applications

Multiple Access Point Names (APNs)

Multiple Access Point Names requirement will be there for segregation of trafﬁc based on priority. APNs can be configured for operational data and maintenance communication. This ensures that each service has its dedicated resources and Quality of Service (QoS).

5G network Architecture Diagram

(3GPP Release 16)

High-level diagram for 4G / 5G (NSA and SA) support in a single box, along with MCX and VoIP Capabilities

The scope for the project

i. **Provide 5G coverage in NWR HQ and DRM office** connected for seamless working with at these two locations over IP MPLS. All subsystems to be in High availability load sharing N+1 mode.

ii. **Seamless Integration of various railway pre-existing communications**

systems like TCCS, Emergency Communication, IP PBX, Gate phone with 5G network. **Mission**

Critical Services (MCX) with Multicast & Broadcast services, eMBMS, Floor Control services, MCPTT for Communication between Train Controller/Station Master and Driver/Guard, Track Maintenance staff. Present project will showcase these without actually using on running train.

iii.   **Demonstration of IoT services** over 5G including Camera surveillance, Help desks and various sensors used in NWR.

iv.   **5 QCI bearers** Multiple bearers for priority and assured quality for each category of calls.

v.   **IoT based Signaling** Integrate with some IOT services like Coach/Wagon Axle Monitoring, System.

vi.   **Non 3GPP IOT integration** Seamless working with non 5GPP IOT applications on Lora or WiFi. Integration of Biometric attendance systems in IR, Driver Alert/Assist System etc.

vii.   **Network Management & Control.**
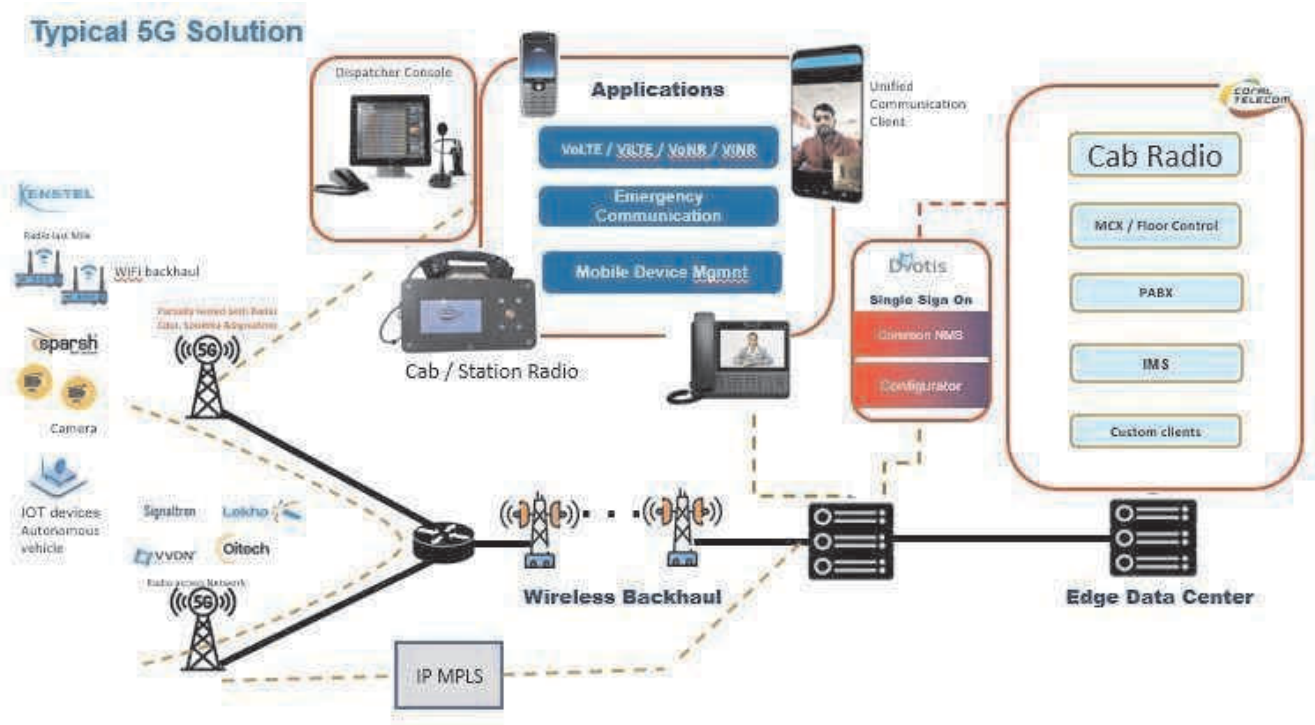
Deployment at NWR project

5G at NWR HQ – seamless with High Availability IMS as well as Core

Challenges

a) Concept acceptability with Metros because of inertia and incumbent (MNC) pressure.
b) Spectrum Availability.
c) Inter-operability with existing equipment's and sub systems

Expectations from DOT

a) Strong endorsement of the project by credible authority well connected in Metro and Indian Railways
b) DOT to champion the cause and ensure support.
c) SRI division to orchestrate with each individual design company the way it was done for TCIL labs.
d) Involve DCIS / TTDF who have funded development projects in this space to push for clearance of next instalment with UAT under these projects.

The following domestic Vendors product and services can be used to implement Mission Critical services for Public Safety. This is not an exhaustive list of VoICE stakeholders but many more would be available for complete end to end solution delivery: -

Sr. No.	Items Name	OEM Name
1	Radio	C-DOT, Signaltron, VVDN, Lekha, Resonous, Wave Sooktha, Tejas Networks, BigCat Wireless, WiSig
2	Core	C-DOT, Coral, Cientra, Amantya, Galore, Sooktha, Niral, WiSig
3	NMS	Niral, Dyotis, Echelon
4	IMS	Coral, NXG
5	Drone / Rover	Menthosa
6	Antenna	Kenstel, Astrome,
7	Backhaul	Astrome, Lekha, BigCat, WiSig
8	Command control Console	Coral, Dyotis,
9	MCX handsets	Coral, Optimus Logic
10	5G Phones	Optimus Logic
11	UHF/ VHF/ FXS Gateways	Coral, Matrix
12	Network Switch	Nivetti, Tejas Networks, HFCL
13	Router	Nivetti, Cosgrid, Infinity Labs, Tejasnetworks, Networks, HFCL, Indio N/w
14	IoT	Cosgrid, Sensorise

Yellow highlighted products are partially tested as part of Consortium demonstrations

Estimated Cost of the POC on pre-existing communication infrastructure

Sl No.	Item	Qty	Unit Cost	GST in %	GST Amount	Unit cost including tax	Total Cost Without Tax	Total Cost with Tax
1	Duplicated HA Core, SW License, EPC, IMS & NMS including HW server for 1000 subscribers.	2	1,50,00,000	18	2700000	1,77,00,000	3,00,00,000	₹ 3,54,00,000.00
2	Antenna and erecting for Radio network	6	6,00,000	18	108000	7,08,000	36,00,000	₹ 42,48,000.00
3	5G gNode-B, 2 sector, 4x4 MIMO, 40W per port, Installation Material etc.	6	35,00,000	18	630000	41,30,000	2,10,00,000	₹ 2,47,80,000.00
4	5G gNode-B, 2 sector, Pico Radios	10	22,00,000	18	396000	25,96,000	2,20,00,000	₹ 2,59,60,000.00
5	Installation & Commisioning of 5G gNodeB with Pico	10	3,50,000		63000	4,13,000	35,00,000	₹ 41,30,000.00
6	Despatcher	15	4,01,200	18	72216	4,73,416	60,18,000	₹ 71,01,240.00
7	MCX handsets	50	47,790	18	8602.2	56,392	23,89,500	₹ 28,19,610.00
8	Station Radio	15	3,54,000	18	63720	4,17,720	53,10,000	₹ 62,65,800.00
9	24 port switch	6	150000	18	27000	1,77,000	9,00,000	₹ 10,62,000.00
10	Router	2	1500000	18	270000	17,70,000	30,00,000	₹ 35,40,000.00
11	High Resolution Camera	15	75,000	18	13500	88,500	11,25,000	₹ 13,27,500.00
12	IOT sensors & integration	1	10,00,000	18	180000	11,80,000	10,00,000	₹ 11,80,000.00
13	5G CPE / Phones	50	50,000	18	9000	59,000	25,00,000	₹ 29,50,000.00
14	Installation commissioning support for 5 years	1	80,00,000	18	1440000	94,40,000	80,00,000	₹ 94,40,000.00
	Total Cost						₹ 11,03,42,500.00	₹ 13,02,04,150.00

All line items include extra quantities to experiment with products from more than

one vendor.

Rounded Off to Rs. 15 Crores with balance towards Administrative Expenses, other activities/ works and equipment that may be needed to added as per dynamic requirements.

Lead Implementor

Coral Telecom has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VOICE CNPN PROJECT 3
Mobile Ad hoc MESH for
Multiple Mobile Network In BOXs staying connected while on the move

Objective

Build mobile networks covering multiple moving / non static platforms while meeting the operational requirements.

Network in a box (NIB) are very popular 4G/ 5G network setups that is nomadic and can provide services in a limited area. Such NIBs can be in moving vehicle with mast antenna on the top of the vehicle, with capabilities to work in standalone mode or where multiple networks of this type could form a larger network connected over a "MOBILE MESH" that is self-configuring and self-healing. One of the fundamental objectives would be to maintain communication of multiple NIBs, with each other, "While on the Move".

This would be an integral part of the requirement of mobile convoys or ships operating in a formation. Present requirements presently are generally met by foreign players Raytheon and Thales and others. Mobile MESH networks would become the most appropriate solution for management of battlefield communication and will become integral part of NIB vehicles as also for managing other armed forces assets in the battlefield.

Customers

Naval ships, Coast guard, ONGC trawlers, Army vehicles in a battlefield

Category

Import substitution & development of Indian solution with domestic specifications.

What is required

1. Design and development of specialised Mesh Radio techniques, using low frequency 802.11ah or existing 4G / 5G radio with "in band" signalling support.

2. Capability for Azimuth and beamforming control to work with existing Multiple-hop MESH radios.

3. Capability to integrate with Smart Antenna systems supporting electric tilt and

beamforming in the direction of receiver.

4. Would have IMS as well as EPC in active-active, N+1 load sharing architecture so that both the Core and IMS /MCX would be distributed in self-healing geo-redundant user planes. Redundancy features to be truly robust for the environment of its deployment.

Video IP Phone
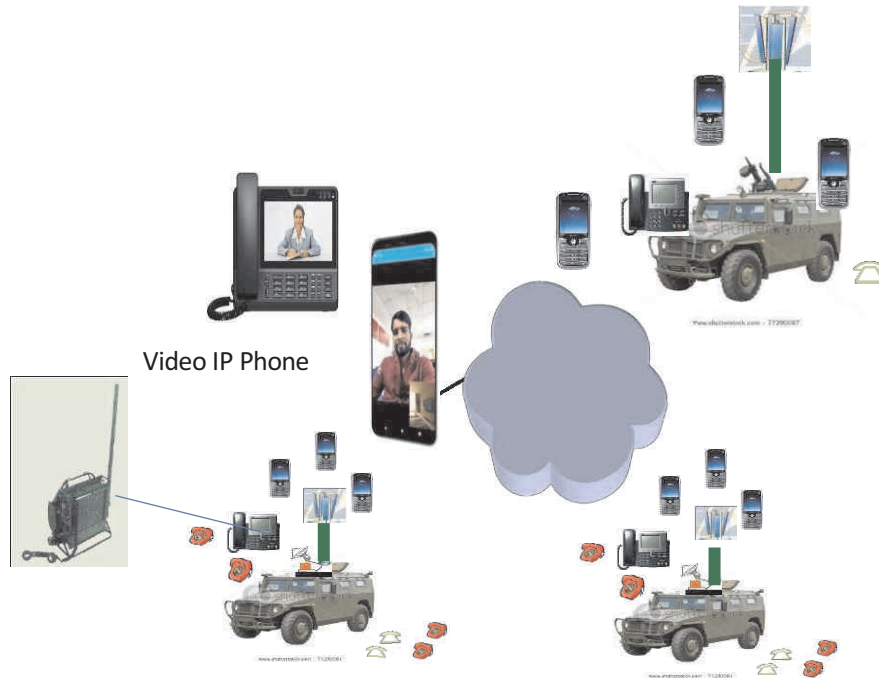
Challenges

1. Défense does not adopt any telecom equipment with commercial encryption. They need security clearance of Défense (SACFA) that has to come from one of the four identified PSUs. Private company products will not be normally entertained even if we were to approach with Indian crypto libraries developed by IITs. Exceptions are made for select few.
2. Incumbent inertia.
3. Mindset on adoption of Domestic products so tender specs are made to oust us rather than support.
4. Quality certification and robustness of domestic products. Genuine concerns need to be addressed collectively.

Expectations from DOT

1. Strong endorsement of the project by credible authority.
2. DOT to champion the cause and ensure support.
3. SRI division to orchestrate with each individual design company the way it was done for TCIL labs.
4. Involve DCIS / TTDF who have funded development projects in this space to push for clearance of next instalment linked with UAT under these projects.

Budget required for Prototyping design and development is likely to be Rs 12 Crores over a period of 1 Year with at least 60% domestic content

It is assumed that there would be two deployments covering three vehicles.

Once prototype design is completed, multiple VoICE partners would be added as per requirement on lines similar to Project 1 and 2.

Lead Implementor

Coral Telecom has forwarded the Project and it is proposed that they can lead the Project as System Integrator and also finalizing the prototype design in consultation with the potential client. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VOICE CNPN PROJECT 4
5G POWER GRID

DOT is expecting to kickoff critical 5G Captive Non-Public Network (CNPN) projects in 2024, using Indian-made 5G equipment. This Project from VoICE team is mainly outlined based Lekha Wireless' suggestions in this regard, as an Indian 4G & 5G OEM. Specifically, the **Electric Power vertical is covered in this submission and discusses as to how 5G can make a major difference to the power grid in India.**

Impact and Use Cases

Power generation and distribution through the power grid is of course mission critical, and any security breaches have horrendous consequences to society, as we during the May 2023 malware attack on Mumbai's power grid. In a large country like India with a huge number of electricity distribution organizations in India, it is critical to ensure protection of the power grid at all times, and as well, operations efficiency.

5G addresses these key challenges, handling demanding connectivity needs: collecting sensor data from thousands of points in the grid, and transferring them at high-speeds to central monitoring and safety centers. By quickly detecting malware attacks from anywhere in the huge grid and transferring the monitoring data to decision points, interrupt/ blackout durations can be significantly reduced, if not prevented. Equally critically: operations efficiency is enhanced, by balancing generation and consumption.

Typical use cases include:

- **Gathering sensor data from thousands of grid monitoring points periodically, and transferring these to decision centers**

- **Remote live video monitoring and video analytics of power grids at key locations** - for perimeter surveillance, vehicle movement monitoring, facial recognition, non-compliance/unsafe activity alerting etc.

- **Anomaly detection, e.g., fire, blackout monitoring**

- **Remote, teleoperation over 5G of Terrestrial Guided Vehicles (TGVs),** transporting material, navigating dangerous areas, indoor or outdoors

- **Real-time asset-tracking** - for fixed and movable assets using GPS, and accessed via 5G

Key clients include NTPC and other producers, and a large number of state electricity boards.

Solution
Project proposes the deployment of Indian-owned 5G CNPN Open Radio Access Network (O-

RAN) and 5G Core (5GC) infrastructure at power generation and distribution centers:

5G RAN:

Lekha's **maRUt O-RAN RUs** in the N28 band for wide cell coverage, with 20MHz channel bandwidth, operating at 40W/antenna and with a 2T2R configuration, and Lekha's CU-DU software

Spectrum:

Leasing directly by the customer at a reasonable cost, either directly from DOT or from operators who can offer on lease **without bundling** equipment and services, allowing the CNPN to procure these as they see fit to meet needs.

Sizing:

To start with, a pilot deployment is proposed:

- 3 RUs with omnidirectional antennas, on monopoles or towers at about 30m height, and with 4–8-hour battery-backup or generators

- COTS servers: For the DU-CU stack, 5GCand the EMS/NMS, located in a temperature-controlled server room, ideally on site

- PTP Grandmaster for clock synchronization, and miscellaneous items: rack, a top- of-rack switch, cables and other accessories

- Fronthaul optical cable, and backhaul to a transport network point-of-presence, fibre or microwave, that connects to the Internet.

Project Timeline

The project is expected to be executed in 4-6 months. Budget

Estimate

The estimated price of the above solution is INR 5 Crores, plus spectrum leasing costs. Future

Expansion and Commercialization

Once the solutions is deployed and proven at a single location such as NTPC or a state electricity board, rolling it out across India and even globally (particularly in Australia, USA and Canada and in various African countries) is quite likely. 5G meets the real and compelling needs of safety, security and operations efficiency of the power grid, including in remote locations.

Other Partners

VoICE has multiple players who can be part of complete end to end 5G CNPN solution. Once in principle, go ahead signal is available, further details can be worked out.

Lead Implementor

Lekha Wireless has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VoICE CNPN
Project 5
5G MINING

DOT is expecting to kickoff critical 5G Captive Non-Public Network (CNPN) projects in 2024, using Indian-made 5G equipment. This VoICE Project is outlined based on Lekha Wireless' suggestions in this regard, as an Indian 4G & 5G OEM. Specifically, **Project covers the mining vertical here and discusses how 5G can take it to Mining 4.0.**

Impact and Use Cases

Coal and metal mines in India - and abroad - have special challenges: they are often located in remote areas with poor cellular coverage; have inadequate residential and schooling facilities for families, so key personnel have to live in nearby bigger towns and cities rather than at the mines; have security, fire and safety challenges; are difficult to wire for IT and telecom needs; and costs.

5G infrastructure brings a range of benefits to address these challenges, with its attributes of mobility, high t h r o u g h p u t and low latency and jitter. Typical mining use cases include:

- **Remote live video monitoring of mining activities via 5G** for daily progress monitoring, security, safety, compliance monitoring, etc.

- **Anomaly detection - mine fire monitoring**: drone-based surveillance through 5G to provide thermal imagery for identification of heat map/ thermal zones/ fiery coal areas. Video telemetry allows remote detection of coal fires [texmin.in]

- **Video analytics based on live feed**, e.g., for perimeter surveillance, vehicle movement monitoring, facial recognition, non-compliance/unsafe activity alerting etc.

- **Remote, teleoperation over 5G of Terrestrial Guided Vehicles (TGVs),** transporting material, navigating dangerous areas, indoor or outdoors

- **Real-time asset-tracking** - for fixed and movable assets using GPS, and accessed via 5G

Key clients

Key Clients for the project include Coal India, NMDC, Vedanta, Hindalco, HCL, GMDCL and others.

Solution

Project proposes the deployment of Indian-owned 5G CNPN Open Radio Access Network (O- RAN) and 5G Core (5GC) infrastructure at mining sites:

5G RAN

Lekha's **maRUt O-RAN RUs** in the N28 band for wide cell coverage, with 20MHz channel bandwidth, operating at 40W/antenna and with a 2T2R configuration, and Lekha's CU-DU software

Spectrum

Leasing directly by the customer at a reasonable cost, either directly from DOT or from operators who can offer to lease it - **without bundling** equipment and services, allowing the CNPN to procure these as they see fit to meet needs

Sizing

A typical open-pit mine may cover an area of 20 Km^2, with a depth of about 500-600m. To cover this area, we can start with:

- 3 RUs with omnidirectional antennas, on monopoles or towers at about 30m height, and with 4-8 hour battery-backup or generators

- COTS servers: For the DU-CU stack, 5GCand the EMS/NMS, located in a temperature-controlled server room, ideally at the mine

- PTP Grandmaster for clock synchronization, and miscellaneous items: rack, a top-of-rack switch, cables and other accessories

- Fronthaul optical cable, and backhaul to a transport network point-of-presence, fibre or microwave, that connects to the Internet.

Project Timeline

The project is expected to be executed in 4-6 months.

Budget Estimate

The estimated price of the above solution is INR 5 Crores, plus spectrum leasing costs.

Future Expansion and Commercialization

Once the solutions is deployed and proven in a real mine, we expect major business, rolling it out to mines in India and globally, particularly in Australia, USA and Canada and in various African countries. 5G meets the real and compelling needs of mine safety, security and operations efficiency, in remote locations.

Other Partners

VoICE has multiple players who can be part of complete end to end 5G CNPN solution. Once in principle, go ahead signal is available, further details can be worked out.

Lead Implementor

Lekha Wireless has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VOICE CNPN PROJECT 6
5G MINING

-

Contents

VoICE CNPN Project 6 is on MINING Vertical and is led by MatreComm Technologies, a Startup based out of Bangalore that is focussed on Digital Transformation products for Telco's / ISP's/ Enterprises, in association with BlueCloud SoftTech, a System Integrator in the IT/ Technology field. The Project proposes setting up of 5G Captive Network Pilot with applications for Mining operations.

The below proposal seeks to propose ground breaking project aims to revolutionize communication, safety, and efficiency in remote mining sites, bringing about a transformative   impact on the mining industry.

Executive Summary:

This proposal outlines a project that seeks to establish a dedicated 5G Captive Network in mining operations, addressing the challenges inherent in remote and rugged mining environments.   The initiative includes advanced communication technologies, the integration of IoT applications,   and real-time data analytics to enhance safety, productivity, and operational efficiency.

Project Objectives:

   a) **Secure Communication Infrastructure:**

   Establish a reliable and secure 5G Captive Network to facilitate high-speed communication in remote mining sites where traditional connectivity is often challenging.

   b) **IoT Integration for Real-time Monitoring:**

   Implement IoT applications to enable real-time monitoring of mining equipment, personnel, and environmental conditions, thereby improving operational visibility and control.

   c) **Enhanced Safety Measures:**

   Integrate advanced communication and emergency response systems   to   enhance safety measures for mining personnel working in isolated and hazardous conditions.

   d) **Operational Efficiency through Data Analytics:**

   Improve mining processes by leveraging 5G-powered data analytics for predictive maintenance, process optimization, and overall operational efficiency.

Current Challenges in Mining Operations:

Mining operations currently face significant challenges, including:

a)   Communication Issues:

In remote mining sites, traditional communication infrastructure often fails to provide reliable and high-speed connectivity, leading to operational inefficiencies and potential safety concerns.

b)   Safety Concerns:

Hazardous working conditions in mines require robust communication and emergency response systems to ensure the well-being of personnel.

c)   Operational Inefficiencies:

Delays in equipment operation, inefficient sorting processes, and procedural bottlenecks contribute to increased costs and reduced productivity.

How Project's 5G Captive Network Solution Addresses Challenges:

a)   Reliable Communication Infrastructure:

The implementation of a 5G Captive Network ensures consistent, high-speed communication in remote mining sites, overcoming the challenges associated with traditional communication systems.

b)   IoT-Driven Real-time Monitoring:

IoT applications powered by 5G enable real-time monitoring of equipment, personnel, and environmental conditions, addressing safety concerns and optimizing operational efficiency.

Advanced Safety Measures: The 5G Captive Network facilitates the integration of advanced communication and emergency response systems, ensuring rapid and effective responses to potential safety incidents.

c)   Data-Driven Operational Efficiency:

Utilizing 5G-powered data analytics, the mining industry can achieve predictive maintenance, process optimization, and streamlined operations, reducing delays and operational inefficiencies.

Potential Clients:

Primary beneficiaries of the 5G Captive Network in mining include mining companies, equipment manufacturers, and stakeholders involved in mineral extraction. The project's outcomes directly impact these entities by providing a secure, efficient, and technologically advanced communication infrastructure.

- NMDC
- Coal India
- So forth /.

Provisional Partners:

We have identified potential partners, including leading telecommunications companies from VoICE family (Consortium based support), mining equipment manufacturers, and relevant government agencies. Collaboration with these partners will ensure a holistic approach to overcoming the unique challenges faced by mining operations. Project I and 2 examples will be followed For example, Lekha Wireless can support through Private 5G Radios.

Project Cost Breakdown:

The estimated project cost is to provide the detailed breakdown. This includes:

a) Infrastructure Setup:

Installation of 5G base stations, antennas, and communication nodes in remote mining sites.

Technology Deployment: Integration of IoT devices, communication systems, and data analytics tools.

b) Research and Development:

Continuous refinement of the system for optimal performance in challenging mining environments.

c) Ongoing Maintenance:

Regular updates, security measures, and support services.

Area	Expense
5G O-RAN Radio's Routers, Switches Computer Servers Optical Cables So forth	Rs 15 crores
System Integration and Deployment	Rs 4 crores
Research and Development- Continuous Improvement Ongoing	Rs 4 crores
Maintenance per annum	Rs 4 crores

CAPEX = Rs. 23 Crores and OPEX Rs. 4 Crores/ Year

There would be certain add on costs (Say 10 %) which will be required to be added covering new items and administrative costs.

Project expects 50% of the costs to be supported by DoT and the remaining 50% could be borne by Project partners.

Assumptions/ Limitations:

While optimistic about the project's success, we acknowledge certain assumptions and limitations:

a) **Remote Location Challenges:**

Challenges related to the remote nature of mining sites, requiring a resilient and adaptable communication infrastructure.

b) **Technical Challenges:**

Potential technical hurdles in implementing advanced communication systems in rugged environments.

c) **Regulatory Compliance:**

Adherence to regulatory requirements and standards governing the deployment of 5G in mining operations.

Expectations on Spectrum:

We expect the spectrum to be allocated by DOT for the pilot and testing. The final allocation of the spectrum for production, could be have the following options:

a)   Spectrum is shared/taken on lease from Telco's

b)   Spectrum is allocated to us on lease as per Govt of India - DoT policies.

We anticipate the allocation of a dedicated spectrum for the 5G Captive Network to ensure optimal performance and minimize interference. Collaboration with regulatory bodies and industry stakeholders will be crucial in determining suitable frequency bands for mining operations.

Mode of Allocation:

The allocation of spectrum will involve collaboration with regulatory bodies, ensuring an inclusive process with industry stakeholders to determine the most suitable frequency bands for mining operations.

Pricing Model:

The pricing model for the project will comprise of upfront payment covering the Capex and the 5G CNPN being provided on an Opex model.

Area	Pricing Model
Network and IT Infrastructure	Upfront at the start of the project
System Integration and Ongoing maintenance	SaaS model – quarterly advance payment
Any new features	To be discussed and payment to be mode upfront or as part of the SaaS license

Time for Completion:

The project is expected to be completed within 18 months, encompassing planning, infrastructure setup, technology deployment, and testing to ensure the seamless integration of the 5G Captive Network in mining operations.

Area	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18
Assessment and Finalizing the scope across the																		

Approval of the Project			■	■														
Installation and setup					■	■	■	■										
Trial runs									■	■	■	■	■	■				
Training and Handover															■	■	■	
Continues operations																		■

Lead Implementor

Matrecomm has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

Conclusion:

The successful implementation of a 5G Captive Network in mining operations represents a crucial step forward in overcoming the challenges faced by the industry. By fostering secure communication, enhancing safety measures, and optimizing operational efficiency, the project aims to redefine the standards for mining operations in remote environments.

VOICE CNPN PROJECT 7

5G Rural Ecosystem Enablement

Table of Content

Objective

The Micro, Small and Medium Enterprises (MSME) sector is important for the economy, as it contributes significantly to innovation, economic growth and to provide employment opportunities. Mandi Samiti and Gram Panchayat are equally important pillars for rural development. Objective is to develop digital infrastructure and inclusions in villages for eMandi, eBazar, eHospital, ePathshala and to provide similar services at same place.

5G private network with appropriate adoption and integration can help tremendously to increase revenues, decrease costs, increase efficiency, productivity, and quality of products/services and overall life style and to grow economically with the nation through the usage of cutting-edge technologies.

Potential Clients

- MSME
- Gram Panchayat
- Mandi Samiti

Provisional Partners

Tata Consultancy Services and its Vendor Ecosystem

Project cost

RAN, 5G Core, Servers, Digital platforms, and management with required devices (Digital Screen, Audio Video System and support services are main components. Approximate Cost is INR 10.3 Crores for one village. With Administrative and other unforeseen items likely, the Project cost per village is kept at Rs. 11 Crores.

Estimated cost for one village						
Items	Description	Quantity	1st Year	2nd Year	3rd year	Total for 3 Years
MPN	5 Radio +5G SA core	1				
	Infra/Cable/CpE	1				
ePathshala	Digital Screen	2				
	HD Smart Camera	2				
	Audio video System	2				
	etutorials & Materials	1				
eMandi and eBazar	Digital Inventory Management Platform	1	4,19,76,000	2,91,96,000	2,91,96,000	10,03,68,000
	Digital Demand and Supply managemt Platform	1				
eHospital	Digital health record management	1				
Professional Services	Professional Services (1 Year)	2				
	SI Services(1 Years)	2				
Centralized System with Storage	Server with Storage	1				
	PC	2				

Assumptions/limitations

1. Infrastructure: IP connectivity through Bharat Net can be used. Mount, Pole, Power related civil work support are excluded.
2. Spectrum: 5G Spectrum will be required to set up 5G private networks.

Expectations on spectrum

5G spectrum for CNPN to be provided by government for this initiative.

Suggested spectrum can be n78 Band with 20MHz Bandwidth as the device ecosystem majorly support this band.

High Level Project Plan

1. Clarification of the requirements (SOW, LLD, Identification of villages and Sign-off)
2. Budget approval
3. Execution Roadmap
4. Deployment
5. O&M support
6. Evolution

How success can lead to multiple requests

5G Mobile private network can play significant role in Digital drive. This will result in improvement of MSME/ Gram Panchayat/ Mandi Samiti by leveraging e-commerce and digital adoption.

ePathshala will help to provide better education system with the availability of advanced platform and infrastructure.

eHospital will provide world class interactive consultation of doctors in remote areas to improve overall healthcare system in villages.

eBusiness will provide enhanced revenue opportunities to support economical power on the nation.

Lead Implementor

TCS has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VOICE CNPN PROJECT 8

5G Autonomous Drone Based

Network Radio Frequency Exposure Measurement

Table of Content

Objective

Drone based mobile network inspection and monitoring.

Potential Clients

- DOT, TRAI and Government Regulators
- Telecom Service providers

Provisional Partners

Tata Consultancy Services and its Vendor Ecosystem

Project cost

5G Drone-in-a-box, Pickup truck, Servers, Digital platforms, and management with required devices and support services are main components. Approximate Cost is INR 9.83 Crores for one city.

Administrative and other unforeseen add ons are also likely and project can be capped at Rs. 10.8 Crores for one city.

Estimated cost for one city					
Description	Quantity	1st Year	2nd Year	3rd year	Total for 3 Years
5G Drone-in-a-Box	1				
4WD PickUP truck (Toyota/ISUZU)	1				
Web Platform for analytics	1				
Devices and Sensors	1				
Professional Services	1	4,58,63,250	2,62,25,750	2,62,25,750	9,83,14,750
Drone Pilot	1				
Vehicle Driver	1				
Developer and analyst	2				
Server with Storage	1				

Assumptions/limitations

1. Testing required to automate the regulatory devices with Drone.
2. Available public network of telco will be used.
3. Vehicle maintenance up-to 8000 Km per month is included and fuel cost is not considered.
4. Drone flying permission to be secured by concerned authorities.

High Level Project Plan

1. Clarification of the requirements (SOW with test procedure and measurements, LLD etc)
2. Budget approval
3. Execution Roadmap
4. Deployment
5. O&M support
6. Evolution

How success can lead to multiple requests

The methodology will utilize Modern techniques for testing of telecom radio frequency exposure which is more efficient and cost effective.

This will provide the real-time measurement and methodology will be transparent with standard procedure of all the operators.

Testing will be applicable for initial certification for ensuring all EMF guidelines and norms set by DoT and Telecom Engineering Commission (TEC).

Periodic audit and validation can be conducted to ensure EMF guidelines are continued to be adhered.

Lead Implementor

TCS has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VoICE CNPN Project 9 :
Enabling Innovation in IoT M2M Connectivity &
Lifecycle Management together with 5G Public and Private capabilities

Sensorise is an industry leader in Internet of Things (IoT) and Machine to Machine (M2M) services in India, with expertise in supplying end-to-end solutions for improving Quality of Service (QoS), remote management and lifecycle management of embedded SIMs and IoT   devices. As a registered M2M service provider with the Department of Telecommunications (Govt. of India), it significantly bridges the gaps in infrastructure, technology and services with   diligent contribution to standards, policies & regulations to drive M2M adoption in India.

As pioneers of eSIM technology in India, Sensorise offers an enhanced portfolio of diversified products and services to support the various industries in their M2M and IoT requirements. Characterised by a unique proposition for multi-network remotely manageable   connectivity, Sensorise offers exclusive QoSim and SenseLCM products under IoT/ M2M services with real-time monitoring and data access for enhanced operational efficiencies, productivity and new business opportunities based on the data packed intelligence.

Recently Sensorise together with Niral networks Unleash Next-gen 5G Potential with Sensorise QoSim for seamlessly navigate between Public and Private Networks on a Single eSIM   an innovative SIM card that allows users to seamlessly switch between public 5G networks and Niral's Private 5G and Edge Solutions, delivering a fusion of global connectivity and secure networks. The solution bridges between public and private networks, unlocking the potential of 5G technology ensuring uninterrupted high-quality connectivity, simplifying network management, and fostering innovation. This collaboration seeks to provide users with a unified, efficient, and innovative 5G experience that eliminates common connectivity challenges   while pushing the boundaries of technology.

The innovations and in-depth technical expertise of the company offers a win-win position to the customers, offering end-to-end solutions with much wider and integrated technology capabilities for a future ready automobile scenario. The Quality of Service(QoS) provided by Sensorise ensures critical connectivity during network outages, meeting local connectivity requirements with multi-profile QoSim (M2M SIM) supported by the in-built intelligence to automatically switch the network for seamless connectivity on the go.
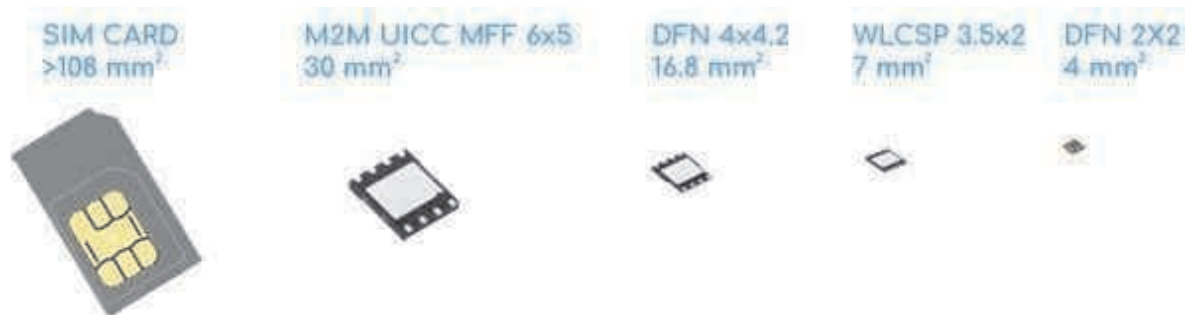
QoSim services offered by Sensorise are also provisioned for a remote subscription update, enabling quick and hassle-free download of any profile/ subscription on the same SIM over- the- air. This multi-network eSIM connectivity is powered by SenseLCM, which is a cloud- based connectivity lifecycle management platform offering user-friendly dashboard features for connectivity management, analytics, reports along with remote diagnostics for troubleshooting connectivity issues. The sensitive telematics data from sensors, control units and other components is secured by QoSec, which is a complete end-to-end security solution for data encryption. Sensorise has managed an end-to-end solution for secure registration of connected devices/ applications and custodian verification as per digital KYC norms issued by the government. SenseTouch platform manages eKYC services such as platform, app, data, screening, validation etc for facilitating hassle-free custodian verification for M2M connectivity.

Thus, Sensorise enables Intelligent connectivity vital to the GPS/ VLT device for transforming businesses by monitoring their high-value assets in real-time.

As the market leader with more than 2.5 million card base in various verticals, Sensorise is trusted by more than 100 OE/ OEMs for the QoSim®, SenseLCM® , SenseTouch® services.

Sensorise solutions remove complexity from IoT implementations, allowing for rapid achievement of business outcomes with the proven Sensorise capabilities and customer centric approach fuelled with innovation and in-depth expertise for provisioning end-to-end services & solutions for the digital and IoT domain. As a trusted brand for Intelligent M2M connectivity and end-to-end IoT solutions by partners and customers across the various segments, Sensorise enables real-time data for effective monitoring and control by the widespread adoption and proliferation of affordable wireless communication, making the overall system much more sustainable, profitable and reliable.

Lead Implementor

Sensorise has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VoICE CNPN Project 10

5G Enabled Smart Farming
Use Cases

Table of Contents

List of Figures

List of Tables

1. Executive Summary

DOT is set to launch 5G Captive Non-Public Network (CNPN) initiatives in 2024, utilizing indigenously manufactured 5G equipment. This VOICE project is outlined based on Amantya Technologies' suggestions in this regard, as an Indian OEM. The project includes how 5G CNPN can enable Smart Farming.

Smart farming can be enabled with cutting-edge technologies, specifically Private 5G and IoT. The implementation of these technologies aims to revolutionize traditional farming methods and enhance overall productivity. The focus is on solving problems such as inefficient resource usage, blanket pesticide spraying, and manual labor dependency.

The smart farming use cases include deployment of 5G and IoT-based Soil Nutrition Management, Drone Based Pesticide Spraying, and Smart Hydroponic systems in a 1,00,000 Sq. Ft. area.

2. Key Problems Faced by Farmers

The key problems faced by farmers currently are:

2.1 Inefficient Use of Resources

This includes the below challenges:
- Overuse or underuse of fertilizers
- Wastage of resources such as water and energy
- High operational costs for farmers

2.2 Blanket Pesticide Spraying

This includes the below challenges:
- Inefficient and expensive
- Harmful to the environment
- Development of pesticide-resistant pests

## 2.3 Manual Labor Dependency

This includes the below challenges:
- Time-consuming
- Heavy reliance on manpower
- Prone to human error

3. 5G CNPN in Smart Farming Use Cases - Details

The proposed smart farming use cases are as under:

1. Soil Nutrition Management
2. Drone based Pesticide Spraying
3. Smart Hydroponic Systems

Note: The above use cases will be deployed on an agricultural area of 1,00,000 Sq. Ft.
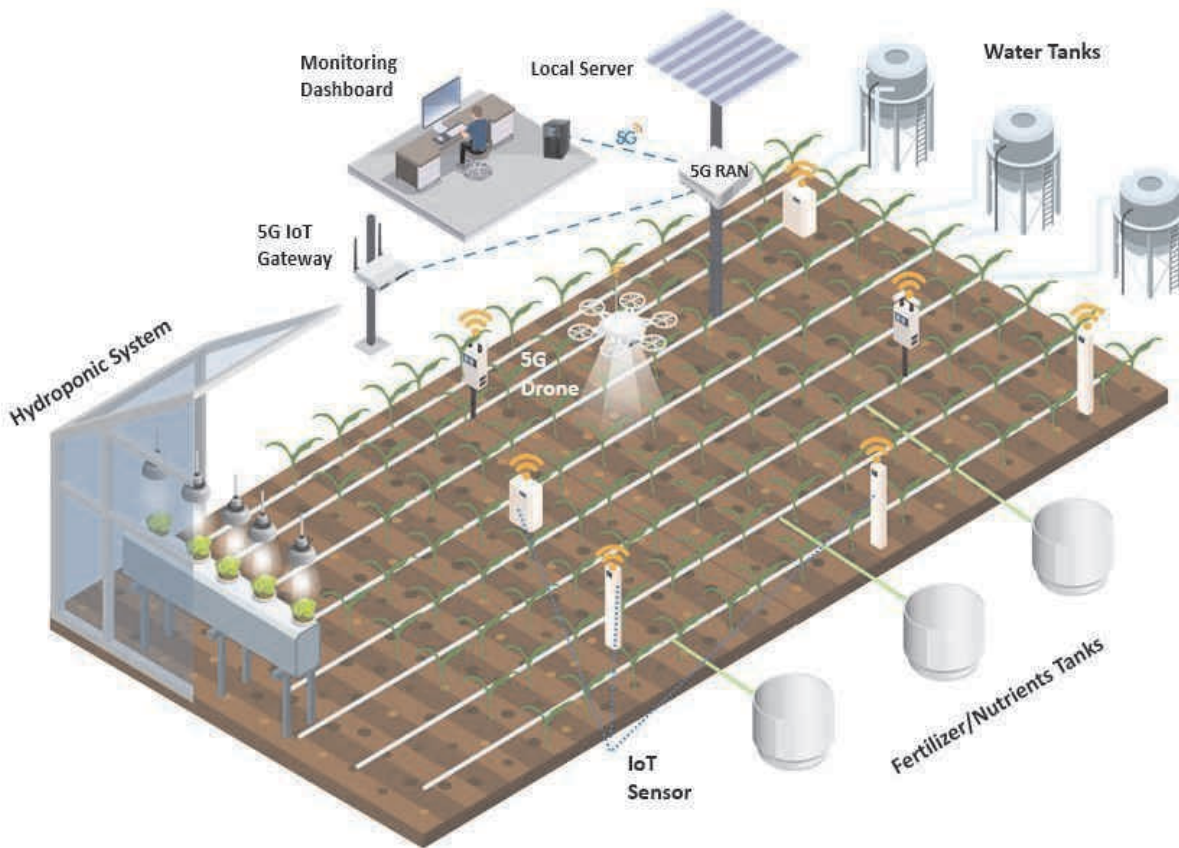
3.1 High-level Architecture:

The Smart Farming Solution features a sensor network capturing farm data transmitted to an IoT gateway. A 5G CNPN facilitates communication to a local server for analytics. Automation systems,   such as drones and pumps, respond to analytics, and a centralized dashboard provides interface for monitoring and control. This architecture integrates sensors, IoT, 5G, analytics, and Automation for smart agriculture use cases.
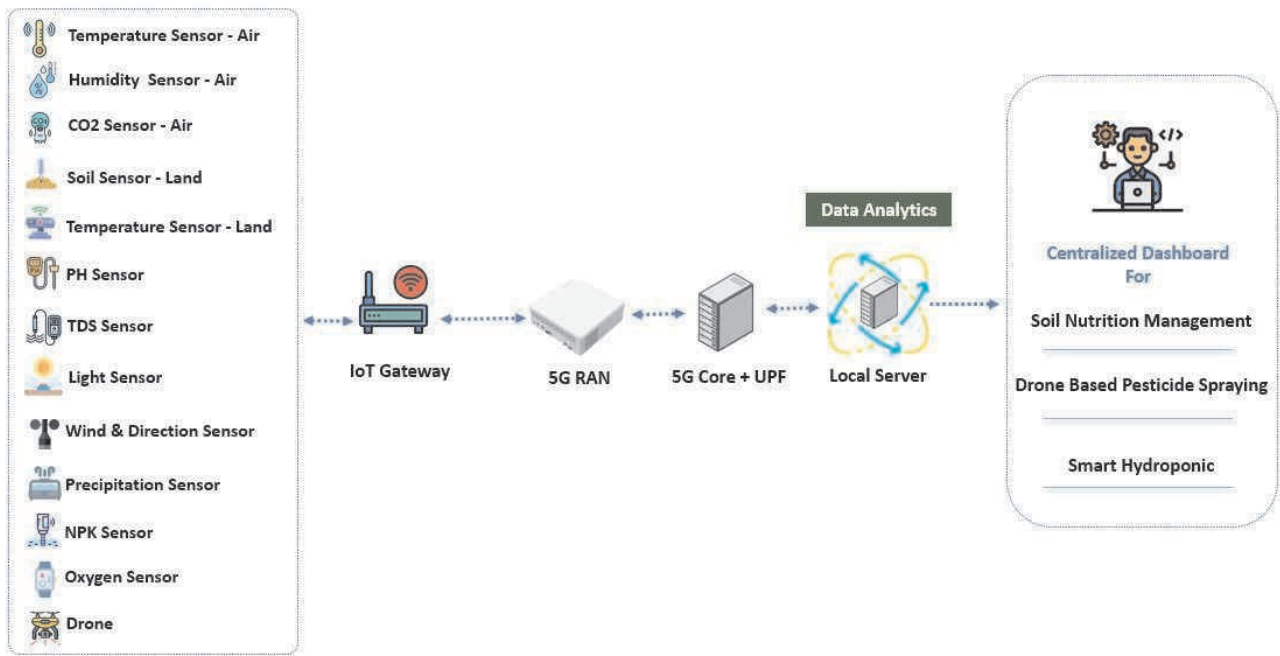
Figure 02 High-Level Architecture Diagram

3.2 Key Solution Components:

The key components of the solution include:

Sl. No.	Solution Component	Details
1	**5G CNPN**	Includes High-powered Outdoor gNodeB and 5G Core Network
2	**IoT Sensors**	Includes sensors – Temperature, Humidity, CO2, Soil Moisture, PH, TDS, Light, Wind, Precipitation, NPK, Oxygen, EC Salt etc.
3	**5G IoT Gateway**	Establishes connectivity between the sensors to send data to the server over 5G network
4	**Local Server**	The data from the sensors are stored and processed in this server
5	**Data Analytics**	The data received from sensors over 5G network is processed to derive analytics and perform automated tasks
6	**Automation Systems**	The systems perform actions based on the analytics through drones, water pump, nutrition and water tanks
7	**Monitoring Dashboard**	A central monitoring system enables farmer to remotely monitor farms

Table 01 Smart Farming Use Cases – Solution Components

4. 5G CNPN Enabled Smart Farming Use Cases

Below are the detailed proposed smart farming use cases:

4.1 Soil Nutrition Management:

Precision farming is achieved through real-time monitoring of soil nutrients. Remote spraying of required nutrients and mist enables farmers to optimize fertilizer application, leading to healthier crops and reduced resource wastage.
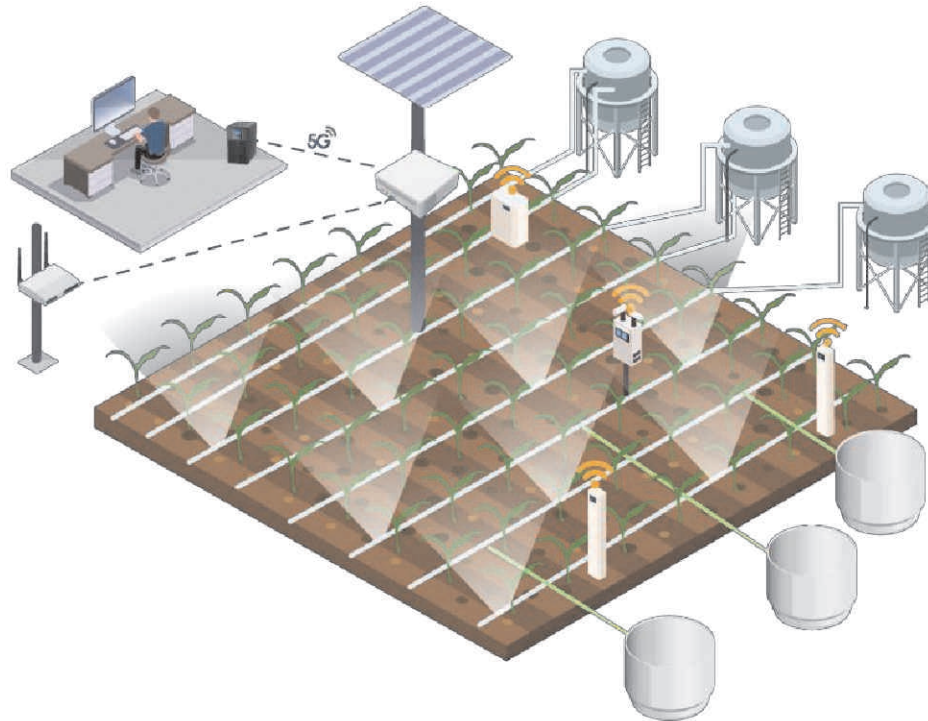

Figure 03 Soil Nutrition Management

Solution Details:

- Farm-installed IoT sensors transmit data to a 5G-enabled IoT Gateway
- The IoT Gateway facilitates inter-sensor connectivity
- Data is conveyed to the local server through a Private 5G Network
- Received data undergoes analytics for insights
- Subsequent to analytics, a remote pump is activated to dispense water and nutrients

Sensors Included:

Temperature Sensor – Air, Humidity Sensor – Air, CO2 Sensor – Air, Temperature Sensor – Land, Soil Moisture Sensor – Land, PH Sensor, TDS Sensor, Light Sensor, Wind and Direction Sensor, Precipitation Sensor, NPK Sensor, Oxygen Sensor

4.2 5G Drone-based Pesticide Spraying

With 5G-enabled drones, the Farm can achieve targeted pesticide spraying. This approach minimizes environmental impact, reduces costs, and addresses the issue of pesticide-resistant pests.
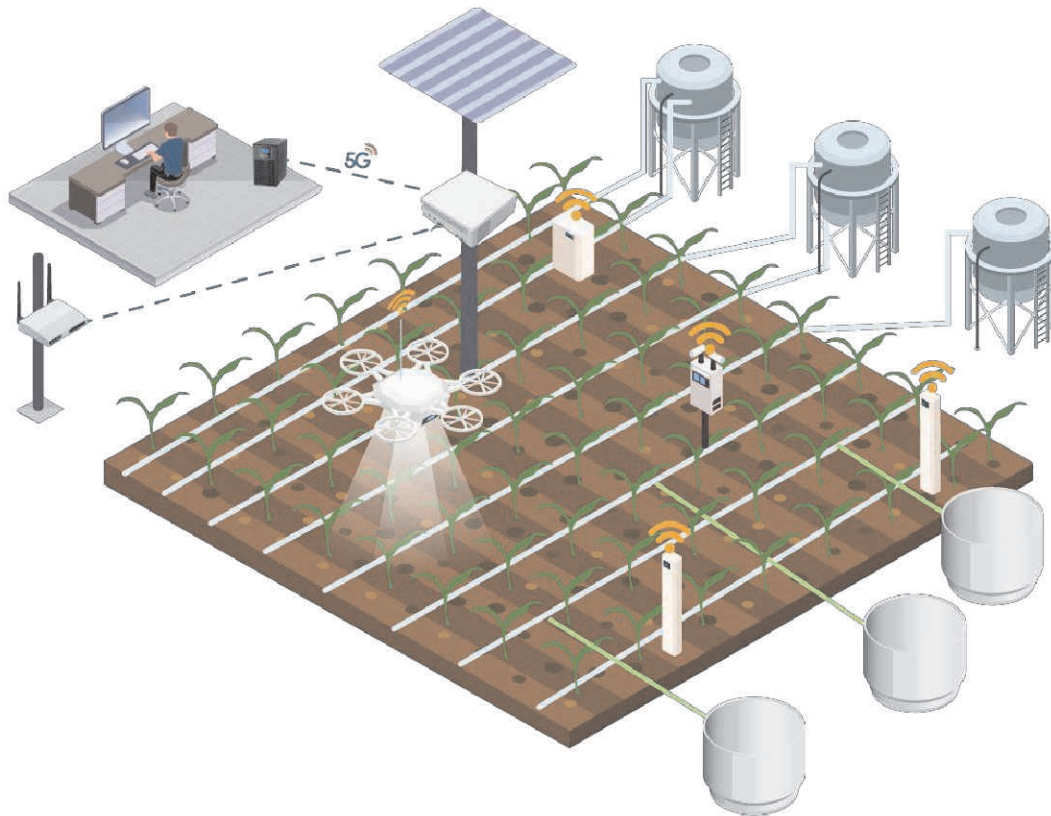

Figure 04 Drone-based Pesticide Spraying

Solution Details:

- Mapping of farm field that shall be used for drone orchestration
- Automated Guided system & Operation of Drone
- Drone will fly on pre-defined time schedule to spray pesticides
- Farmer/Operator can also manually operate drone and adjust the flight path or spraying parameters as needed.

Sensors Included:

Temperature Sensor – Air, Humidity Sensor – Air, CO2 Sensor – Air, Temperature Sensor – Land, Soil Moisture Sensor – Land, PH Sensor, TDS Sensor, Light Sensor, Wind and Direction Sensor, Precipitation Sensor, NPK Sensor, Oxygen Sensor

4.3 Smart Hydroponic System

Installed in the hydroponic reservoir, IoT sensors transmit data to the local server through a private 5G network. Analytics conducted on the local server inform pump automation, facilitating the supply of necessary nutrients based on derived insights. This method of soilless farming promotes resource efficiency and produces healthier crops.
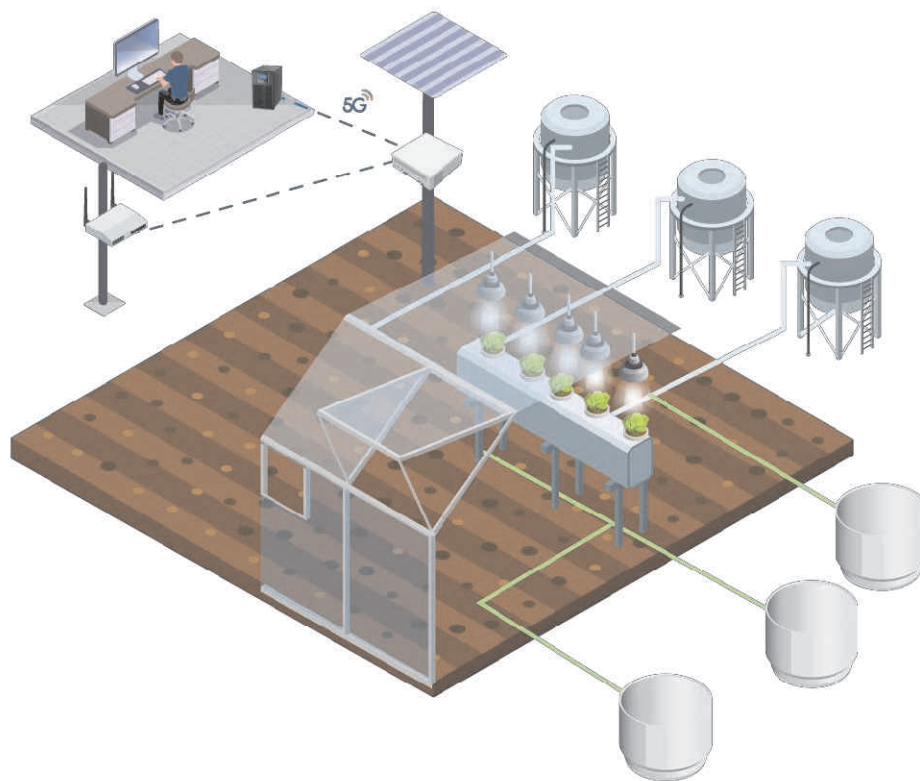

Figure 05 Smart Hydroponic System

Solution Details:

- IoT sensors installed in the hydroponic reservoir transmit data to a 5G-enabled IoT Gateway
- The IoT Gateway facilitates inter-sensor connectivity
- Data is conveyed to the local server through a Private 5G Network
- Received data undergoes analytics for insights
- Remote water pump is activated to supply necessary nutrients based on insights

Sensors Included:

Temperature Sensor – Air, Humidity Sensor – Air, Temperature Sensor – Land, CO2 Sensor, PH Sensor, TDS Sensor, Light Sensor, Wind and Direction Sensor, NPK Sensor, Oxygen Sensor

5. Expected Impact & Outcomes

The expected outcomes include:

1. **Bridging Technology Divide:** By introducing private 5G and other advanced technologies into agriculture, we are bringing technological advancements to a sector that has traditionally been deprived of such innovations.
2. **Development of other 5G Use Cases:** The same platform will act as fertile ground for prototyping, developing, and implementing various new 5G use cases, thereby fostering innovation in the agricultural sector.
3. **Impact on Society:** In India, where more than 50% of the population relies directly or indirectly on agriculture, narrowing the gap through technology brings innovative solutions to a specific segment.
4. **Partner Ecosystem:** We will collaborate with agricultural universities, R&D institutes, and strategic partners to develop new use cases in agriculture, fostering holistic sectoral progress.
5. **Higher Yield per sq. Yard:** The precision and efficiency introduced by 5G and IoT-based Soil Nutrition Management and Smart Hydroponic systems will significantly enhance crop health and yield.
6. **Higher Standard of Living:** By reducing resource wastage, controlling costs through targeted pesticide spraying, and improving overall yield, the Farm will uplift the standard of living for farmers through increased income and reduced economic uncertainties.
7. **Reduced Manual Efforts:** The incorporation of 5G-enabled drones for precision agriculture and Remote Pump Management significantly reduces the time and manual efforts.
8. **Sustainable Farming:** With real-time data, farmers can make informed decisions, leading to resource conservation and environmentally conscious agricultural practices.

The above use cases aim to promote efficient, sustainable, and technology-driven farming practices that positively impact the lives of farmers and contribute to the development of the agricultural sector.

6. Project Timeline

The project can be executed in a duration of 3-5 months.

7. Commercialization Plan

Our commercialization plan for the 5G Smart Farming Solution, centers on an initial rollout in the Indian agriculture sector, addressing the diverse needs of local farmers.

We will also work with agricultural universities, R&D institutes, and strategic partners to develop new use cases in agriculture, fostering holistic sectoral progress.

8. Budget Estimate

The estimated price of the above solution is INR 5 Crores plus taxes.

A recurring 15% AMC charges will be applicable for support and maintenance.

The Department of Telecommunications (DOT) can help companies in securing spectrum, or alternatively, we offer the option to obtain spectrum through BSNL with an additional cost.

Other Partners

VoICE has multiple players who can be part of complete end to end 5G CNPN solution. Once in principle, go ahead signal is available, further details can be worked out.

Lead Implementor

Amantya Technologies has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

***********End of Document***********

5G CNPN Enabled Smart Refinery

Table of Contents

1. Executive Summary

DOT is set to launch 5G Captive Non-Public Network (CNPN) initiatives in 2024, utilizing indigenously manufactured 5G equipment. This VOICE project is outlined based on Amantya Technologies' suggestions in this regard, as an Indian OEM. The project includes how 5G CNPN can enable Smart Refinery.

The adoption of 5G technology in the oil and gas industry has significant financial benefits. By implementing 5G, companies can achieve cost savings, increased productivity, improved supply chain, enhanced safety, and potential revenue increases.

2. Operational Benefits of 5G in Oil and Gas Industry

The introduction of 5G technology in the oil and gas industry brings significant operational benefits by enabling advanced communication and data transfer capabilities. Here are some areas where 5G can make a significant impact:

Seamless 5G Network with voice and high-speed data: There is a need to leverage the high throughput 5G Data network for various use cases to be deployed for enabling Smart Refinery. For any cellular communication, voice remains a key feature for seamless communication. IMS within a 5G Network enables a seamless voice communication.

Remote Monitoring and Control: The oil and gas industry often operate in remote and harsh environments, such as offshore drilling platforms and remote extraction sites. With 5G, companies can establish reliable and high-speed connections to remotely monitor equipment, pipelines, and operations in real-time. This enables better control, predictive maintenance, and reduces the need for manual inspections, improving operational efficiency and safety.

Data Analytics and Edge Computing: 5G networks enable faster data transfer and processing, making it easier to analyze large volumes of data collected from sensors and devices. Edge computing, which brings data processing closer to the source, can be implemented more efficiently with 5G, allowing real- time analysis of data at the edge devices. This facilitates quick decision-making, predictive maintenance, and optimization of oil and gas operations.

Enhanced Safety and Emergency Response: The oil and gas industry involve hazardous processes, and safety is of paramount importance. With 5G, workers can wear connected devices equipped with sensors that monitor vital signs and detect dangerous conditions. In case of emergencies, high-speed and reliable communication can facilitate immediate response and coordination, potentially saving lives and minimizing damage.
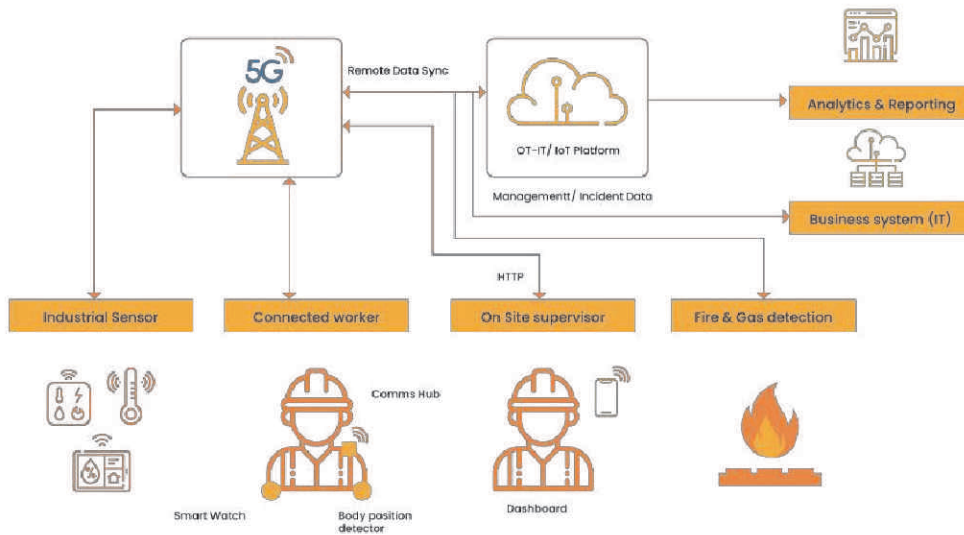
Wearable based tracking for workers

Automation and Robotics: 5G networks can support the deployment of autonomous vehicles, drones, and robots in oil and gas operations. These devices can perform tasks such as pipeline inspection, equipment maintenance, and hazardous operations without human intervention. The high bandwidth and low latency of 5G facilitate real-time data processing and control, enhancing the efficiency and safety of operations.
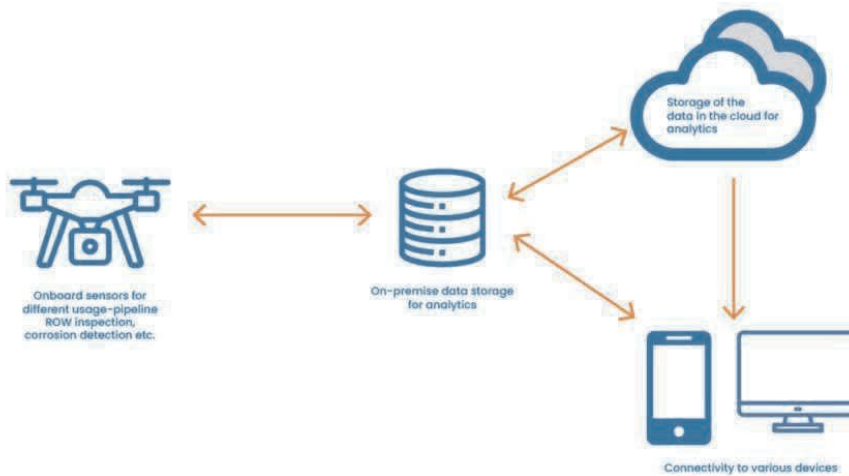
Drone-based surveillance of assets and infrastructure

Drones can reduce inspections times by 90%, downtime costs caused by manual inspections by 65% and health and safety incidents, resulting in 35% less cost to the provider. (Source: Fueling transformation in Oil and Gas by Ericsson)

Drones can reduce traditional surveilling costs by nearly 90 percent, prevent environmental disasters, and head off property damage.

3. 5G CNPN Advantages and Role in Refineries

5G CNPN brings in a lot of advantages for Smart Refineries and is critical for new age data hungry application. It helps to improve both safety and operational efficiency within the refinery.

Few key reasons are as below:

1. **Reliable and Low-Latency Communication:** Private 5G networks provide reliable and low-latency communication, crucial for real-time control, monitoring, and automation in smart refineries. This is especially important in processes where quick decision-making and response times are critical for safety and operational efficiency.

2. **High Bandwidth and Capacity:** Smart refineries generate vast amounts of data from sensors, cameras, and other devices. Private 5G networks offer high bandwidth and capacity, allowing for the seamless transmission of large volumes of data. This supports applications such as video surveillance, augmented reality, and data-intensive analytics.

3. **Wireless Connectivity for IoT Devices:** With a multitude of IoT devices and sensors distributed throughout the refinery, private 5G networks provide efficient and scalable wireless connectivity. This enables the deployment of a large number of sensors, actuators, and other connected devices across the facility.

4. **Secure and Isolated Communication:** Private 5G networks offer enhanced security features, including encryption and network slicing. This ensures that communication within the refinery is secure and isolated from external threats, minimizing the risk of cyberattacks on critical infrastructure.

5. **Customization and Network Slicing:** Private 5G allows for network slicing, which enables the creation of virtual networks with specific characteristics tailored to different applications. This customization ensures that the network can meet the diverse requirements of various refinery processes and applications.

6. **Edge Computing Integration:** Private 5G networks can be integrated with edge computing capabilities, allowing data processing to occur closer to the source. This reduces latency and supports applications that require real-time analysis, such as advanced process control and predictive maintenance.

7. **Mobility Support:** In a dynamic industrial environment, where equipment and personnel are often on the move, private 5G networks provide reliable and high-speed wireless connectivity, supporting mobile applications and devices.

8. **Scalability and Flexibility:** Private 5G networks are designed to be scalable and adaptable to the evolving needs of the refinery. As the number of connected devices increases or new technologies are introduced, the network can be expanded and upgraded to accommodate these changes.

9. **Reduced Dependency on Wi-Fi Networks:** Private 5G networks provide an alternative to traditional Wi-Fi networks, reducing dependency on shared spectrum bands and potential interference. This is particularly advantageous in environments where reliability and performance are critical.

4. Key Components for a CNPN – Refinery

A smart refinery can be enabled through different phases of deployment where we can start the 5G Deployment along with 5G use cases. Following components would be deployed:

Sl No	Component	Qty
1	5G Indoor Radio's	3
2	5G Outdoor Radios	1
3	3GPP Compliant 5G SA Core	1
4	Network Slicing for Security and solution specific network	
5	Mobile Edge Computing Platform for Low Latency Applications.	
6	Support for various Quality of Services for different Applications	
7	Single Administrative Console	
8	Data Plane support of up to 10 Gbps	
9	IMS Solution for voice calls	
10	5G Gateways for Integration with legacy IoT Sensors	10
11	5G enabled smart HD cameras	10
12	AI enabled analytics for Worker safety & Edge Analytics devices for Local video processing	1
13	5G enabled drones for remote monitoring and IoT Sensors	1
14	Drones Orchestration platform over 5G	1
15	Multiple IoT Sensors with IoT Platform	1

5. Project Timeline

The project is expected to be executed in 4-6 months.

6. Budget Estimate

The estimated price of the above solution is INR 8 Crores plus taxes.

A recurring 15% AMC charges will be applicable for support and maintenance.

The Department of Telecommunications (DOT) can help companies in securing spectrum, or alternatively, we offer the option to obtain spectrum through BSNL with an additional cost.

Other Partners

VoICE has multiple players who can be part of complete end to end 5G CNPN solution. Once in principle, go ahead signal is available, further details can be worked out.
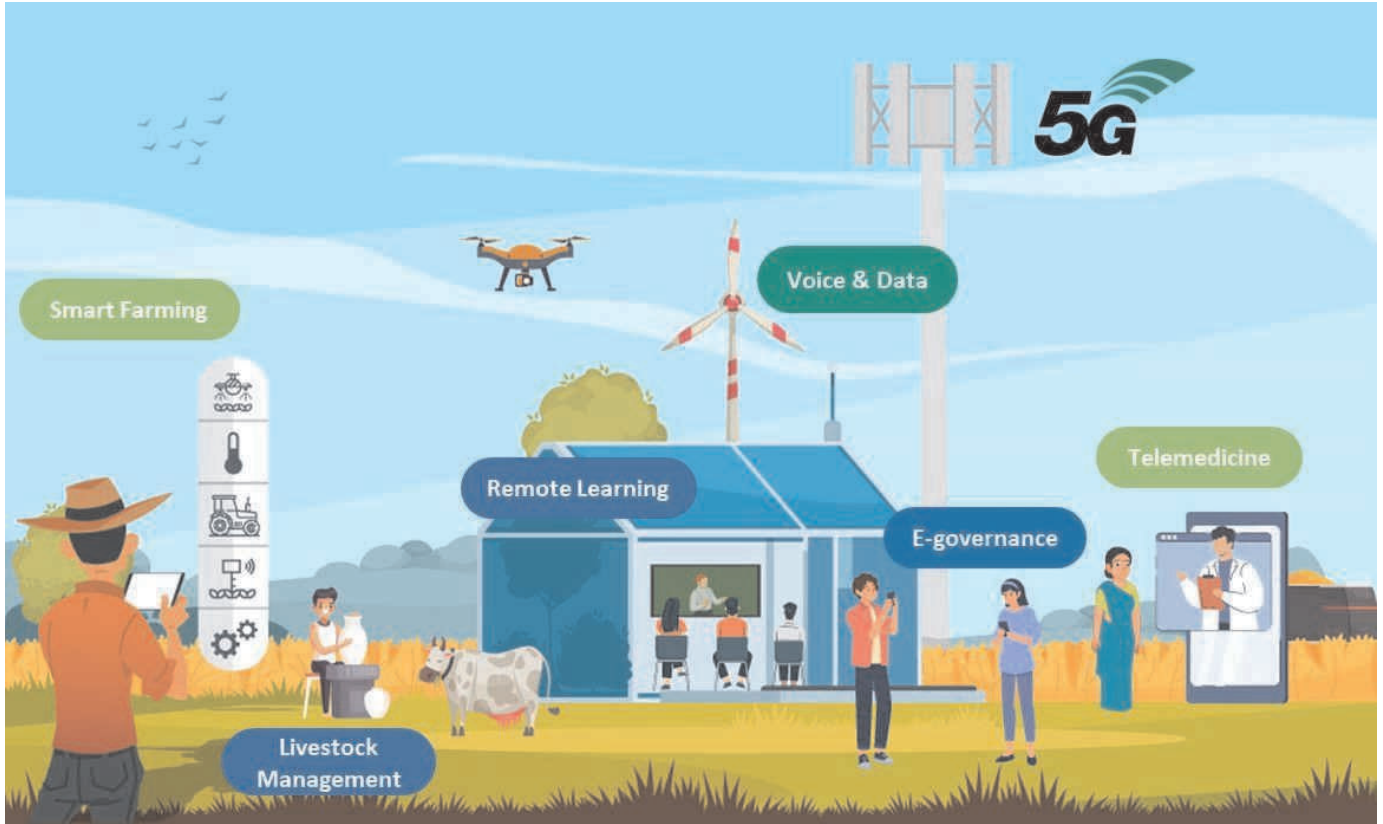
Lead Implementor

Amantya Technologies has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

***********End of Document***********

5G Connectivity to Unconnected Villages

(Enabling 5G-enabled Smart Village Ecosystem)

Table of Contents

1. Executive Summary

DOT is set to launch 5G Captive Non-Public Network (CNPN) initiatives in 2024, utilizing indigenously manufactured 5G equipment. This VOICE project is outlined based on Amantya Technologies' suggestions in this regard, as an Indian OEM. The project includes how 5G CNPN can Connect the unconnected villages with voice and high-speed data network.

Introducing 5G technology in these regions can revolutionize the way rural communities access services, fostering sustainable development and improving the overall quality of life. The document entails 5G potential in overcoming challenges and bridging digital divide through collaborative efforts and strategic investments in India's remote regions.

2. Key Challenges in Unconnected Villages

Out of 5,97,618 inhabited villages in the country, 25,067 villages lack mobile connectivity and Internet, according to the Ministry of Communications based on Telecom Service Providers (TSP) data. This makes up about 4% of villages that lack mobile connection services.

Several factors contributing to the lack of mobile connectivity in these areas:

1. **Geographical Challenges:** Harsh terrain, dense forests, and difficult geographical conditions can make it challenging and expensive to set up mobile towers.
2. **Unavailable/ Unreliable backhaul network:** Setting up fiber cables in hard-to-reach areas becomes a significant challenge, hampering the network's ability to extend its coverage.
3. **ROI for Operators:** In economically underdeveloped areas, the return on investment for telecom companies may be low.
4. **Infrastructure Development:** The lack of basic infrastructure such as roads and electricity can hinder the installation and operation of mobile towers.
5. **Population Density:** Telecom companies often prioritize areas with higher population density to maximize their reach and revenue.

3. 5G Use Cases in Villages

Villages can leverage 5G CNPN networks in various ways to enhance connectivity, improve infrastructure, and enable the implementation of advanced technologies.

5G Enabled Voice and high-Speed data: 5G offers reliable voice and significantly faster data speed for applications like video conferencing, online education, and telemedicine.

Education and Digital Literacy: Enables access to online learning platforms, digital libraries, educational materials, and remote education promoting continuous learning.

E-governance and Citizen Services: Allows villagers to access government services, policies and initiatives online reducing the need for physical visits to government offices.

E-health and Telemedicine: Doctors can use video conferencing to consult with patients in remote areas, providing diagnosis and treatment without traveling.

4. Key Components for a 5G CNPN – Smart Villages

Access to reliable connectivity remains a critical challenge in rural areas. 5G CNPN connectivity emerge as a promising avenue to bridge this gap, offering scalable and high-speed internet access.

Sl. No.	Component	Qty
1	5G Outdoor Radio	3
2	3GPP Compliant SA Core	1
3	Monitoring and Management Dashboard	
4	Support for various Quality of Services for different Applications	
5	Single Administrative Console	
6	Data Plane support of up to 10 Gbps	
7	IMS Solution for voice calls	
8	5G CPEs	10
9	Backhaul connectivity links	1
10	Outdoor power cabinets	1
11	IT and other Infrastructure	1

5. Benefits of 5G CNPN in Village Connectivity

Here are the benefits of 5G CNPN in villages:
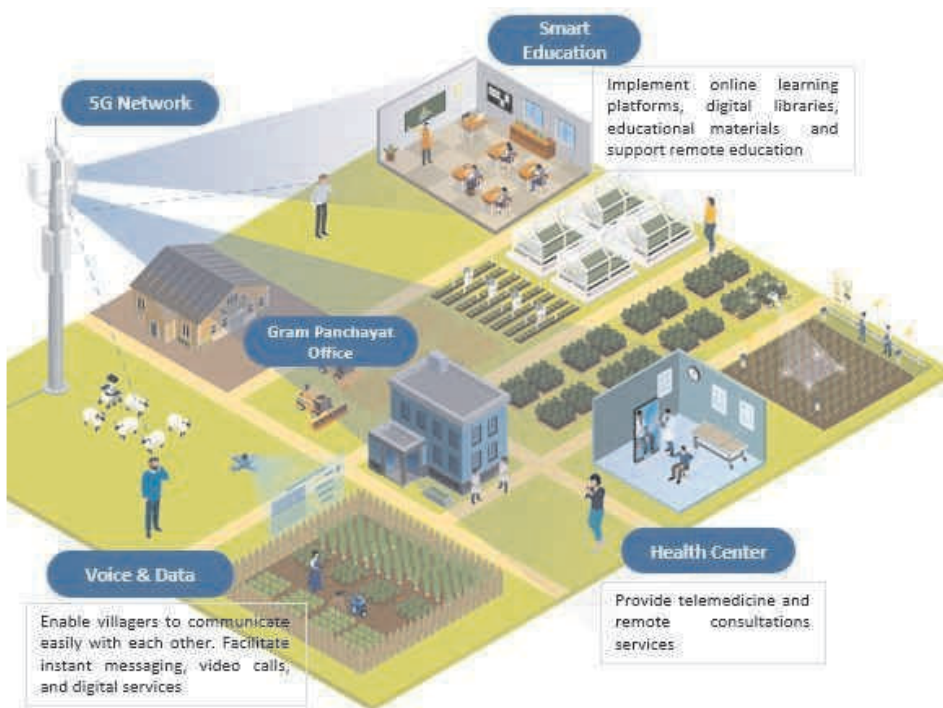
Figure 02: 5G Enabled Smart Village Diagram

- **Enhanced Connectivity:** 5G offers significantly faster data speed and ensures a stable and reliable connection for applications like video conferencing, online education, and telemedicine.
- **Access to Information:** Provide access to the information regarding government services, policies and initiatives for the welfare of people.
- **Healthcare Advancements:** Rural residents gain access to remote healthcare services, connecting with doctors and specialists without the need to travel making healthcare more proactive and accessible.
- **Education Revolution:** High-speed internet ensures enhance access to educational resources, online courses, and e-learning materials, improving the quality of education in rural areas.
- **Fostering Digital Economy:** Fosters a conducive environment for startups and small businesses in rural areas to supports the growth of e-commerce, connecting rural businesses with a broader market.
- **Job Creation:** Enables skill development in emerging technologies, creating job opportunities. Rural areas become integral to the digital economy, contributing to national growth.

6. Project Timeline

The project can be executed in a duration of 3-5 months.

7. Expansion and Commercialization

As part of future expansion, multiple smart villages can be connected through Village-to-Village connectivity from a central site for multiple cluster connectivity.

Village to Village connectivity

8. Budget Estimate

The estimated price of the above solution is INR 7 Crores plus taxes.

A recurring 15% AMC charges will be applicable for support and maintenance.

The Department of Telecommunications (DOT) can help companies in securing spectrum, or alternatively, we offer the option to obtain spectrum through BSNL with an additional cost.

Other Partners

VoICE has multiple players who can be part of complete end to end 5G CNPN solution. Once in principle, go ahead signal is available, further details can be worked out.

Lead Implementor

Amantya Technologies has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

***********End of Document***********

VOICE CNPN PROJECT 13
Ocean Floating Telecom Tower in Offshore

Objective

Very first Deployment of 5G on ocean has been carried out by Innogle.
World first Invention of Ocean floating Telecom tower (OFTT) is designed with High-end marine grade material which suits for the marine environment to extend the telecommunication even in Deep Sea. Network is necessary to provide essential safety, environmental, and efficiency considerations for those living in the local isolated areas and in off-shore settings. Applicable for Island, ONGC, Wifi access on ocean to the end user coast guards, Navy, ocean researcher, Tourist, fishermen.

Technology Involved:
5G, Lora, IoUT (internet of underwater things), Sensors, embedded system related Marine grade material Telcom tower, cameras, installation components and technology, AIS system.

Category
An Atma Nirbhar Bharat patented and Novel product of Innogle.

Project
Considering the ocean environment, it is important for the sustainability and the structural strength of the total devices, choosing the data coordinates to identify the points on Deep sea including development planning and Honeycomb grid price, site selection, R&D investment, environmental protection policy, and offshore power supply for the tower to define.

Major objectives of the OFTT is to verify the system design and working prototype from P1 tower, p2 tower on ocean and checking the feasibility and implementation in real-time.

Establishing a communication, stability and sustainability from Tower to Tower on Ocean.

Creating End to End Complete solution to cover the part of telecom tower.

As it is a Atma Nirbhar product, which achieve high crucial needs for offshore connectivity without long duration. This solution is complete End to end solution, which paves to market for telecom on ocean.

Creating Wifi using OTFF as we are deploying this solution on above the sea surface

Novelty of the solution
- Site selection Based on the identification.
- We are using terrestrial communication which can be deployed as quickly when compare to submarine underwater cables.
- Adaptable Design for dynamic Waves / wind.
- Unique design to withstand on sea with Extendable 4 arm Bouy design
- Embedded with Solar panels:

- Geofencing linked with Number of sensors To avoid the collision with ships or man drive vessels.
- Challenges in protecting OFTT from sea species.
- The OFTT structural design is highly resistance:
  Creating Wifi using OTFF as we are deploying this solution on above the sea surface.
- Easy to install and deploy.
- Remotely controllable and Monitorable using AI functionality with High end sensors. Less manpower intervention.
- Remotely operatable and controllable Monitoring Dashboard about the tower.
- All the material for structuring this OFTT will be highly marine grade material.   ex: in different countries, ocean researcher lab, are built in the Mid of sea to do real-time lab test.

Vendor Inter-operability:

Based on 3GGP and global standard, we can implement this project under Voice consortium with multi player in the domain.

Deployment scenario

PoC with Island shown interest, implementing OFTT P1 and OFTT P2 on ocean with network establishing distance and spreading the Wifi on ocean and additionally possible collaboration with TDB in countries like Spain, Singapore and UK.

1) PoC on Establishing communication with OFTT P1 and OFTT P2 point on ocean according the patent.
2) Spreading Wifi using Ocean Floating telecom tower.
3) Network Management & Control of entire network at a centralized Command Control System.

Challenges

- Though we can install the limited OFTT towers in ocean, still we can extend the deep ocean connectivity through fishing Vessels as USB (through our application called Kadal compass installed in each boat).
- Telecom will
- By implementing the above solution, we can implement the below solution effectively open up new market opportunities and Job creation.
- Spectrum Availability.
- Inter-operability with existing equipment's and sub systems.

Expectations from DOT

a) Permission and PoC letter from DoT to test the Novel OFTT.
b) We will be using the Product and solution which are domestically available within the voice stakeholder also.
c) Funding support from DoT like USOF for research and PoC.

The following domestic Vendors product and services can be used to implement Mission Critical services for Public Safety. This is not an exhaustive list of VoICE stakeholders but many more would be available for complete end to end solution delivery: -

Srl. No.	Items Name	OEMs
1	Core, EPC	VVDN, Signaltron, Niral, Resonous, Coral, WiSig & others
2	Radio	Signaltron, VVDN, Lekha, Resonous, C-DOT, BigCatWireless, HFCL, Sooktha, WiSig & others
3	IMS / IP PABX / PA / Voice logger	C-DOT, Niral, Dyotis, Cientra, Rebacca, Coral, Echelon Edge, Innogle
4	Antenna	Innogle, Kenstel, Astrome
5	Despatcher Console	Coral, Sanchar Tele, CDOT, IIT Mubai Startup
6	MCX handsets	Sanchar Tele, CDOT, Coral, IIT Mumbai Startup, Optimus Logic
7	24 port Switch	Nivetti, Tejas, Indio Networks
8	NMS	Dyotis, Amantya, Coral, Galore, C-DOT, Rebacca
9	High-end Router	Innogle, Nivetti,
10	!rtificial Intelligence	Innogle
11	IOT sensors	Innogle, Coral, Cosgrid
12	Ocean workers life safety	Innogle
13	IoUT device for communication and data mining	Innogle
14	Fabrication of Grid tower	Innogle, Ozone engineering
15	Hydraulic floating system	Innogle, Ozone engineering
16	Power unit with battery backup	Innogle, Ozone engineering, Qualmatrix
17	Software development and server management	Qualmatrix
18	Embedded boards with water proof	Qualmatrix, Innogle

PROVISIONAL Estimated Cost:

Sl No.	Item	Qty.	Unit Cost	GST in %	Unit cost including tax	Total Cost Without Tax	Total Cost with Tax
1	Buoy Base (1 Large and 4 small set)	2	6500000	18	76,70,000	1,30,00,000	1,53,40,000
2	Concrete Base	10	250000		2,50,000	25,00,000	25,00,000
3	Hydro elastic suspension pipe	2	4000000	18	47,20,000	80,00,000	94,40,000
4	Underwater Cabel & springs	10	780000	18	9,20,400	78,00,000	92,04,000
5	Grid tower with hardwoud plastic spring	2	980000	18	11,56,400	19,60,000	23,12,800

6	5G gNode-B, 2 sector, 4x4 MIMO, 40W per port, Installation Material etc	12	30,00,000	18	35,40,000	3,60,00,000	4,24,80,000
7	Antenna and erecting for Radio network	4	7,00,000	18	8,26,000	28,00,000	33,04,000
8	Duplicated HA Core, SW License, EPC, IMS, PA system, Voice logger	2	1,50,00,000	18	1,77,00,000	3,00,00,000	3,54,00,000
9	Despatcher	5	4,01,200	18	4,73,416	20,06,000	23,67,080
10	MCX handsets	10	47,790	18	56,392	4,77,900	5,63,922
11	StaFon Radio	5	3,54,000	18	4,17,720	17,70,000	20,88,600
12	Water proof 24 port Switch	6	450000	18	5,31,000	27,00,000	31,86,000
13	High-end Router	2	2500000	18	29,50,000	50,00,000	59,00,000
14	IOT sensors, Cameras & integration	15	10,00,000	18	11,80,000	1,50,00,000	1,77,00,000
15	Installation in Initial ocean site	45	55,000	18	64,900	24,75,000	29,20,500
16	Ship rental and its related	10	5,00,000	18	5,90,000	50,00,000	59,00,000
17	Rental of other vessels and fuel(days)	150	1,50,000	18	1,77,000	2,25,00,000	2,65,50,000
18	Cabins on the buoy	2	7,80,000	18	9,20,400	15,60,000	18,40,800
19	Labour and Auditing staffs (5x30)	150	55,000	18	64,900	82,50,000	97,35,000
20	Life safety watches, KC and other	5	4,85,000	18	5,72,300	24,25,000	28,61,500
21	Installation commissioning support for 5 years	2	75,00,000	18	88,50,000	1,50,00,000	1,77,00,000
22	Communication vessel	1	84,00,000	18	99,12,000	84,00,000	99,12,000
23	3rd Party audit, support and Consultation	3	1,08,00,000	18	1,27,44,000	3,24,00,000	3,82,32,000
	Total Cost					**22,70,23,900**	**26,74,38,202**

Rounded Off to Rs. 30 Crores with admin and management expenditures and insurance and other activities/ works and equipment that may be needed to added as per dynamic requirements.

Deployment scenario
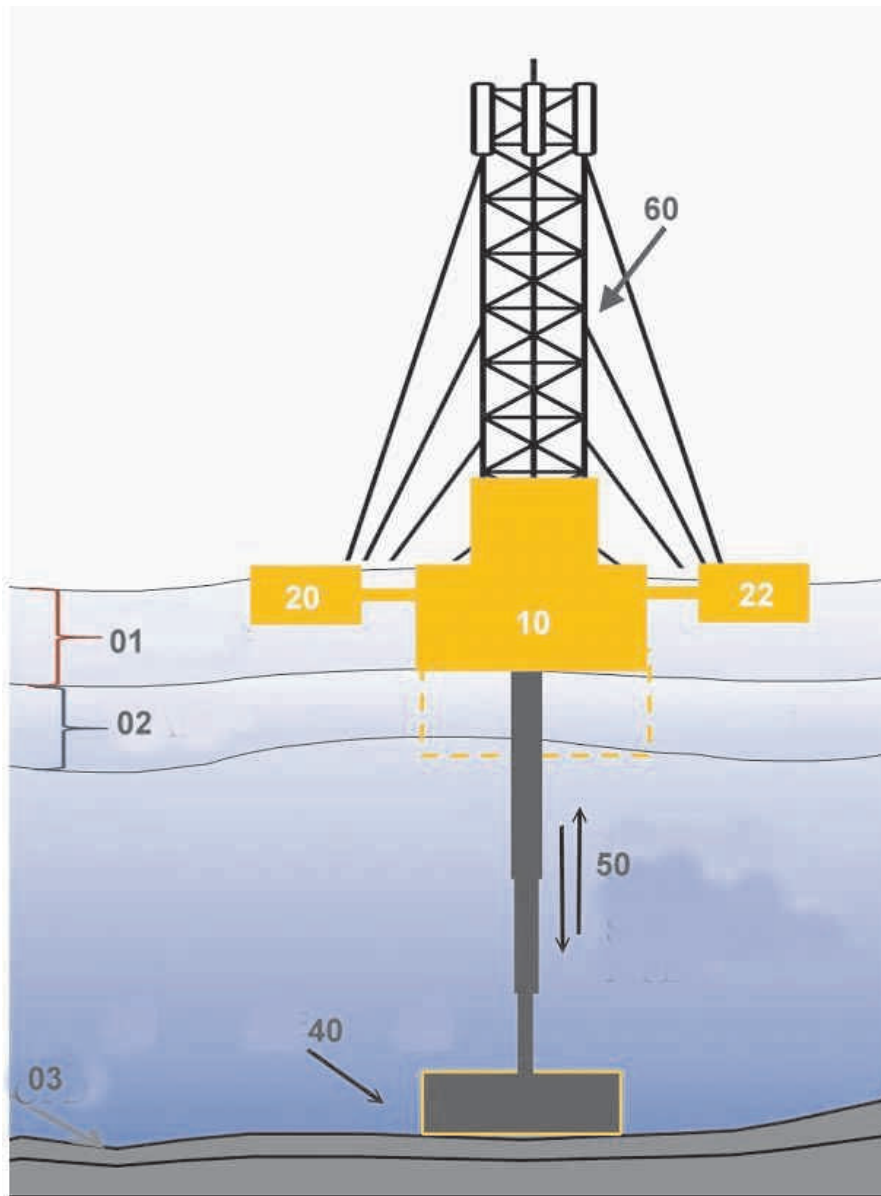
Codes in diagram:

01 – Steric sea level
02 – Ocean Mass
03 - OPD of the ocean
10 – Primary floatable buoy
20,21,22, 23 – Secondary floatable buoy attached to the primary buoy
40 – Concrete blocks which can be connected vertically and horizontally
50 - Extendable Hydraulic Pipes to connect the buoy and the Concrete blocks to vertically movable depend on the water level and to avoid horizontal move.
60 – Telecom tower made by
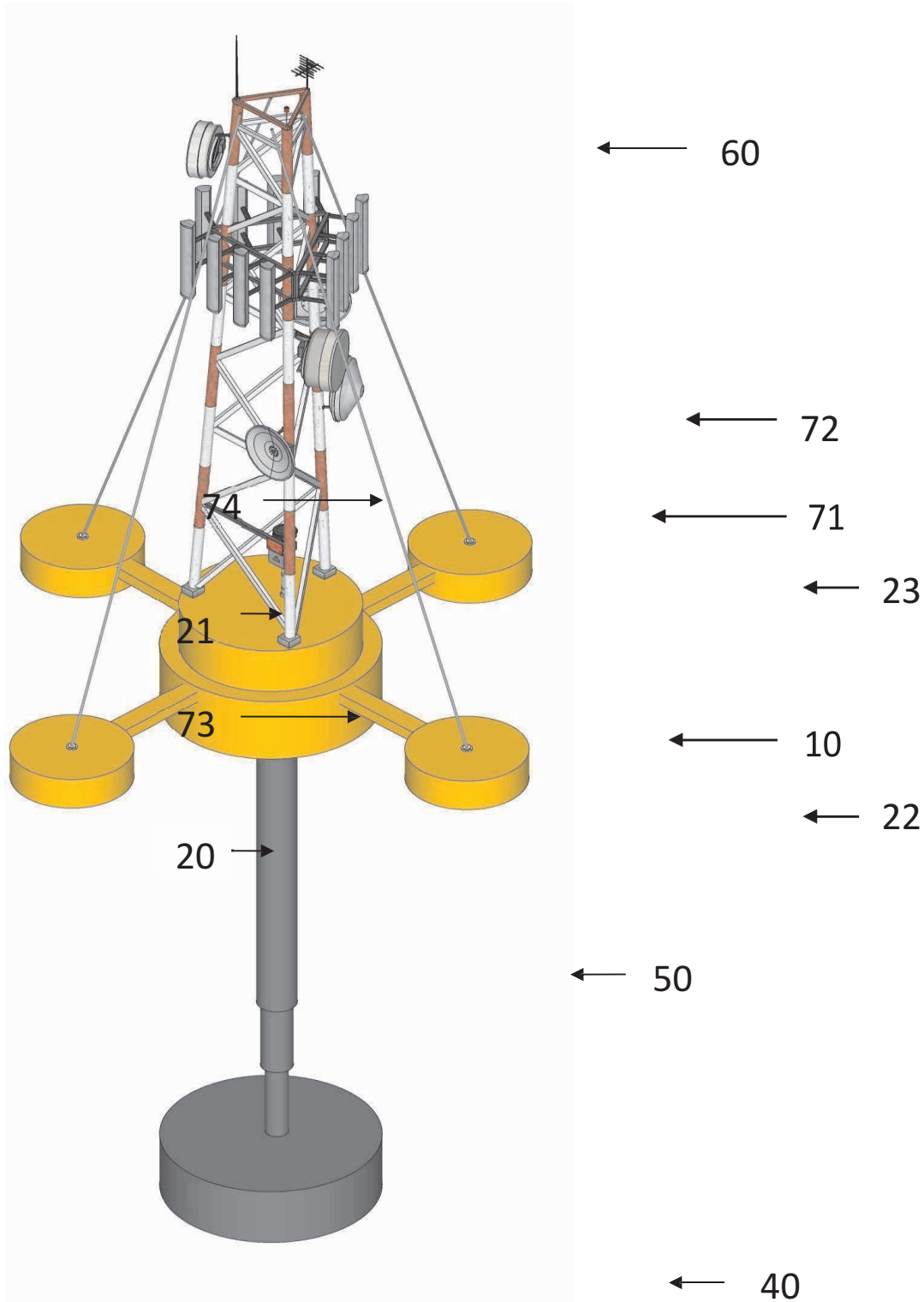
10 – Primary floatable buoy

20,21,22, 23 – Secondary floatable buoy attached to the primary buoy

40 – Concrete blocks which can be connected vertically and horizontally

50 - to connect the buoy and the Concrete blocks to vertically movable depend on the water level and to avoid horizontal move.

71, 72, 73, 74 – Balancing cable between tower and secondary buoy 20,21,22, 23

60 – Telecom tower made by combination of stainless Steel, fiberglass, resin or plastic
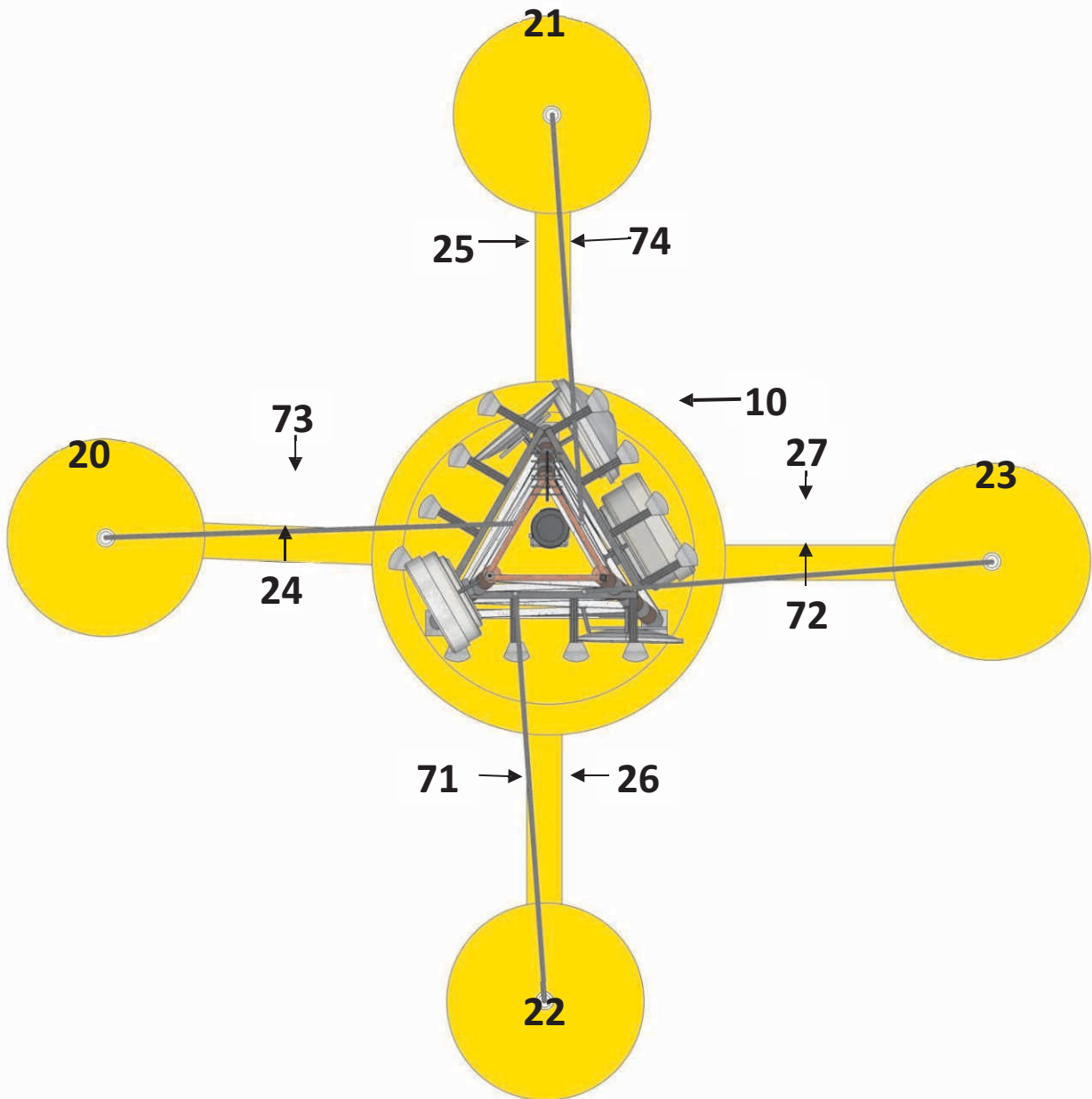
10 – Primary floatable buoy
20,21,22, 23 – Secondary floatable buoy attached to the primary buoy to avoid horizontal move.
24,25, 26, 27 – Connection between primary and secondary floatable buoy, this connection will balance the tower and allow the power supply connectivity from 20, 21, 22, 23 to 10.
71, 72, 73, 74 – Balancing cable between tower and secondary buoy 20,21,22, 23

Lead Implementor
Innogle has forwarded the Project and it is proposed that they can lead the Project as solution provider. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VoICE CNPN Project 14
Gram Panchayat Connectivity

Impact and Use Cases

Many Gram Panchayats and Villages in India have special challenges: they are often located in remote areas with no Fiber coverage; have inadequate facilities for citizens, so key personnel have to travel to nearby bigger towns and cities to use government schemes, banking facilities, Internet etc.

In case it is not feasible to lay the OFC (either underground or ADSS), the deployment of alternate technology to connect such GPs based on 4G & 5G Network using Next Generation SDWAN Router. The alternate technology will be integrated with State- Network Operation Centre (S-NOC). The SI shall be responsible for connectivity across all Gram Panchayat (GP) and ensure connectivity to the existing network infrastructure into ring topology with IP-MPLS network. The GPs already connected on Satellite media under BharatNet Phase-II project shall also be planned for connectivity on 4G & 5G Network using Next Generation SDWAN Router.

4G & 5G Network using Next Generation SDWAN Routing Technology infrastructure brings a range of benefits to address these challenges, with its attributes of mobility, operation cost, Secure Network. high throughput and low latency and jitter.

The network architecture deployed meet the following:

> i. Redundancy across GPS to maintain higher uptime by using multiple TSP 4G / 5G Links or any other connectivity's provided by TSPs.
> ii. Optimal link utilization
> iii. Flexibility to allow easy insertion of new GPs / Villages
> iv. From Day-1, the network shall support and enable retail, enterprise, and wholesale ervices as per the citizen application available from government.
> v. All type of data and voice services, Connectivity to existing/new IP MPLS Infrastructure , layer2 VPN, layer3 VPN, point 2 Multipoint VPN. The network created should have capability to establish end to end integration as per requirement up to State-Wide Area Network (SWAN) and National Knowledge Network (NKN).

Key clients

Key Clients for the project include State Governments.

Solution

Project proposes the deployment of Make In India Next Generation SDWAN Router on existing 4G / 5G Network from TSPs or Make In India 5G CNPN Network.

Components and Sizing

A typical SDWAN Router Technology covers following Components to be connected on 4G / 5G Network using dongle / SIM

- SDWAN Controller at DC & DR
- SDWAN Hub at DC & DR
- SDWAN Router at CPE
- NMS and Orchestration Application for monitoring
- Bandwidth from TSPs

Project Timeline

The project is expected to be executed in 6-9 months.

Budget Estimate

The estimated price of connecting 2000 includes mix of GPs and CPEs is between ₹20 to ₹24 Crores.

Future Expansion and Commercialization

Once the solutions is deployed and proven in a real mine, we expect major business, rolling it out to mines in India and globally, particularly in Australia, USA and Canada and in various African countries. 5G meets the real and compelling needs of mine safety, security and operations efficiency, in remote locations.

Other Partners

VoICE has multiple players who can be part of complete end to end 4G & 5G Network using Next Generation SDWAN Router solution. Once in principle, go ahead signal is available, further details can be worked out.

Lead Implementor

Infinity Labs has proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VoICE CNPN PROJECT 15
Fixed Wireless Access for PSU and Enterprises

Objective

Network connectivity for humans and machines has become very critical in the modern world. As we move towards a more connected society, the need for affordable, reliable and fast connectivity is becoming paramount for everyone.

While there has been lot of discussion of using 4G or 5G technologies for CNP networks, we at Indio Networks believe that many captive networks can be built using regular unlicensed spectrum like Wi-Fi. If designed correctly, the Wi-Fi based captive networks can provide a phenomenal cost saving while addressing majority of the customer's use cases.

Most the enterprise requirements for connectivity can be solved by having a reliable and well covered unlicensed band network. WiFi is a very good choice and will be able to address most of the user scenarios.

The main limitation for WiFi networks over 5G networks is latency and coverage. However, we believe that many enterprises use cases don't need very low latency and coverage. These use cases can be solved by using Wi-Fi networks instead.

Typical Use cases

Here's the list of possible use cases that can be addressed by deploying a private Wi-Fi, captive network for a campus:

1. Backhaul for video surveillance

2. Backhaul for IOT applications like smart parking, monitoring sensors, asset tracking solutions, etc

3. Streaming applications – Enterprises needing high-speed streaming services can use Wi-Fi connectivity

4. Factory automation – WiFi is a good choice for various industrial automation and Industry 4.0 applications

Advantages

Captive Wi-Fi networks have lot of advantages over other LTE technologies. They also complement these 4g and 5G technologies to enable wide range of use cases. Many FWA networks are designed using 5G backhaul along with outdoor or indoor WiFi access points to enable end-to-end connectivity

The main advantages of FWA and WiFi networks are as follows:

1. Low cost: Wi-Fi networks are the best options for last-mile connectivity today. These networks can be deployed at a fraction of cost of other LTE networks. The equipment are readily available and easy to install and operate

2. Easy installation: Wi-Fi networks are very easy to install and operate. There are a lot of skilled resources available to deploy these networks.

3. No Recurring Cost: Wi-Fi networks once installed are virtually free since they operate in unlicensed band and don't need special SIM to operate.

4. Wide adoption: Almost all the devices today come with built-in Wi-Fi chipset thus making them very easy to adopt. Furthermore, if any IOT applications need to use Wi-Fi, the chipsets are very easily available and very low cost.

5. High Speed: With the advent of WiFi-6 and upcoming Wi-Fi7 standard, the speed for Wi-Fi networks have increased tremendously. It is possible to design networks with multi-Gig throughput thus enabling advance applications like AV/VR, Real-time Streaming and other bandwidth hungry applications

Solution

As mentioned earlier, Indio can build reliable backhaul and access networks using a combination of WiFi and 5G technology to enable wide range of enterprise use cases.

The FWA network can be laid to carry the Internet connectivity to base stations on various building in the campus. Once the building is connected to the backhaul, Indio can deploy a secure and reliable WiFi networks within the building premises to provide end-to-end connectivity for the users and IOT applications.

Similarly, Indio can also deployed its long-range outdoor WiFi access points to cover open area or factory floor with WiFi signal.
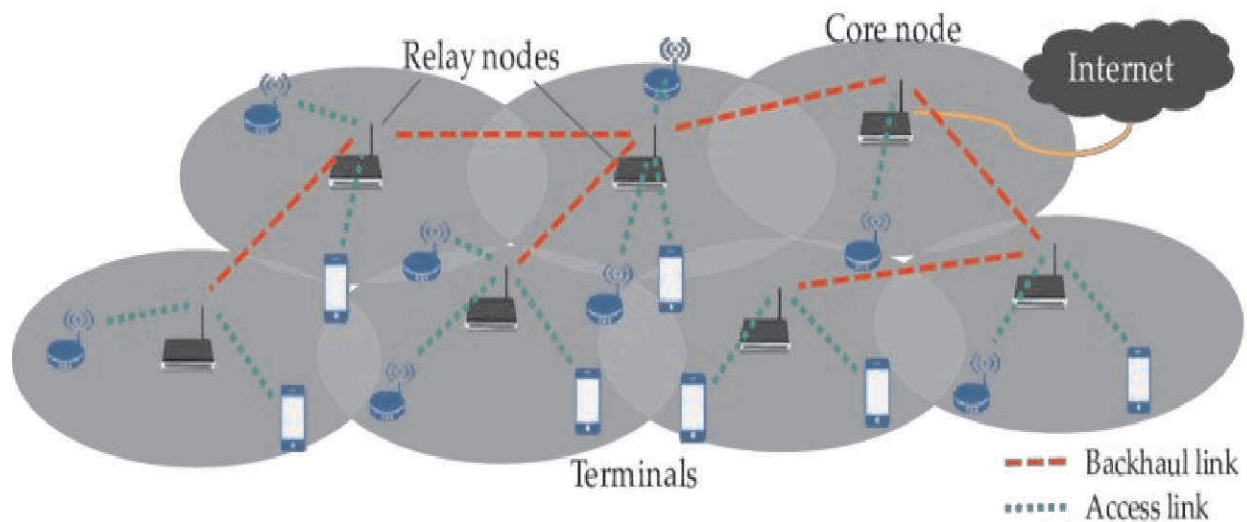
What is required?

Indio Networks need the following assistance from DoT and other government institutions to enable these networks

1. Opening of 6 Ghz band to enable WiFi-6E within India. This will allow India to match the rapid advances done in WiFi technology in the other parts of the world.
2. Endorsement of Indio products by credible authority
3. Reduce cost of lab testing for TEC and other certifications
4. Enabling funding schemes to help local manufactures like Indio to build all the technology in India

Challenges

Although FWA has been there for a while now, it does have some challenges when compared to the other FWA technologies like 5G. They are as follows:

1. Coverage: Wi-Fi based FWA may not be able to cover the wider areas since it operates in unlicensed spectrum and has limitations on how much power it can radiate. As a result, the network needs to be designed carefully to provide coverage in the needed areas
2. Latency: WiFi doesn't offer very low latency as compared to 5G technologies. Hence it cannot be used for some applications where ultra low latency is needed
3. Power: Unlike many IOT technologies like NB-IOT, LoRA which require very low power, WiFi needed much more power and hence many not be adequate for some IOT applications. However, WiFi has released some new standards like WiFi Halow that has been widely used for IOT applications with low power requirements

Estimated Budget

Indio Networks has been doing R&D work for building low-cost, made-in-India WiFi technologies for last 10 years. It currently produces the UBR and WiFi access points in India and plans to further expand the R&D efforts.

Indio needs 10 Cr to help setup a manufacturing plant for making all the equipment locally within India. Part of the funds will be utilized for R&D in wireless and backhaul technologies.

Indio plans to make all its equipment in India with at least 60% local content.

Lead Implementer

Indio Networks can function as a lead implementer for these projects. Indio Networks has been working in the field of Wi-Fi technology for over 18 years and has done extensive deployments across the country. It is already empaneled with BSNL and is currently executing various campus projects for BSNL. Indio can also work with other 5G players to offer a combination of WiFi and 5G solutions for captive networks.

VOICE CNPN PROJECT 16:
5G Wireless Access Network and the Network Manager

Sooktha offers common, flexible, and intelligent solutions for multiple verticals. Sooktha proposes to offer 5G captive wireless connectivity for Railways, Ports, and Factories. Sooktha recommends that the networks be completely private. The spectrum may be leased from a public network service provider, for example, BSNL.

Flexibility

Our software allows network topology, hardware platform, radio units, wireless coverage, and Quality of Service combinations that meet all the requirements of a vertical.

Reliability

Our proprietary improvements to the 3GPP Release 15 enhanced broadband functionality enable Machine Type Communications (MTC) and Ultra Reliable Low Latency Communications (URLLC). These are strengthened by the roadmap to incorporate specific parts of 3GPP Releases 16 and 17 that is aligned to the availability of the right devices.

Security

Our solutions offer indigenous, trusted, and secure communications.

Collaboration

Sooktha will work with entities in different verticals and with various ecosystem partners to define end-to-end technology solutions. Sooktha has indigenous ecosystem partners on the device side, the applications side, and for backhaul communication.

Benefits

Sooktha will provide professional services to the vertical entity to help integrate automation, data analytics, and AI.

Approach

Sooktha proposes a step-by-step approach as follows:

1) Enable basic connectivity via a Proof-of-Concept deployment at site.
2) Extend this deployment to demonstrate complete coverage and connectivity.

3) Integrate devices, application servers, and applications to enable use cases and assess their impact.

4) Scale selected use cases, and integrate automation, analytics, and AI.

5) As an option, handover the entire network operation either to the vertical entity itself or a large system integrator of their choice.

Generic Solution View

A genetic solution view is illustrated below. Sooktha will offer the wireless access network and the network manager and help connect various devices, phones, machines, gateways, drones to this network and to enable centralized control of all of these from application servers.

The functions and workflows of a particular vertical may all be automated and optimized via applications enabled by these application servers. The applications will leverage the power of data analytics and AI to maximize the benefits.
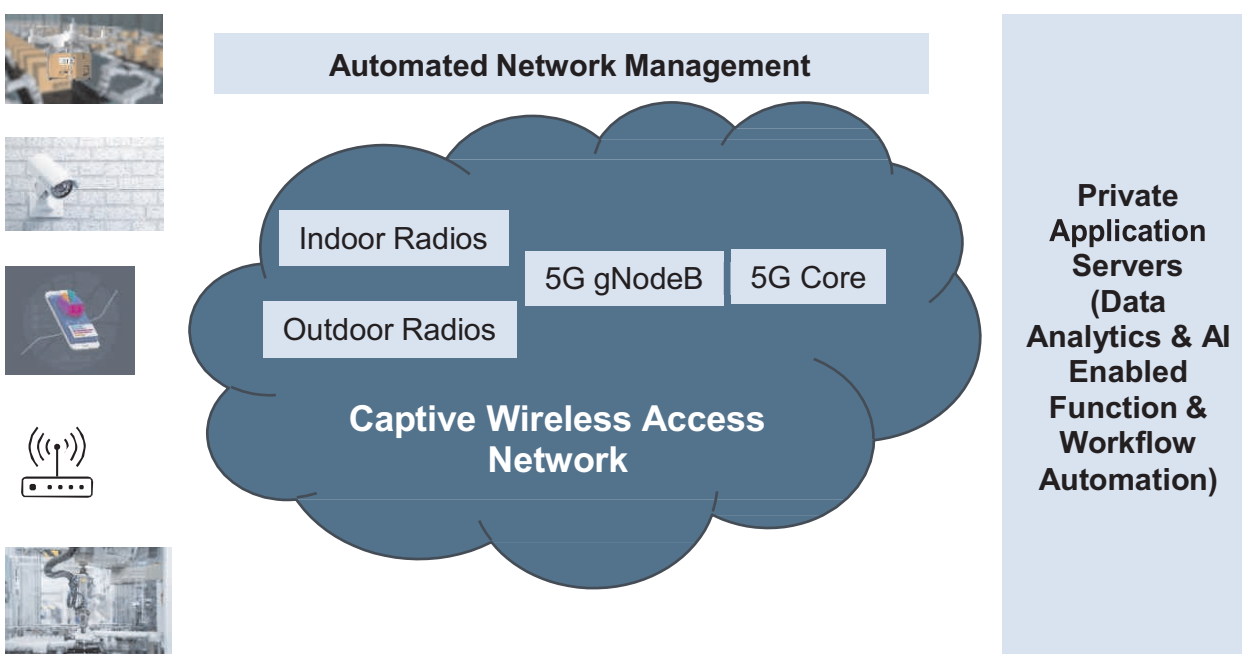
Figure 1: Generic CNPN Architecture

Partner List (Representative Only)

Solution Component	Partner/Vendor
Radio Unit	Resonous, IIT-M, Other Indian RU Vendors
Base Station Hardware	NetWeb, Dell, GeneVISIO (AMD, Intel, NXP)
Handset	Optimus, Bhar OS enabled phones
Drone	Menthosa
5G Enabled Camera	Sparsh
CPE	Kenstel
IoT Gateway	COSGrid
5G Core	Resonous
Application Servers	Niral
IMS Application	Coral

Table 1: Sooktha Ecosystem Partners

Readiness

Immediate	x Indoor coverage (250 mW)
	x Outdoor coverage (up to 10 W)
	x Band n78
	x Disaggregated BBU on standard server (Intel/AMD, Dell/Netweb)
	x 4T4R RU from partner.
6 months	x Band n28 outdoor coverage (up to 10 W)
1 year	x Integrated indoor small cells in Band n78 (250 mW)
	x Integrated outdoor small cells in Band n28/n78 (up to 10 W)
On Request	x Other Bands and transmit power options.

Table 2: Sooktha Solution Readiness

Cost Estimate

Will be provided after detailed definition.

Lead Implementor

SOOKTHA has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project

VOICE CNPN PROJECT 17
OIL & NATURAL GAS

Contents

Introduction

MatreComm Technologies a Startup based out of Bangalore, focussed on Digital Transformation products for Telco's /ISP's/Enterprises, in association with BlueCloud SoftTech, a System Integrator in the IT/Technology field, would like to propose setting up of 5G Captive Network Pilot with applications for Oil and Gas operations.

The below proposal seeks to propose transformative initiative aims to revolutionize communication, safety, and efficiency in remote oil and gas sites, bringing about a positive impact on the industry.

Executive Summary:

This proposal outlines a project that seeks to establish a dedicated 5G Captive Network in oil and gas operations, addressing the challenges inherent in remote and rugged environments. The initiative includes advanced communication technologies, the integration of IoT applications, and real-time data analytics to enhance safety, productivity, and operational efficiency.

Project Objectives:

- Secure Communication Infrastructure: Establish a reliable and secure 5G Captive Network to facilitate high-speed communication in remote oil and gas sites where traditional connectivity is often challenging.

- IoT Integration for Real-time Monitoring: Implement IoT applications to enable real-time monitoring of oil and gas equipment, personnel, and environmental conditions, thereby improving operational visibility and control.

- Enhanced Safety Measures: Integrate advanced communication and emergency response systems specific to oil and gas operations, ensuring the safety of personnel working in isolated and hazardous conditions.

- Operational Efficiency through Data Analytics: Improve oil and gas processes by leveraging 5G-powered data analytics for predictive maintenance, process optimization, and overall operational efficiency

Current Challenges in Oil and Gas Operations:

- Communication Issues in Remote Oil and Gas Sites: In remote oil and gas sites, traditional communication infrastructure often fails to provide reliable and high-speed connectivity, leading to operational inefficiencies and potential safety concerns.

- Safety Concerns in Oil and Gas Operations: Hazardous working conditions in oil and gas operations require robust communication and emergency response systems to ensure the well-being of personnel, particularly in the context of potential gas leaks or other emergencies.

- Operational Inefficiencies in Oil and Gas Operations: Delays in equipment operation, inefficient sorting processes, and procedural bottlenecks contribute to increased costs and reduced productivity in oil and gas operations.

How Proposed Project 5G Captive Network Solution Addresses Challenges:

- Reliable Communication Infrastructure for Remote Oil and Gas Sites: The implementation of a 5G Captive Network ensures consistent, high-speed communication in remote oil and gas sites, overcoming the challenges associated with traditional communication systems.

- IoT-Driven Real-time Monitoring in Oil and Gas Operations: IoT applications powered by 5G enable real-time monitoring of oil and gas equipment, personnel, and environmental conditions, addressing safety concerns and optimizing operational efficiency.

- Advanced Safety Measures in Oil and Gas Operations: The 5G Captive Network facilitates the integration of advanced communication and emergency response systems specific to oil and gas operations, ensuring rapid and effective responses to potential safety incidents, including gas leaks.

- Data-Driven Operational Efficiency in Oil and Gas Operations: Utilizing 5G-powered data analytics, the oil and gas industry can achieve predictive maintenance, process optimization, and streamlined operations, reducing delays and operational inefficiencies specific to oil and gas operations.

Potential Clients:

Primary beneficiaries of the 5G Captive Network in oil and gas include oil and gas companies, equipment manufacturers, and stakeholders involved in extraction and production. The project's outcomes directly impact these entities by providing a secure, efficient, and technologically advanced communication infrastructure tailored to oil and gas needs

- ONGC
- So forth /.

Provisional Partners:

We have identified potential partners, including leading telecommunications companies, Oil and Gas equipment manufacturers, and relevant government agencies. Collaboration with these partners will ensure a holistic approach to overcoming the unique challenges faced by Oil and Gas operations.

- Lekha Wireless - Private 5G Radio's
- Blue-Cloud - System Integration
- Digisol IT Hardware
- 6WIND - Virtual Routers
- So forth /

Project Cost Breakdown:

The estimated project cost is [provide the detailed breakdown]. This includes:

- Infrastructure Setup: Installation of 5G base stations, antennas, and communication nodes in remote Oil and Gas sites.

- Technology Deployment: Integration of IoT devices, communication systems, and data analytics tools.

- Research and Development: Continuous refinement of the system for optimal performance in challenging Oil and Gas environments.

- Ongoing Maintenance: Regular updates, security measures, and support services.

Area	Expense	Remarks
5G O-RAN Radio's Routers, Switches Compute Servers Optical Cables So forth	Rs 15 crores	
System Integration and Deployment	Rs 4 crores	
Rsesearch and Development-Continuos Improvement	Rs 4 crores	
Ongoing Maintenance per annum	Rs 4 crores	

MatreComm expects 50% of the costs to be supported by DoT and the remaining 50% will be borne by MatreComm and Consortium partners.

Assumptions/ Limitations:

While optimistic about the project's success, we acknowledge certain assumptions and limitations:

- Remote Locations in Oil and Gas: Challenges related to the remote nature of oil and gas sites, requiring a resilient and adaptable communication infrastructure tailored to oil and gas requirements.

- Technical Challenges in Oil and Gas: Potential technical hurdles in implementing advanced communication systems in rugged oil and gas environments.

- Regulatory Compliance in Oil and Gas: Adherence to regulatory requirements and standards governing the deployment of 5G in oil and gas operations.

Expectations on Spectrum:

We expect the spectrum to be allocated by DOT for the pilot and testing. The final allocation of the spectrum for production, could be have the following options:

- Spectrum is shared/taken on lease from Telco's

- Spectrum is allocated to us on lease as per Govt of India - DoT policies.

We anticipate the allocation of a dedicated spectrum for the 5G Captive Network to ensure optimal performance and minimize interference. Collaboration with regulatory bodies and industry stakeholders will be crucial in deterOil and Gas suitable frequency bands for Oil and Gas operations.

Mode of Allocation:

The allocation of spectrum will involve collaboration with regulatory bodies, ensuring an inclusive process with industry stakeholders to determine the most suitable frequency bands for Oil and Gas operations.

Pricing Model:

The pricing model for the project wil comprise of upfront payment covering the Capex and the 5G CNPN being provided on an Opex model.

Area	Pricing Model
Network and IT Infrastructure	Upfront at the start of the project
System Integration and Ongoing maintenance	SaaS model – quarterly advance payment
Any new features	To be discussed and payment to be mode upfront or as part of the SaaS license

Time for Completion:

The project is expected to be completed within 18 months, encompassing planning, infrastructure setup, technology deployment, and testing to ensure the seamless integration of the 5G Captive Network in Oil and Gas operations.

Area	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18
Assessment and Fianalizing the scope across the Oil & Gas operation	■	■																
Approval of the Project			■	■														
Installation and setup					■	■	■	■										
Trial runs									■	■	■	■	■	■				
Training and Handover															■	■	■	
Continuous operations																		■

Other Partners

VoICE has multiple players who can be part of complete end to end 5G CNPN solution. Once in principle, go ahead signal is available, further details can be worked out.

Lead Implementor

Matrecomm has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

Conclusion:

The successful implementation of a 5G Captive Network in Oil and Gas operations represents a crucial step forward in overcoming the challenges faced by the industry. By fostering secure communication, enhancing safety measures, and optimizing operational efficiency, the project aims to redefine the standards for Oil and Gas operations in remote environments.

VOICE CNPN PROJECT 18   5G MULTIPLE USE CASES for

Multiple Verticals with NIR!L's   5G CORE

(Niral will be Core Implementor & DG VoICE will Coordinate

Project Cost Details will be worked out later after discussion on the Client's requirements)

Private 5G Use cases
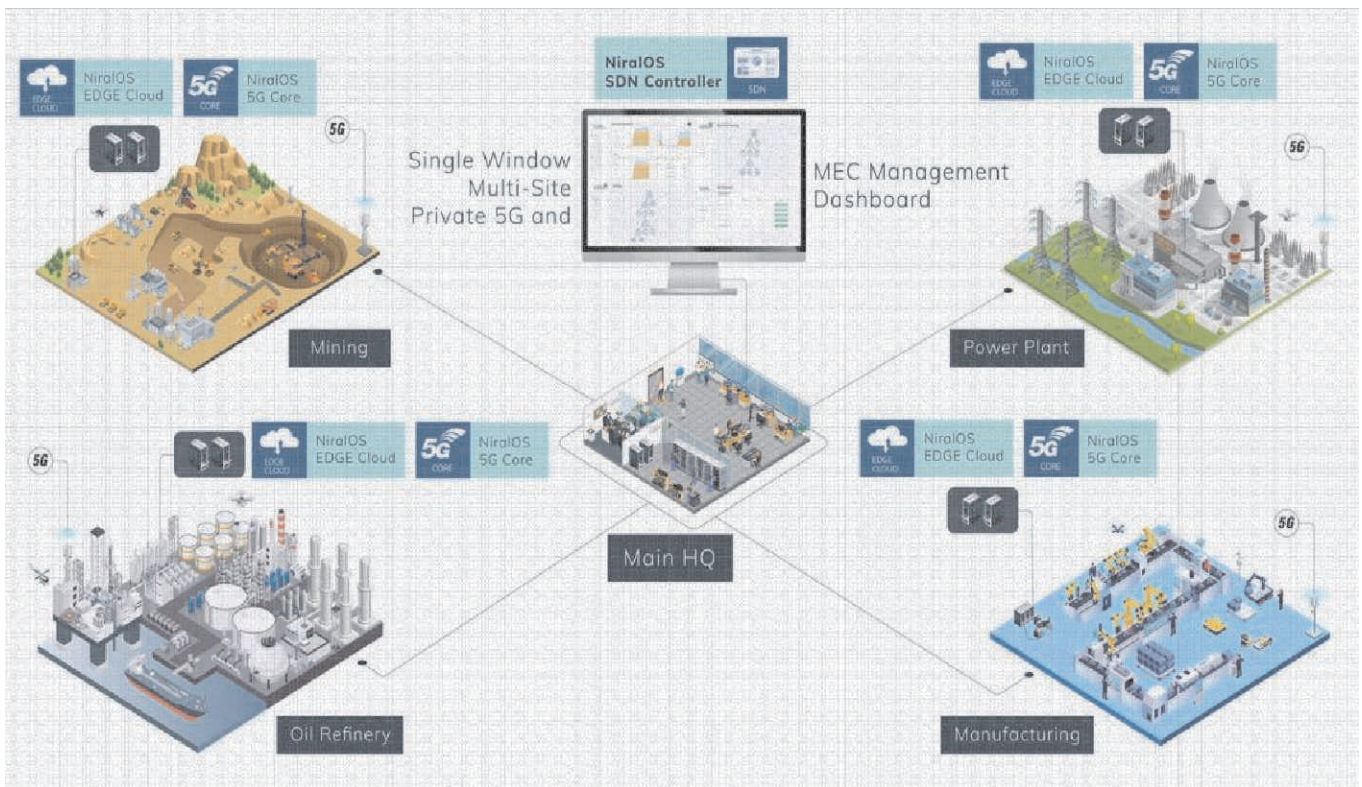
NiralOS

Secure & Reliable End-to-End Private 5G and Edge Solution for Enterprises

Niral Networks provides tailored end-to-end private 5G and Edge solutions to empower enterprises to accelerate their operational effectiveness. Our offerings include NiralOS, a modular Network Operating System featuring the 5G Packet Core, Multi-access Edge Compute (MEC) Platform and the SDN Controller. NiralOS operates efficiently on commodity hardware and seamlessly integrates with third-party radio systems and edge applications, simplifying multi-site network and edge infrastructure provisioning and management through a unified dashboard.

Niral Networks' Products and Solutions are applied across various industrial operations in mining, oil & gas, manufacturing, ports, leveraging the high-speed, low latency, real-time, secured and reliable connectivity of 5G technology to enable innovation, automation and digitization of applications and processes while maintaining complete control over the network infrastructure.

Smart Manufacturing
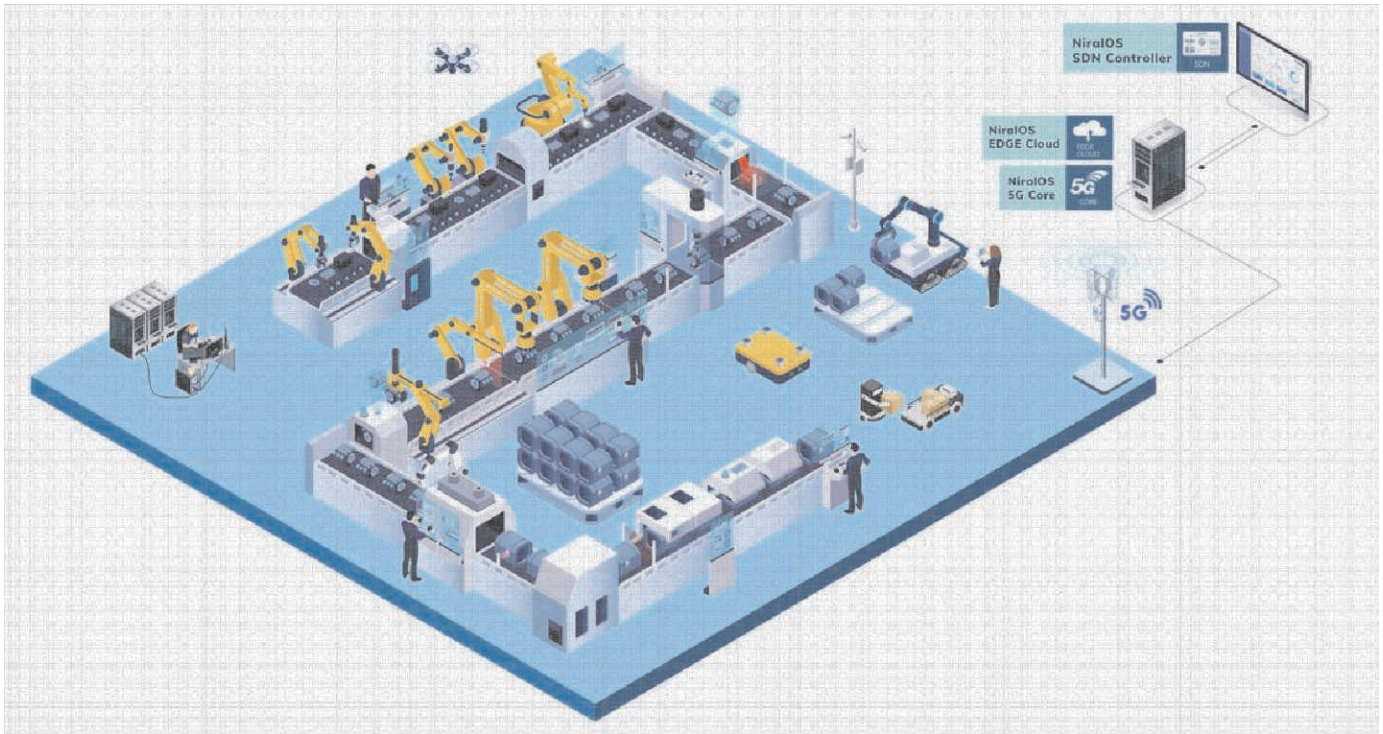
Revolutionizing traditional processes, Smart Manufacturing incorporates cutting-edge technologies to enhance efficiency, safety, and overall productivity. Here's a glimpse into the compelling landscape of Smart Manufacturing, showcasing its diverse use-cases.

Use Cases

PTT/PTV for person-to-person and group communications

VR for employee training, remote support assistance

floor drone inspection, real-time tracking and monitoring of assets, materials and storage

Asset monitoring for predictive maintenance

Wearable Sensors for situational awareness

Connectivity and communication for on floor personnel

Video surveillance, Real-time monitoring and analytics

Worker safety and health with digital PPE

Real-time workflow optimization using Data analytics, AI and digital twins

Machine vision for quality control, defect detection and process monitoring

For robots and autonomous vehicles

Real-time inventory management using AGV
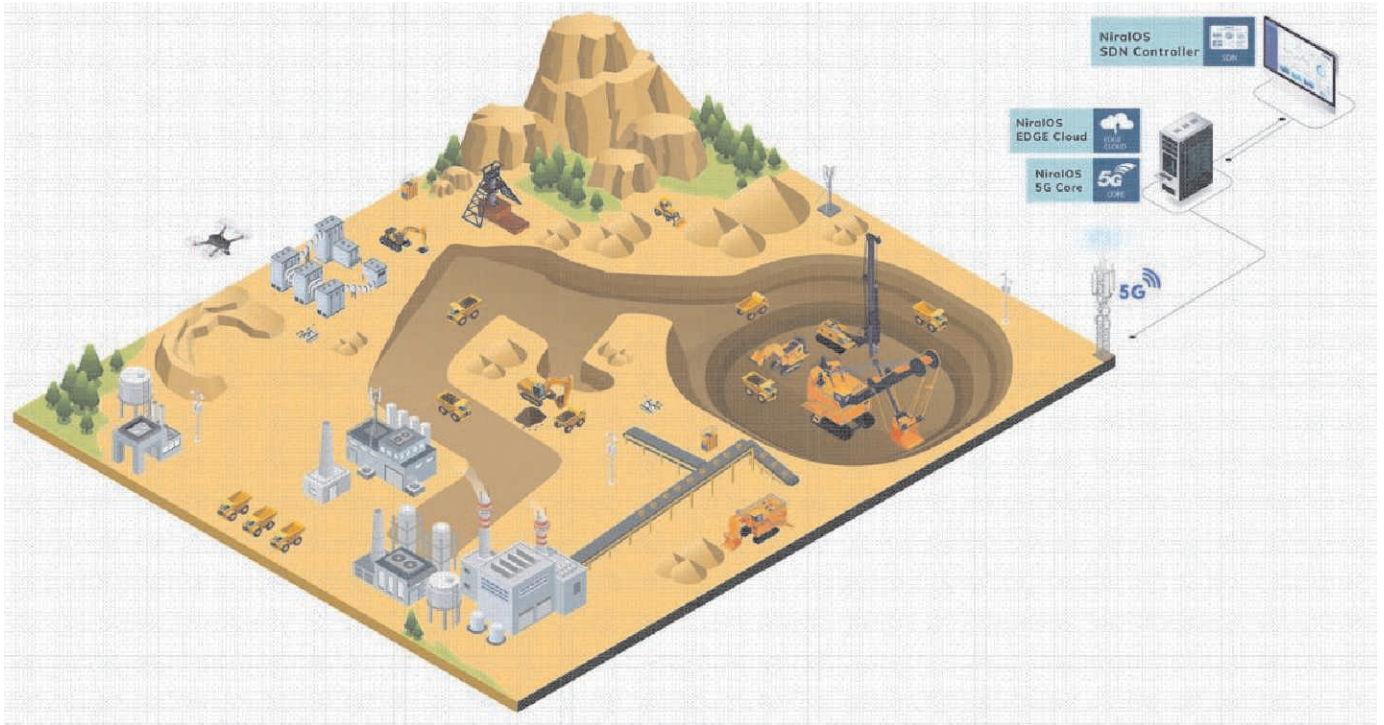
Mining 4.0

Embark on a groundbreaking journey into the future of mining with cutting-edge technologies that redefine the industry — Welcome to Mining 4.0! This transformative approach incorporates a myriad of innovative use-cases to enhance safety, efficiency, and sustainability in mining operations.

Use Cases

PTT/PTV for person-to-person and group communications

Real-time truck telemetry and truck performance monitoring

Drone surveillance and inspection of the mine sites and stockpiles

Asset monitoring for predictive maintenance
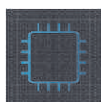
Monitoring of environmental conditions with IoT sensors

Autonomous drilling, loading and hauling

Video surveillance, Real-time monitoring and analytics

Worker safety and health with digital PPE (wearable sensors)
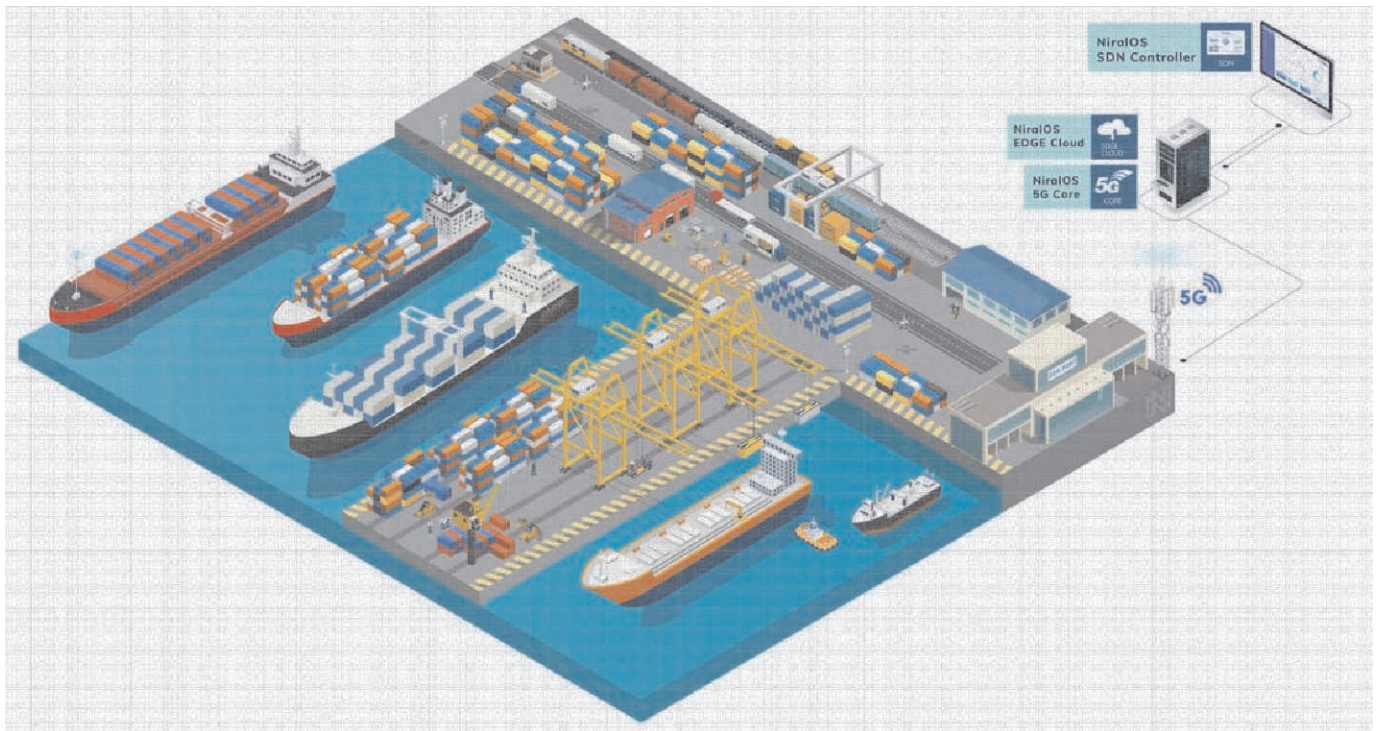
Real-time remote operations, blast control, vehicle control and digital twins
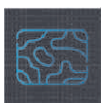
Digitized Geological and topological data, Lidar based 3D Mapping

3D AR/VR and Holographic Projection system

Geo-tracking and geo-fencing of people, vehicles and assets
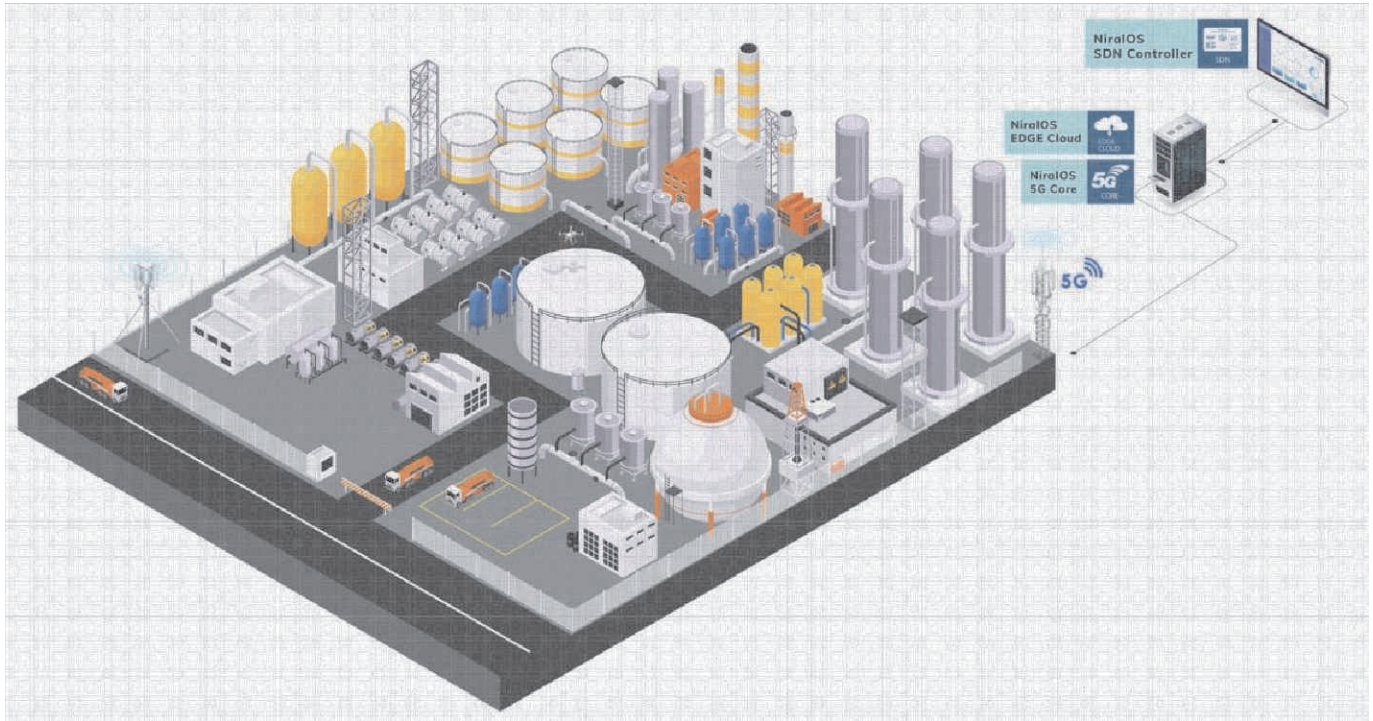
Oil & Gas Refineries

Step into the future of Oil & Gas Refineries, where cutting-edge technologies converge to redefine safety, efficiency and operational excellence. The integration of innovative use-cases sets the stage for a transformative journey in the oil and gas industry.

Use Cases

PTT/PTV for person-to-person and group communications

Drone surveillance and inspection of the sites

AR/VR for employee training, remote support assistance

Real-time monitoring of all assets, Automated inspection & Leakage detection

Connectivity and communication for on floor personnel

Real-time workflow optimization using Data analytics, AI and digital twins

Video surveillance, Real-time monitoring and analytics

Worker safety and health with digital PPE

Wearable Sensors for situational awareness

Geo-tracking and geo-fencing of people, vehicles and logistics

AGVs with monitoring sensors to gather data from critical areas
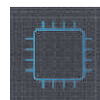
Monitoring of environmental conditions with IoT sensors

Oil Exploration

Oil exploration represents more than an industry; it stands as a frontier of innovation, harmonizing technology with the pursuit of energy. Embrace the forthcoming era of oil exploration, uniting safety, efficiency and sustainability for a more intelligent and responsible approach to resource extraction. This transformative approach incorporates innovative use-cases, elevating safety, efficiency and precision in the exploration of this essential natural resource.

Use Cases

PTT/PTV for person-to-person and group communications

Drone surveillance and inspection of the sites

AR/VR for employee training, remote support assistance

Real-time monitoring of all assets, Automated inspection & Leakage detection

Connectivity and communication for on floor personnel

Real-time workflow optimization using Data analytics, AI and digital twins

Video surveillance, Real-time monitoring and analytics

Worker safety and health with digital PPE

Wearable Sensors for situational awareness

Geo-tracking and geo-fencing of people, vehicles and logistics

AGVs with monitoring sensors to gather data from critical areas
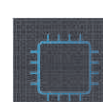
Monitoring of environmental conditions with IoT sensors

Shipping and Ports

Embark on a voyage into the cutting-edge realm of Smart Shipping and Ports — an extraordinary fusion of advanced technologies that is reshaping the very essence of maritime operations. Get ready to navigate the seas of progress with unprecedented efficiency, safety, and sustainability at the helm. Smooth sailing awaits in this new era of maritime excellence! Discover the riveting landscape of Smart Shipping and Ports as we delve into these transformative use-cases.

Use Cases

PTT/PTV for person-to-person and group communications

Remote control and monitoring of containers

Drone surveillance of platforms, cargo, containers, vehicles, shipments and storage

In-ship, across vessels and Port-to-ship communications

Wearable Sensors for situational awareness

Monitoring of environmental conditions with IoT sensors
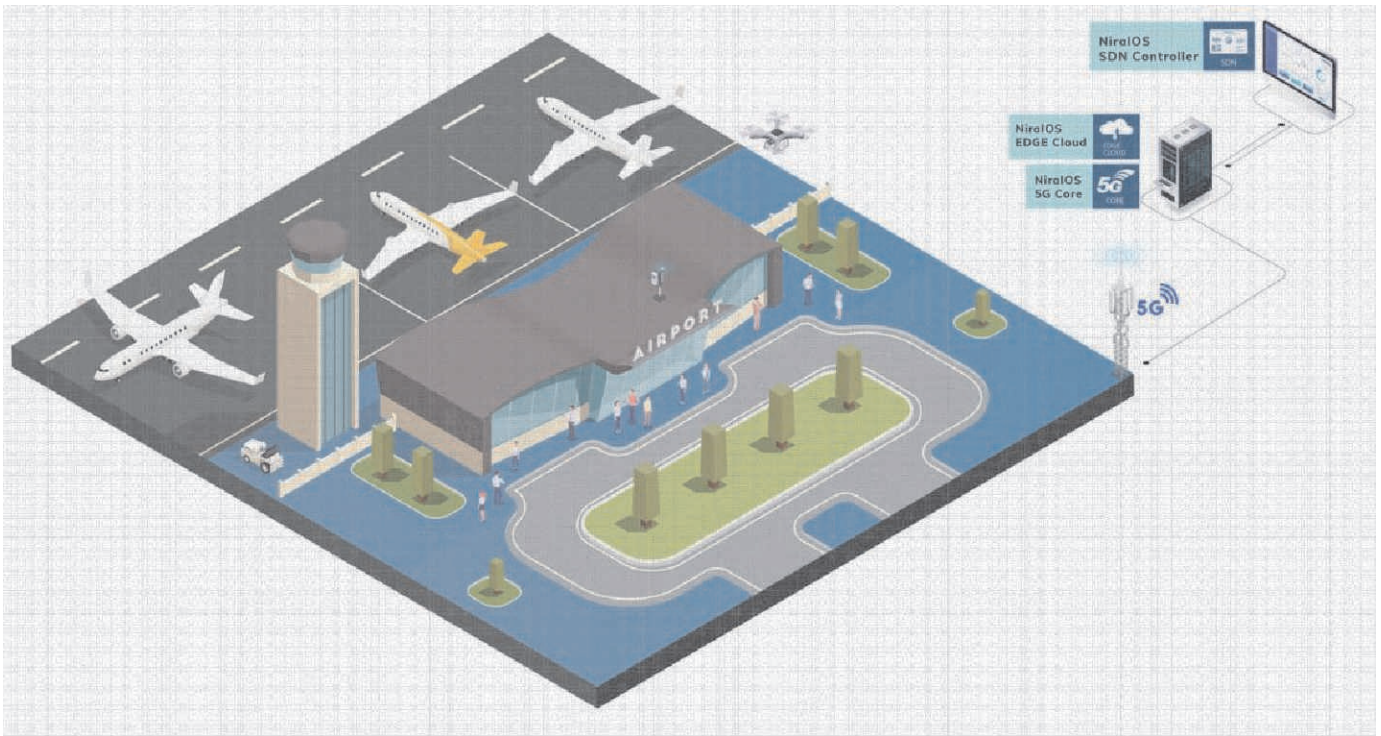
Video surveillance, Real-time monitoring and analytics

Worker safety and health with digital PPE

Real-time workflow optimization using Data analytics, AI and digital twins

Real-time inventory management using AGV

Automation and Remote control of Cranes

Tracking of machines, vehicles and people

Airport

Enter the future of airports with Smart Airport tech — a revolutionary blend of efficiency, safety and seamless experiences. Smart Airports transform gateways into hubs of innovation, offering a brilliantly efficient era of air travel. Welcome to a journey where every step is a smart innovation, making your destination shine even brighter. Explore game-changing use-cases, where technology and operational excellence redefine the airport landscape.

Use Cases

Low Latency for passenger communication, Signage	Flight to ground data upload (black box), Aircraft Telemetry	Monitoring of environmental conditions with IoT sensors
Video surveillance, Real-time monitoring and analytics	Wearable Sensors for situational awareness	Real-time flight operations and scheduling
Luggage and Shipment tracking	Airport Network security and in-depth privacy	Real-time workflow optimization using Analytics, AI , digital twins
Runway traffic monitoring and management	Runway staff safety and health with digital PPE	Emergency Response using Drones
Asset monitoring for predictive maintenance	Connectivity and communication for field personnel	High-speed Low-latency network for robots, AGVs

VOICE CNPN PROJECT 19
BANK ON WHEELS

"Digital Banking Unit (DBU's)"
Last Mile Connectivity of Rural Banking , Money remittance and Money Exchange.

Objective
Global Private Network in FIntech Industry- this product is comprehensive solution which captures the national and global market in the rural to smart cities banking.

It is a Product integrated with other products of Telecom, Fintech and automobile which are combination of Hardware and Software with ERP solution for Rural Banking and money
Exchange for global market.

Therefore, it is a Combination of Hardware and Software**.** Vehicle for Automobile Banking and money exchange a fully loaded rural banking solution with verifiable remittance and money exchange machine with enhanced ATM features including withdrawal and deposit currency from/to any banks using card-less and touch-less technologies.

This solution also have Multi-Currency Dispensing and depositing features which can be used by money changing or money exchange companies in the places where large scale global events are happening like Olympics to enable digital and physical currency Exchange.

Impact and Use Case

According to a World Bank report, about 1.7 billion people remain unbanked and 2/3 of the migrant workers are non bank account holders.

Due to Pandemic, 80% of the remittance activities counters are closed - and the Migrant workers/ rural people are Difficult to send/ Receive the money to their home country as More than 215 million people across the globe live outside and in the same time the 82% of remittance beneficiary or the family member of the migrant workers also living in the rural areas where no or very limited remittance agents nearby.

Most of the cross-border remittance and national remittance are happening between migrant workers and rural population. India received highest ever foreign inward remittances in a single year of $89,127 million in FY 2021-22. During 2021-22, As per https://pib.gov.in/ (Ministry of Finance, India) India received foreign inward remittances of $89,127 million which was the highest ever inward remittances received in a single year. This was stated by Union Minister of State for Finance Shri Pankaj Chaudhary in a written reply to a question in Rajya Sabha on 07 FEB 2023.

To avoid middle man charges, avoid illegal and Crime activities, unwanted travel to rural population and timely remittance, spending half-a-day for a transaction. it is advisable to have automated and digitalize money transfer as a Bank on wheels with high secured, Multilingual facilities with 3rd party on-spot support in the rural areas with KYC, STR, RBA, PEP and other which facilitate Rural population, national and International Migrants to enjoy the Digitalised banking in a profitable way.

This AUTOMATED CROSS BORDER REMITTANCE AND MONEY EXCHANGE PAYMENT MACHINE which has combination of Hardware and software, connected with number of digital devices and IoT's as an IoP (Internet of Payment) for secure banking and Msb's Operation**.**

World First QR based UPI Cash: Game changer of Touchless Card less payment solution, using QR (Quick response code) and dispense the Physical money dispensing.

      a) Cash Disburse - Bank UPI VPA (Yes Bank or similar)
      b) Cash Disburse – Merchants.
      c) Cash Deposit - Bank UPI VPA.
      d) Cash Recycle : Auto Cash recycling as this machine has the to deposit.

Though we focus on digital currency and innovation in Fintech but still there is always a question about last mile connectivity !

" VAMBX is a Very first Evaluation platform as it a combination of Bharatnet and RBI innovation hub Sandbox in Fintech Domain for Analysing the Data communication using Innovative Switch Invented by Finaara "To have a Seamless Connectivity.

We are creating a Soft switch of Bharatnet/4G/5G/SAT as USB to achieve and connect rural/remote area as digitalised solution to have last mile Real-time complete banking solution at the Door step.

VAMBX is an Incremental Innovation lead to Mode of social change.

215 million Rural and Remote area user will be directly Benefited.

As part of the measurable, Indian Rural and Remote remittance recipient earn 96 Billion / Month

80 Million x 300 Rs (Out of 40 USD a week), Increase Banking Facility like Digital transformation / Interoperable in traditional method or cash deposit and withdrawal, Lending and settlements, money exchange or money changing without middle man and +50 use cases to banks.

This will reduce the Risk and mitigate in real time and remotely guide the users in Multilanguage globally.

Connect the last mile stone with banking and MSB's to enable all type of financial connects.

As a Financial Inclusion, create Migrant workers credit score which is not available up to now, this also Reduce illegal transaction and increase banking connects /digital transaction.

Category :

The Product of VAMBX, **An Indigenous, Athama Nirubar Product integrated** with the USB of 4G/5G/ SAT to perform Real-time transaction. It is our indigenous patented product which is manufactured in india. This is a comprehensive product of Finaara which has a Multi patent with the combination of software and hardware.

This is an incremental innovation with our number of own GLOBAL IP's FOE and as a make in india product as it is a implementation IP.

Technology Involved:
5G, AI, IoPT (Internet of Payment things), Block chain, Edge Computing , cyber security, interoperability.

USP

Disruptive innovation to certain countries & **Incremental Innovation** in western countries.

Global money remittance & money changing network without middle man in 2 years.

First Mover Advantage DBU's anywhere 24/7 enabling cost effective **+24 use cases** to banks.

Enabling cash deposit and withdrawal using **Interoperable** (one bank to any bank)

Number of AI for Financial transaction & security to banks, MSB's and Security services.

Next-gen **EKYC, RBA, STR, AI BASED PEP'S CHECKS, SECURITY** and other

+13 IP's Indian and Global patents few more IP's to be registered.

Edge Computing & Blockchain integrated applications.

+25 years global experience Domain experts with direct **Access to global customers.**

Customizable product & solution to different verticals with KYC, Payment and dispensing .

Connected intelligence enabling MSB's, Apps and other to interface or partnering.

5G Private network Tested devices to have **Remote operation & support**

Project

A 5G enabled VAMBX – Vehicle for automobile banking and Money exchange solution - Creates a 5G private network through a vehicle based fully Loaded automated, robust, Highly secured and high speed, banking transaction, remittance sending and receiving, perform cash deposit, cash withdrawal, and also this one stop solution perform money exchange process with Spot cash transaction in Real-time on the go which serves millions of rural /remote user needs.

VAMBX is a Vehicle for Automobile banking and money exchange consist of
Two AVRM automated verifiable remittance machine
And 5G enabled UPI CASH device and AI algorithm

This VAMBX will be driven by the person and each VAMBX also have one banker who can perform transaction based on user request inside the VAMBX for user support and assistance,

VAMBX is designed in such a way, only one person can enter in to the vehicle and perform banking transaction, remittance sending and receiving, perform cash deposit, cash withdrawal, paying utilities bill for a security reason.

VAMBX is designed and integrated with 2 AVRM pro with High Compliance based solution to perform banking activities, money remittance and Money exchange services.

5G/ 4G/ Lora/ SAT Communication based solution:

Example: if the travel path and the speed is 3level out of the range then the infotainment screen get switch off and still communicate to the cloud using digital SIM and or LorA or SAT.

This device can be controlled by centralize monitoring team after viewing, communicating with the vehicle and its activities.

Security based Black Box controller in VAMBX:

VAMBX is enabled with mechanical portion of the vehicle which will have additional vehicle black box and controller which will be connected with the vehicle core-system to record, Identify speed of the vehicle, direction change or travel path change and other internal mechanism to control the vehicle function. This system will be internally placed to enable the users not to control or operate for misprocess or malpractices. Ones the protect signal is transmitted or an AI based secure system is triggered all the doors and windows will be closed and the central security system can allow the vehicle system to activate partially or fully.

100% Dynamic Compliance:
AUTOMATED CROSS BORDER REMITTANCE AND MONEY EXCHANGE PAYMENT MACHINE supports 100% Dynamic Compliance including customer due diligence (CDD), Enhanced customer due diligence ECDD, ongoing Due Diligence of the customer.

eKYC and Risk Assesment in Realtime : This machine and its software verify and check the sender/ receiver of remitter and Support accordingly the dynamic compliance like Anti- money laundering (AML)/ AFT, Risk based assessment (RBA), Political exposed people (PEP), and Credit check to perform IoT based Financial Crime Supervision and Investigations using the technology of Artificial Intelligence.

This VAMBX (VEHICLE FOR AUTOMOBILE BANKING) is very strong and made out of Stainless Steel.

It has 2 monitors one display monitor for an informative screen and other as touch screen monitor for the inputs as well as remittance, payments, booking and other process based views.

The CPU is operatable using Windows or Linux based Operating system and the software which process the functionality is protected using a hardware based protection which will be installed in the headquarters to avoid software theft.

The system can have different configuration of processors, memory (RAM), Mainboard depend on the market availability, Update, Software, functionality and other.

The hardware is interconnected with software module to Perform Remittance Dynamically based on the Compliance of the Country

Further the components and IoT (Internet of Things) are Fixed or Installed in this Machine.

1.   Very strong stainless steel body.

2.   2nd display monitor as an Informative or advertisement screen.
This monitor is connect as 2nd screen from the CPU installed in the remittance machine or additional CPU.
This screen is fully protected or blocked from user access. This screen can be connected with an advertising or support interface separately without any connection with the remittance or payment system.
Specification:
Screen Size (Inches): 17 -22 inch. Brightness: 350 cd/m2. Max Resolution: 1280 x 1024 pixel. Input Voltage: AC 110-240 V.

3.   Camera for monitoring and supporting the users.
i)   A camera with sensor is fixed on top of the machine to have the complete view of the customer and the cabin to find any suspicious activities and the same time to interact with customers and back office staffs to help and support using the machine.
ii)   the cameras are integrated with sensor to identify the moments and scanning the QR/ Barcode.
Specification: Optical Dual Vari-Focal, increase focal length by 40%, Motion Digital Zoom, Night vision

enabled, auto-zoom based on user-defined target area movement, S/N Ratio 52dB 3.0mm 3.0mm, pre-focused, 1.3 Mega Pixel Sensor, 1305 x 1049 pixels Ultra High 800 TVL PAL / NTSC.

4.Touch screen monitor for remittance or payment related process and data Inputs.
Touch screen is primarily used for selection of remittance and payment options and through on screen key board user details can be entered. This screen is connected with the CPU fixed in the remittance machine.
Specification : Screen Size (Inches): 17 -22 inch. Brightness: 350 cd/m2. Max Resolution: 1280 x 1024 pixel. Input Voltage: AC 110-240 V.

5.Biometric or Chip based passport or ID card reader and scanner.
The passport or ID card reader can read "Chip based Deployment in Machine Readable Travel Documents" and also other electronic and non electronic passport and Id cards.
If the passport is non electronic or non chip based passport then its scan and convert the passport and ID and convert Image to Text or data.
This process will enable fastest and accurate KYC and Authentication.

6.Debit and Credit card reader.
Card readers to read credit or debit card to send or do the payment for the Remittance or other payments.
This device will be connected and functional while payment process through the software which we deliver through integrated Payment gateway.

7.Coin acceptor (Optional)
Coin acceptor will accept the coins of the particular country's currency, this is an optional device and on-demand this coin acceptor will be installed.

The type of coin can be set in the coin acceptor.

This device will be connected and functional while payment process through the software which are developed and installed by the us in the machine.

8.Biometric reader for Authentication and Verification.
Biometric reader installed to read the finger print as per the countries compliance and the transaction limit amount under the compliance. This process help to verify the biometric authentication.

9.Signature pad with Digital pen for digital signature.
Signature pad will enable e-signature or digital signature to verify the signature matching the an existing using image processing with or manually.

10..Stainless Steel keyboard with ball mouse.
Stainless Steel keyboard with ball mouse will enable traditional method of data inputs.

11.Coin Dispenser.
•Coin Dispenser will dispense the coins of the particular country, this is an optional device and on demand this coin Dispenser will be installed.
This device will be connected and functional while payment process through the software which we deliver.

12.Cash acceptor and Dispenser. (Single notes or Multiple notes)
Cash acceptor will accept the selected cash of the particular country's currency, on demand this coin acceptor will be installed on the machine.
The denomination can be set in the Cash acceptor and also for Cash Dispenser.
This device will be connected and functional while payment process through the software which   developed and installed by the us in the machine.

13.Thermal printer.
Different size of Thermal printers can be installed in the machine to print receipt or statements of the transaction or payment.

14.5G Antenna
5G antenna and GSM data receiver will enable in case of no wired network is available.
Front door lock has 2 Different locks for security reason :
1st Lock – will be operated Digitally and follows
2nd lock – will be operated manually using Keys.
Two different locks are in place in the remittance machine to open the front door to service thehardware and currency refilling process.
Onces the digital lock open the Key based lock can be open.

16.Remotely connected Mike.
A mike is fixed in the frame to record or listen the voice to identify the unwanted activities or two- way voice based support from the support centre.

17.Speaker.
A speaker is fixed in the frame to listen the guide and support voice from the machine or from the centre.

18.Top display monitor back door.
The top monitor display door can be open using a KEY to service the top display screen only.

19.Touch screen monitor back door.
The touch screen monitor door can be open using a KEY to service the touch screen display screen only.

20.System Cabin.
In the system cabin the CPU will be placed, the configuration such as Main board, Processor, RAM, Hard disk and other can be customize depend on the customers request. This AUTOMATED CROSS BORDER REMITTANCE AND MONEY EXCHANGE PAYMENT MACHINE is very strong and made out of Stainless Steel.

Objective :
This VAMBX facilities the benefit for Last mile rural banking without Middleman cost in **Real-time on the go which serves millions of rural /remote user needs and enjoy digitalization profitably.**

We are the very first company Implementing Digital Banking Units
Creating a telecom Soft switch of 6G/5G/4G/SAT as USB to perform Real-time Next Gen Financial Inclusion solution as full fledge remotely operatable Rural Banking using technologies like AI/ML, Automation for Fintech industry like Banks and other institution to facilitate to have last mile access of Digital Banking without Middle-Man Dependency which saves cost, time , energy for sender and receiver which prevent illegal money transaction and reduction of crime Financial activites and Artificial Intelligence,100% Dynamic, Detecting Fraudulent & Suspicious Activities by linking Sanctions list.

Bank on Wheel named "VAMBX" is build such a way last mile connectivity to the banking and related solution with High secure remotely operatable banking vehicle with 3 side AVRM or Advance ATM to overcome Mobile ATM.

This Dynamic design of VAMBX has AVRM that can also alone place in train compartment or in railways stationed.

Vendor Inter-operability

- Based on 3GGP and global standard, we can implement this project under Voice consortium with multi player in the domain to Provide 5G coverage in VAMBX
- We have different interops including from Bank transactions and the integration interop and type of user interop .
- Globally , Network Management & Control of entire network at a centralized Command Control System.

Deployment :

A 5G enabled VAMBX – Vehicle for automobile banking and Money exchange solution - Creates a 5G private network through a vehicle based fully Loaded automated, robust, Highly secured and high speed, banking transaction, remittance sending and receiving, perform cash deposit, cash withdrawal, and also this one stop solution perform money exchange process with Spot cash transaction in Real-time on the go which serves millions of rural /remote user needs.

This will not only provide the rural banking solution but also a tested 5G private network for the fintech and other verticals using available Indian made telecom devices.
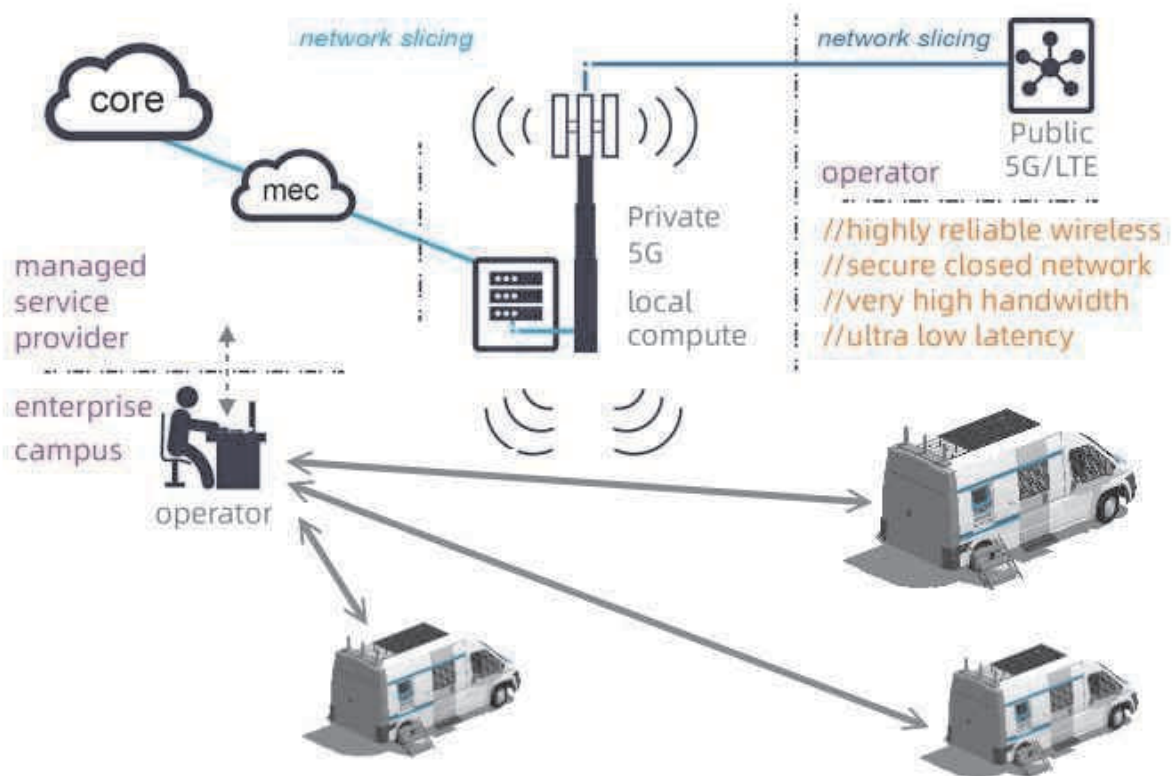
This VAMBX will be driven by the person and each VAMBX also have one banker who can perform transaction based on user request inside the VAMBX for user support and assistance

Challenges:

- Ensure to have private 5G connectivity wherever the connection is required.
- **Further AI based Blocking or vehicle jamming system during Hijacking /threat arise:**

AI or Monitoring based result may block the functionalities or activate the vehicle jammer to block the mechanical operation if AI function indicate any high level suspicious activities or monitoring activities requested to do so.

The jamming technology will do different kind of activities to jamming the engine.
1. Disconnect the power between the battery and the motor.
2. Mechanically a engine locking system will be placed.
3. When the jammer function is activated all the external doors are locked including glass doors.

Expectations from DOT

a) Continual introduction to the banks and NPCI and other relevant industry players
b) Global connect and strategic investor connect
c) Global RandD and PoC funding from DoT.
d) We will be using the Product and solution which are domestically available within the voice stakeholder also.

The following domestic Vendors product and services can be used to implement Mission Critical services for lastmile connectivity. This is not an exhaustive list of VoICE stakeholders but many more would be available for complete end to end solution delivery: -

Srl. No.	Items Name	OEMs
1	Core, EPC	VVDN, Signaltron, Niral, Resonous, Coral, WiSig
2	Radio	Signaltron, VVDN, Lekha, Resonous, C-DOT, BigCatWireless, HFCL, Sooktha, WiSig
3	IMS / IP PABX / PA / Voice logger	C-DOT, Niral, Dyotis, Cientra, Rebacca, Coral, Echelon Edge
4	Antenna	Finaara (with the partnering of Kenstel, Astrome)
5	24 port Switch	Nivetti, Tejas, Indio Networks
6	High-end Router	Nivetti, Lavelle, CosGrid, Inventum
7	!rtificial Intelligence	Finaara
8	IOT sensors/ Security system	Finaara
9	Vehicle (Mechanical)	Force
10	Body building, solar power and Other	Ozone Engineering
11	5G / Other integration modules	Finaara
12	Digital banking units	Finaara
13	AVRM or ATM hardware	Finaara
14	Middleware development	Finaara
15	API and Switch	Finaara / Indian bank / Canara bank

PROVISIONAL Estimated Cost:

Sl No.	Item	Qty.	Unit Cost	GST in %	Unit cost including tax	Total Cost Without Tax	Total Cost with Tax
1	VAMBX Base units	3	1800000	18	21,24,000	54,00,000	63,72,000
2	Body building	3	450000	18	5,31,000	13,50,000	15,93,000
3	Antenna set for vehicle	3	450000	18	5,31,000	13,50,000	15,93,000
4	AVRM for Digital banking units	9	1350000	18	15,93,000	1,21,50,000	1,43,37,000
5	Primery 5G/Other module	6	98000	18	1,15,640	5,88,000	6,93,840
6	5G gNode-B, 2 sector, 4x4 MIMO, 40W perport, Installation Material etc	6	30,00,000	18	35,40,000	1,80,00,000	2,12,40,000
7	Antenna and erecting for Radio network	4	7,00,000	18	8,26,000	28,00,000	33,04,000
8	Duplicated HA Core, SW License, EPC, IMS, PA system, Voice logger	1	1,50,00,000	18	1,77,00,000	1,50,00,000	1,77,00,000
9	Hidden security 5G/4G modules	12	1,01,200	18	1,19,416	12,14,400	14,32,992
10	Digital banking unit	10	13,50,000	18	15,93,000	1,35,00,000	1,59,30,000
11	5G & Other module for DBU	10	98,000	18	1,15,640	9,80,000	11,56,400
12	24 port Switch	6	450000	18	5,31,000	27,00,000	31,86,000
13	High-end Router	3	2500000	18	29,50,000	75,00,000	88,50,000
14	IOT sensors, Cameras & integration	13	10,00,000	18	11,80,000	1,30,00,000	1,53,40,000
15	Assembly of VAMBX, DBU	13	2,50,000	18	2,95,000	32,50,000	38,35,000
16	Server for middleware 5 Years	60	4,50,000	18	5,31,000	2,70,00,000	3,18,60,000
17	Edge computing	36	30,00,000	18	35,40,000	10,80,00,000	12,74,40,000
18	Custom block chain for DBU	36	20,00,000	18	23,60,000	7,20,00,000	8,49,60,000
19	DBA, Network administrators	60	9,00,000	18	10,62,000	5,40,00,000	6,37,20,000
20	5G private network & monetering tools	1	1,50,00,000	18	1,77,00,000	1,50,00,000	1,77,00,000
21	Installation commissioning support for 5 years	1	75,00,000	18	88,50,000	75,00,000	88,50,000
22	Transport & Rentals	1	84,00,000	18	99,12,000	84,00,000	99,12,000

23	3rd Party audit, support and Consultation	1	2,18,00,000	18	2,57,24,000	2,18,00,000	2,57,24,000
	Total Cost					**41,24,82,400**	**48,67,29,232**

Rounded Off to Rs. 50 Crores with balance towards Administrative Expenses, other activities/ works and equipment that may be needed to added as per dynamic requirements.

Lead Implementor

FInaara has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VoICE CNPN Project 20
5G RAN Solution for Major Dams for Power and Irrigation:

Executive Summary

Welcome to United Telecoms Limited where connectivity meets maritime efficiency. We are excited to present our dedicated Private 5G Solution tailored for Major Dams & Irrigation Projects. This advanced technology will optimize communication, enhance operational efficiency, and elevate the capabilities of Major Dam facilities.

1. Introduction

United Telecoms Limited is pioneer in Telecoms Equipment Manufacturing, Network Designing, Network Deploying, and Network Operations of Various Telecoms Gears since 1988.

1.1 Background

In an era of smart mobility, efficient communication is essential for management. Our Private 5G Solution is designed to provide secure, high-speed, and reliable connectivity, optimizing traffic flow and enhancing safety.

1.2 Objectives

Objective of the proposed project is to set up a live pilot using domestic designed 5G products to set up a network that meets and exceeds all Communication hurdles and functionalities at Dams. This project will seamlessly work with Existing communication systems; will be combining mission-critical voice features with multi-media services, to enable unprecedented use cases such as collection of data from Sensors, integrated command and control. These new capabilities will in turn transform the way agencies respond to incidents, improve their efficiency through streamlined workflows, and enhance the safety of frontline personnel because of better situational awareness.

Dam Safety Water Resource Management Focuses on proper surveillance, inspection, operation, and maintenance of specified dams. Aims to prevent dam failure-related disasters and establish an institutional mechanism for safe functioning. **Developing and maintaining effective communication networks, evacuation plans, and emergency shelters in the vicinity of dams is essential to manage potential disasters.**

1.3 Benefits of Private 5G for Dams

❖ Remote Monitoring and Surveillance
❖ Sensor Networks for Structural Health Monitoring
❖ Automation and Control Systems
❖ Emergency Response and Public Safety
❖ Data Analytics for Reservoir Management
❖ Security and Access Control
❖ Scalability and Flexibility
❖ Reliability and Redundancy
❖ Environmental Monitoring

2. Solution Overview

Enterprises are looking to 5G technology to further their digital transformation, including the promise of the Industry 4.0 era. Multiple vertical markets are considering a private 5G network to address their need for clean-spectrum high bandwidth, low latency, higher availability, and increased visibility.

UTL Private 5G is delivered to provide all the benefits of a private 5G network while minimizing the risk of heavy upfront costs (CapEx investment), and its intuitive dashboard eliminates the operational headaches that come with private network ownership.

2.1 Architecture
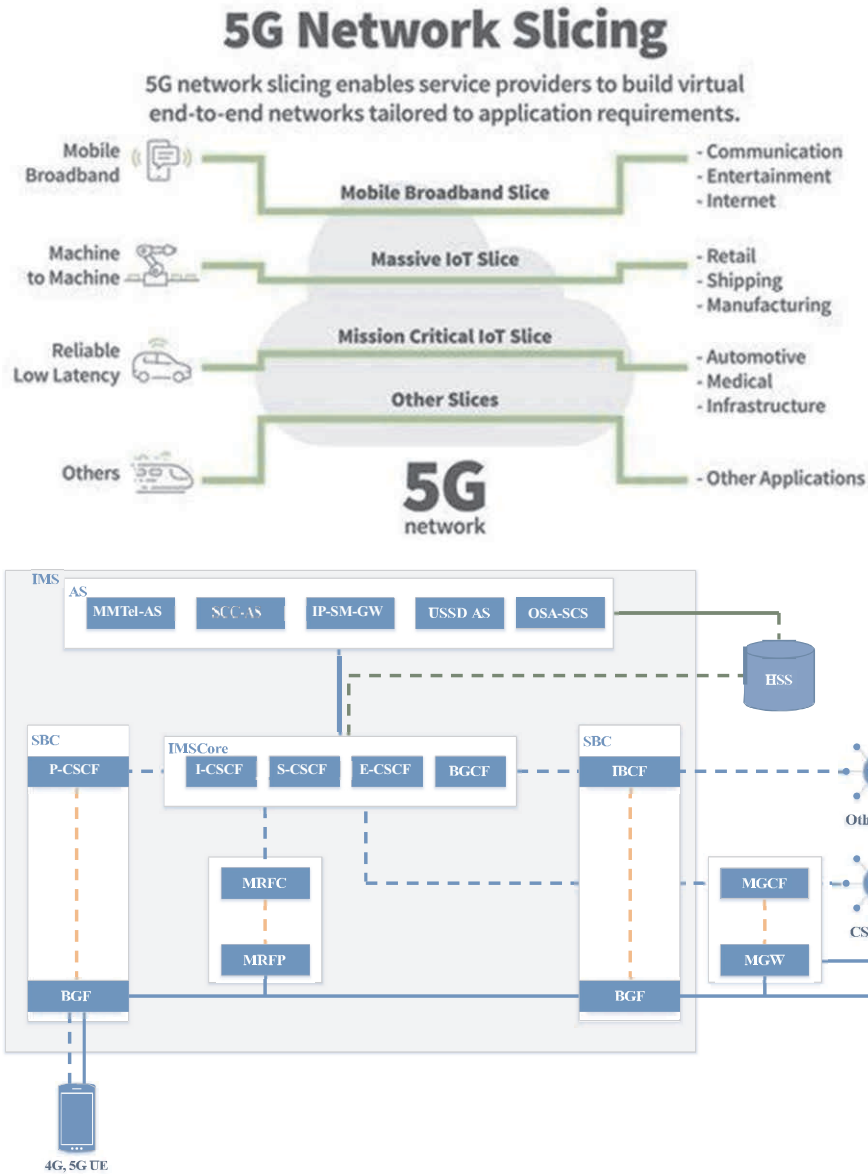
2.2 Key Features

Provides application awareness and identity management to identify end devices and applications while aligning in-depth understanding for building use case–specific policy and security that is unmatched in the industry. UTL-Private 5G provides the following benefits:

- ❖ Operational simplicity – Easy user interface for service and device visibility
- ❖ Network Slicing for prioritized service delivery.
- ❖ Multi-access Edge Computing (MEC) for localized data processing.

- ❖ Advanced Quality of Service (QoS) for mission-critical applications.
- ❖ Integration with existing traffic management systems and IoT devices.
- ❖ SLA management – Cloud-based configuration and monitoring services across all cellular assets
- ❖ Application awareness and identity management
- ❖ 24/7 support – 99.999% cloud availability
- ❖ Cloud managed, high performance
- ❖ Trusted and secure
- ❖ Investment protection – Eliminates obsolescence
- ❖ Seamless software and firmware upgrades included

2.3 3 Integration with Dam Management Systems

Our solution seamlessly integrates with various dam management systems, including:

- Dam Health and Rehabilitation Monitoring Application software (DHARMA)

- Dam Control Systems (SCADA)

- Vehicle Detection and Monitoring Systems

- Emergency Response and Incident Management Systems

- Disaster Management and Alert System.

- EWS (Early warning system)

- Disaster Management system

3. Technical specification.

- ● Highlight features of UTL 5G Private
- ✓ Fully 5G core network functionality (AMF, SMF, SMSF, UDM, AUSF, NRF, NSSF, CHF, PCF, UPF)
- ✓ Combine the 4G core for LTE and 5G NSA access
- ✓ Support Voice service (IMS) via VoNR and VoLTE
- ✓ 3GPP Release 16 Standard
- ✓ High Performance with 40Gbps Data Throughput
- ✓ Advanced session management with traffic influence and basic QoS
- ✓ Network slice support
- ✓ Non-3GPP access support
- ✓ One server for whole Core Network functions

3.1 Network Infrastructure

- 5G NR technology for high-speed and low-latency communication.
- Redundant and resilient architecture for maximum reliability.
- Dedicated air interfaces for secure communication.
- High-capacity backhaul to support data-intensive highway applications.

3.2 Security Measures

- End-to-end encryption to safeguard sensitive data.
- Secure Authentication and Authorization mechanisms.
- Advanced Threat Detection and Response capabilities.

- Network segmentation for added security.

3.3 **Coverage and Connectivity**

Our Private 5G Solution provides comprehensive coverage along the entire stretch of the road highway, ensuring seamless connectivity for smart vehicles and infrastructure. The network is scalable to accommodate the growing number of connected devices and applications.

4. **Customization and Deployment**

4.1 Tailored Solutions
We understand that each Irrigation dam has unique requirements. Our team will collaborate with you to customize the Private 5G Solution to meet the specific needs of your Project, whether it is for Dam management, safety applications, or smart infrastructure.

4.2 Deployment Process

- Comprehensive site analysis and planning.
- Customized network design to align with Dam and Irrigation infrastructure.
- Efficient installation and configuration.
- Thorough testing and optimization to ensure seamless operation.

4.3 Training and Support
Our team will provide extensive training for highway management personnel to effectively manage and maintain the Private 5G Solution. Additionally, our support services are available to address any issues or inquiries promptly.

5. Provisional Estimate

This solution estimated at 12-14cr

5.1 Cost Breakdown

SNO	Item Description	Estimated Cost
01	Site Survey	10 Lakhs
02	Network Design (HLD,LLD)	10 Lakhs
03	Enterprise control 5GP full set (gNodeB, 5G Core, MEC) within their premise	10 Cr
04	End IOT devices, Network Elements (switches, Rack, UPS and Servers)	1 Cr
05	Civil and Electrical Infra (towers etc)	50 Lakhs
06	Installation and Commissioning	75 Lakhs
07	Transportation	5 Lakhs
08	Training and Operations for 1 Years	1 Cr

5.2 Payment Schedule

Will be discussed and decided with customer

5.3 Terms and Conditions

Will be discussed and decided along with customer

6. **Other Partners**

VoICE has multiple players who can be part of complete end to end 5G CNPN solution. Once in principle, go ahead signal is available, further details can be worked out.

7. **Lead Implementor**

UTL has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VOICE CNPN PROJECT 21
5G Network for Coal Industries

Executive Summary

Implementing private 5G networks in the coal industry can ofier several benefits, including improved connectivity, enhanced automation, and increased safety. Here are some considerations and potentials, This VoICE Project is outlined based on **United Telecoms Limited's** suggestions in this regard, based out of Bangalore that is focussed on transmission products for Telco's / ISP's/ Enterprises as an Indian 4G & 5G OEM. Specifically, the Project covers the mining vertical here and discusses how 5G can take it to Mining 4.0 advantages of deploying private 5G in the coal industry:

Project Objectives:

Improved

Connectivity:

Private 5G networks provide high-speed, low-latency connectivity, which is crucial for real time communication and data transfer in industrial settings like coal mining operations.

Low Latency and Reliability:

The low latency of 5G ensures that communication between devices and systems is almost instantaneous. This is vital for applications that require real time control, such as autonomous mining equipment and remote operation of machinery.

Increased Automation:

Private 5G can enable the deployment of autonomous vehicles and machinery in the coal mining process. This can lead to increased efi ciency, reduced operational costs, and improved safety.

Smart Monitoring and Predictive Maintenance:

5G networks can support the deployment of sensors and IoT devices to monitor equipment health and performance in real time. This enables predictive maintenance, reducing down time and extending the lifespan of machinery.

Enhanced Safety:

Private 5G networks can support advanced safety systems, such as real time video surveillance, environmental monitoring, and the integration of wearable devices for worker safety. In the event of an emergency, quick and reliable communication can be critical.

Effi cient Communication:

Private 5G networks allow for secure and reliable communication within the mining site, enabling effi cient coordination and collaboration among workers, machines, and management.

Customization and Scalability:

Private 5G networks can be tailored to the specific needs of the coal industry, providing a scalable solution that can adapt to changes in the mining operation's size and requirements.

Regulatory Compliance:

Deploying a private 5G network can help comply with regulatory requirements by ensuring secure and controlled communication within the mining site.

Data Privacy and Security:

Private 5G networks provide a higher level of security compared to public networks. This is essential in industries like coal mining, where data privacy and protection against cyber threats are paramount.

Energy Effi ciency:

5G networks are designed to be energy-effi cient. By optimizing energy consumption, private 5G can contribute to reducing the overall environmental impact of coal mining operations.

Project Scope

The project scope includes the following activities:

● Site survey and network design: We will conduct a site survey to assess the current wireless infrastructure and coverage at the Coal Mines. We will then design a private 5G network that meets the operational requirements and performance objectives of the Mines.

● Network deployment and integration: We will deploy the private 5G network using UTL's 5G radio access network (RAN) and dual-mode core technology. We will also integrate the private 5G network at mine security systems.

● Network management and maintenance: We will provide ongoing network management and maintenance services to ensure optimal network performance, availability, and security. We will also provide technical support and trouble-shooting assistance as needed.

Technical specification.

➢ Highlight features of UTL 5G Private

➢ Fully 5G core network functionality (AMF, SMF, SMSF, UDM, AUSF, NRF, NSSF, CHF, PCF, UPF)

➢ Combine the 4G core for LTE and 5G NSA access

➢ Support Voice service (IMS) via VoNR and VoLTE

➢ 3GPP Release 16 Standard

- High Performance with 40Gbps Data Throughput

- Advanced session management with trafﬁc inﬁuence and basic QoS

- Network slice support

- Non-3GPP access support

- One server for whole Core Network functions

Bill of Materials

The bill of materials for the project includes the following items:

- 5G RAN equipment: This includes 5G base stations, antennas, cables, power supplies, etc. The number and type of equipment will depend on the size and layout of the Coal mines.

- 5G core equipment: This includes 5G core servers, switches, routers, firewalls, etc. The core equipment will be located at a secure data centre within or near the collieries.

- Network management software: This includes software tools for monitoring, configuring, optimizing, and trouble shootIng the private 5G network.

- Installation services: This includes labour costs for installing and testing the network equipment at the Coal Mines.

- Management services: This includes monthly fees for managing and maintaining the private 5G network.

The estimated cost of the bill of materials is 12-14cr.

Payment Schedule
Will be discussed and decided with the customer

Terms and Conditions
Will be discussed and decided along with the customer

Potential Clients:

Primary beneficiaries of the 5G Captive Network in mining include mining companies, equipment manufacturers, and stakeholders involved in mineral extraction. The project's outcomes directly impact these entities by providing a secure, efﬁcient, and technologically advanced communication infrastructure.

- **NMDC**
- **Coal India**

Other Partners

VoICE has multiple players who can be part of complete end to end 5G CNPN solution. Once in principle, go ahead signal is available, further details can be worked out.

Lead Implementor

UTL has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

Conclusion

It's important to conduct a thorough feasibility study, considering factors such as cost, infrastructure requirements, and regulatory considerations, before implementing a private 5G network in the coal industry. Collaborating with technology providers, telecommunications companies, and experts in industrial automation can be beneficial in the planning and implementation phases.

VoICE CNPN PROJECT 22
5G Captive Networks in Ports

Contents

1   Introduction:

Ports, being vital hubs of global trade, face evolving challenges in managing increasing cargo volumes, ensuring faster turnaround times, and enhancing safety and security. This proposal advocates for the adoption of 5G Captive Networks in ports to revolutionize operations through automation, real-time connectivity, and enhanced efficiency.

2   Current Scenario: The Significance of Ports in India's Trade Landscape

India's economic landscape is intricately tied to its maritime activities, with ports playing a pivotal role in facilitating both domestic and global trade. As of now, the country heavily relies on maritime transport, with a substantial portion of its trade conducted through ports. Understanding the current scenario is crucial to appreciate the challenges faced by these ports and to propose effective solutions through the adoption of 5G Captive Networks.

2.1   Trade Statistics:

Trade Volume: A staggering 95% of India's total trade by volume is facilitated through maritime transport, underlining the critical importance of ports in the nation's trade ecosystem.

Trade Value: While 70% of trade by value is conducted through ports, this figure emphasizes the substantial monetary transactions and economic significance associated with these maritime gateways.

2.2   Port Infrastructure:

Major Ports: The country boasts 13 major ports, strategically located along its vast coastline, to efficiently handle the inflow and outflow of goods.

Minor and Intermediate Ports: In addition to major ports, there are 205 notified minor and intermediate ports, collectively contributing to the comprehensive maritime infrastructure.

Sagarmala Project: Recognizing the need for expansion and development, the Sagarmala Project is a national initiative aimed at establishing six new mega ports. This project signifies the government's commitment to enhancing port capabilities and connectivity.

2.3   Traffic and Revenue Statistics:

According to the Annual Report 2019-20 by the Ministry of Ports, Shipping, and Waterways, the total traffic handled by all the ports in India during the year 2019-20 was an impressive 1,229.98 million metric tonnes (MMT). This figure underscores the sheer magnitude of activities at these ports.

In the fiscal year 2021, the total revenue generated by major ports across India surpassed 1.48 trillion Indian rupees. This consistent increase in revenue over the past decade highlights the economic growth and significance of these ports.

3   Challenges:

Ports grapple with multifaceted challenges, necessitating a transition towards advanced technological solutions:

Manual Operations: Traditional port operations are predominantly manual, leading to inefficiencies, delays, and increased operational costs.

Safety Concerns: Ports involve hazardous activities, and reliance on manual labor, especially in crane operations, poses risks to personnel safety. Shift changes and downtimes can create inefficiencies.

Inefficiencies with Wired Infrastructure: Wired sensors and cameras, while providing benefits, have limitations in terms of flexibility and cost. The wired infrastructure constrains the scalability and adaptability required for evolving port operations.

Lack of Real-time Connectivity: Traditional networks struggle to provide real- time connectivity, hampering efficient coordination between various assets such as vessels, containers, and cranes.

Operational Inefficiencies: The inefficiencies inherent in manual operations contribute to increased turnaround times, reducing the overall operational efficiency of ports.

Studies on Jawaharlal Nehru Port (JNPT) and Chennai Port:

In a research study on the use of private 5G in ports, Prof. Rekha Jain, Visiting Professor at ICRIER and Former Chair of IIMA Telecom Centre of Excellence, estimated that through the use of private 5G, Jawaharlal Nehru Port (JNPT) could derive benefits in efficiency and RoI improvement up to 138 percent, and Chennai port could improve its RoI up to 76 percent.

4   5G Impact in Ports:

Automation and Safety: Private 5G enables the deployment of autonomous cranes, robotic systems, and real-time monitoring, reducing human-operated risks and enhancing safety measures.

Connectivity and Efficiency: Private 5G offers low latency and high bandwidth, enabling real-time communication and coordination between devices. This results in optimized resource allocation, reduced response times, and up to a 30% reduction in operation time.

Massive IoT Deployment: Private 5G networks handle a massive number of IoT devices, facilitating predictive maintenance, asset tracking, and intelligent decision- making. It can lead to up to a 15% reduction in CO_2 emissions.

Enhanced Security: Private 5G ensures secure and isolated communication environments, protecting sensitive data and minimizing cyber threats.

5   Key Benefits of 5G in Ports:

Increased Operational Efficiency: Automation and optimization of tasks, such as crane control, lead

to higher operational efficiency.

Reduced Operational Costs: Higher levels of automation may reduce operational expenditure (OPEX) costs.

Enhanced Worksite Safety: AI-enhanced CCTV systems identify safety issues, increasing worksite safety

6 Use Cases for 5G in Ports:

Remote control and monitoring of containers: Private 5G enables efficient management and monitoring of container movements.

Automation and remote control of cranes: Autonomous cranes powered by private 5G networks improve loading and unloading times.

CCTV system with AI capabilities: Private 5G enhances video surveillance with AI for advanced security measures.

Augmented Reality (AR) and Virtual Reality (VR) support: 5G supports AR and VR applications for operations and maintenance teams.

7 Technical Solution:

To surmount the challenges entrenched in traditional port operations and unlock the full potential of private 5G networks, we propose a comprehensive technical solution poised to redefine the landscape of maritime connectivity and automation.

7.1 Network Infrastructure Deployment:

Implementation of a dense network of 5G base stations strategically positioned throughout the port area to ensure comprehensive coverage.

Leveraging small cells, distributed antenna systems (DAS), and beamforming technologies to address short distances between base stations and mitigate inter-cell interference.

Adhering to a TDD (Time Division Duplex) pattern optimized for smart ports, balancing uplink and downlink data transmission for enhanced efficiency.

7.2 Massive IoT Integration:

Deployment of a robust Internet of Things (IoT) ecosystem encompassing sensors, RFID tags, and smart devices for real-time data gathering.

Utilization of private 5G's capacity to handle a massive number of IoT devices concurrently, ensuring seamless data transmission without congestion.

Implementation of predictive maintenance algorithms and asset tracking functionalities to optimize resource allocation.

7.3 Edge Computing for Low Latency:

Introduction of edge computing nodes within the port infrastructure to reduce latency in data processing.

By processing data closer to the source, critical decisions and commands can be executed with minimal delay, facilitating real-time coordination of automated processes.

7.4 Autonomous Systems and Robotics:

Integration of autonomous cranes, robotic systems, and automated guided vehicles (AGVs) into port operations for streamlined container handling.

Private 5G's ultra-low latency and high bandwidth capabilities empower these autonomous systems to operate seamlessly, reducing loading and unloading times.

7.5 CCTV Systems Enhanced with AI:

Upgrade of existing CCTV systems with artificial intelligence (AI) capabilities for advanced video surveillance.

AI-driven functionalities such as facial recognition and anomaly detection enhance security measures and ensure compliance with safety standards.

7.6 Augmented Reality (AR) and Virtual Reality (VR) Support:

Implementation of AR and VR technologies to support operations and maintenance teams.

AR-assisted maintenance procedures, remote troubleshooting, and VR-based training modules contribute to increased efficiency and reduced downtime.

7.7 Environmental Monitoring:

Deployment of environmental sensors connected to the private 5G network for real- time monitoring of ecological conditions.

Ensuring adherence to sustainability standards and minimizing the ecological footprint of port operations.

This holistic technical solution envisions a connected and automated port ecosystem, where private 5G networks act as the backbone, weaving together disparate elements into a seamless tapestry of efficiency and innovation. By embracing this blueprint, ports can not only address current challenges but also position themselves as trailblazers in the era of smart and sustainable maritime operations.

8   Budget for 5G-Powered Port Project

The proposed budget for the 5G-powered port Project is estimated at ₹11.66 crores. This comprehensive budget covers critical aspects of the Proof of Concept, ensuring a thorough exploration of the feasibility and benefits of implementing private 5G networks in port operations. Key components include network infrastructure deployment, massive IoT integration, edge computing implementation, autonomous systems, CCTV systems enhancement, AR and VR technologies, environmental monitoring, and a contingency fund for unforeseen challenges. The budget provides a solid foundation for testing and validating the transformative potential of 5G in optimizing port operations.

9   Conclusion:

Private 5G networks are pivotal in transforming ports into smart, automated ecosystems. By leveraging the advantages of 5G, ports can optimize operations, enhance safety, and increase overall efficiency. The deployment of autonomous systems, IoT devices, and real-time analytics strengthens the competitiveness of ports in the global trade landscape. As we move towards a connected future, private 5G networks will continue to play a vital role in shaping the port industry and revolutionizing global supply chains.

10 Other Partners

VoICE has multiple players who can be part of complete end to end 5G CNPN solution. Once in principle, go ahead signal is available, further details can be worked out.

11 Lead Implementor

UTL has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VoICE CNPN Project 23

Proposal Private 5G Solution for Smart Cities

Executive Summary

Welcome to United Telecoms Limited, where innovation meets connectivity. We are pleased to present our comprehensive Private 5G Solution designed specifically for Smart Cities. This ground breaking technology will revolutionize urban infrastructure, enabling seamless communication, efficient resource management, and enhanced public services.

Table of Contents

1. **Introduction**

1.1 Background

As cities strive to become smarter and more connected, the need for a robust and reliable communication infrastructure is paramount. Our Private 5G Solution aims to address this need by providing a dedicated and high- performance network tailored to the unique requirements of Smart Cities.

1.2 Objectives

- Enable seamless communication between devices and systems.

- Enhance public safety and emergency response capabilities.

- Optimize resource management through real-time data analytics.

- Improve citizen services and quality of life.

1.3 Benefits of Private 5G for Smart Cities

- Ultra-low latency for real-time applications.

- Massive device connectivity for the Internet of Things (IoT).

- Enhanced security and privacy.

- Scalability to accommodate future technological advancements.

2. Solution Overview

2.1 Architecture

Our Private 5G Solution utilizes a state-of-the-art architecture that ensures high-speed, low-latency communication across the city. The network is designed to support a multitude of devices and applications, from smart traffic management to environmental monitoring.

2.2 Key Features

- Network Slicing for customized service delivery.

- Edge computing for faster data processing.

- Advanced Quality of Service (QoS) mechanisms.

- Seamless integration with existing city infrastructure.

2.3 Integration with Smart City Applications

Our solution seamlessly integrates with various smart city applications, including:

- Intelligent Transportation Systems (ITS)

- Smart Grids for efficient energy management

- Environmental Monitoring for air and water quality

- Public Safety and Surveillance

3. Technical Specifications

Our 5G Private has been designed to connect your onsite teams and devices from the edge to the cloud. Empower your enterprise with the speed, control, security and complete coverage needed to transform your customer, digital and employee experience.

Our full range of consulting, implementation and managed services are designed to seamlessly integrate transformative private 5G technology with existing enterprise IT networks and industrial IoT infrastructures. We provide a global connectivity platform with one point of contact, giving you full control while ensuring all critical data remains in-house.

Our Private 5G platform has been designed to supply reliable, high-bandwidth and low-latency connections on your critical infrastructure. With the ability to support multiple enterprise use cases on a single network. Our solution offers a full stack of network, device and service options to meet the challenge of scaling private 5G installations within your organization

UTL's 5G (or 4G/LTE) Private solution includes an access device (eNodeB/ gNodeB), a transmission device (Site Router) and a combined core network (*includes 4G/5G networks (EPC, 5GC) and IMS system for data, voice and message services*).

This solution provides a flexible and highly customizable solution to deploy a private network with full functions to serve organizations and businesses with specific requirements such as: medium and large sized companies, factories, seaports, oil and gas, toll stations and national defense situations, search and rescue etc. All The product meets the latest GSMA and 3GPP standards for EPC/5GC/ IMS core network.

● **Highlight features of UTL 5G Private**

  ✓ Fully 5G core network functionality (AMF, SMF, SMSF, UDM, AUSF, NRF, NSSF, CHF, PCF, UPF)
  ✓ Combine the 4G core for LTE and 5G NSA access
  ✓ Support Voice service (IMS) via VoNR and VoLTE
  ✓ 3GPP Release 16 Standard
  ✓ High Performance with 40Gbps Data Throughput
  ✓ Advanced session management with traffic influence and basic QoS
  ✓ Network slice support
  ✓ Non-3GPP access support
  ✓ One server for whole Core Network functions

● **Access device: 5G gNodeB**

RRU - 5G RADIO REMOTE UNIT

BBU - 5G BASEBAND UNIT

No	Feature Name	Information
1	5G mode	Stand-Alone (SA); Non Stand-Alone (NSA)
2	Supported Frequency Band	n78 (3600-3800 MHz), TDD n41 (2600 MHz), TDD
3	Supported Cell Bandwidth (MHz)	100, 50
4	Subscarier Spacing (SCS)	30 kHz
5	Number of Antenna ports	8T8R, 32T32R, 64T64R (Macro/Micro) 4T4R (AIO)
6	Maximum DL/UL Throughput (Mbps)	1890/380 Mbps (Scalable to 2+ Gbps DL with Macro cell).
7	Number of Cells	3 (Macro) 1 (Micro/AIO)
8	Modulation	DL up to 256QAM UL up to 64QAM

● **Transmission device: Site Router**

✚ Main characteristic of UTL Site Router

✔ Switching capacity: 100/300Gbps.

✔ Supports Layer 2 (IEEE 802.1, IEEE 802.3), Layer 3 (OSPF, BGP, RIP v1/2, PBR) protocols.

✔ Supports IP/MPLS (L2VPN, L3VPN), Segment routing, SDN.

✔ Supports Multicast feature (PIM SM, PIM SSM, IGM v1/v2/v3).

✔ Support IPv6 and features working on IPv6 (routing, VPN, segment routing).

✔ Compatible with Aggregation devices of other Vendor.

✔ Message handling capacity: 100/300Mpps.

✔ Number of optical ports: 2x100Gbps; 8 x 25/10Gbps; 16 x 10/1Gbps.

● Core device: 5G Core and IMS
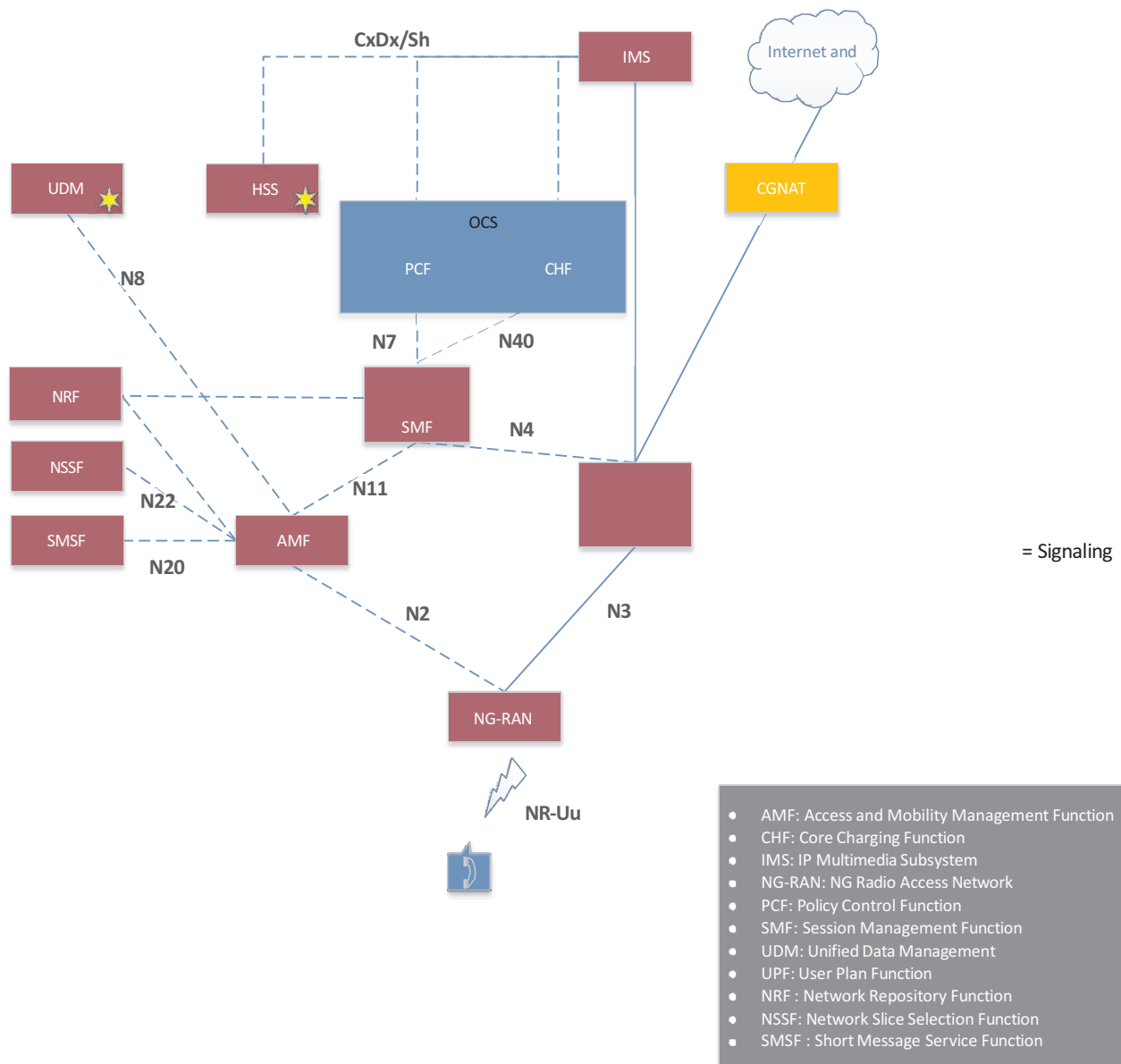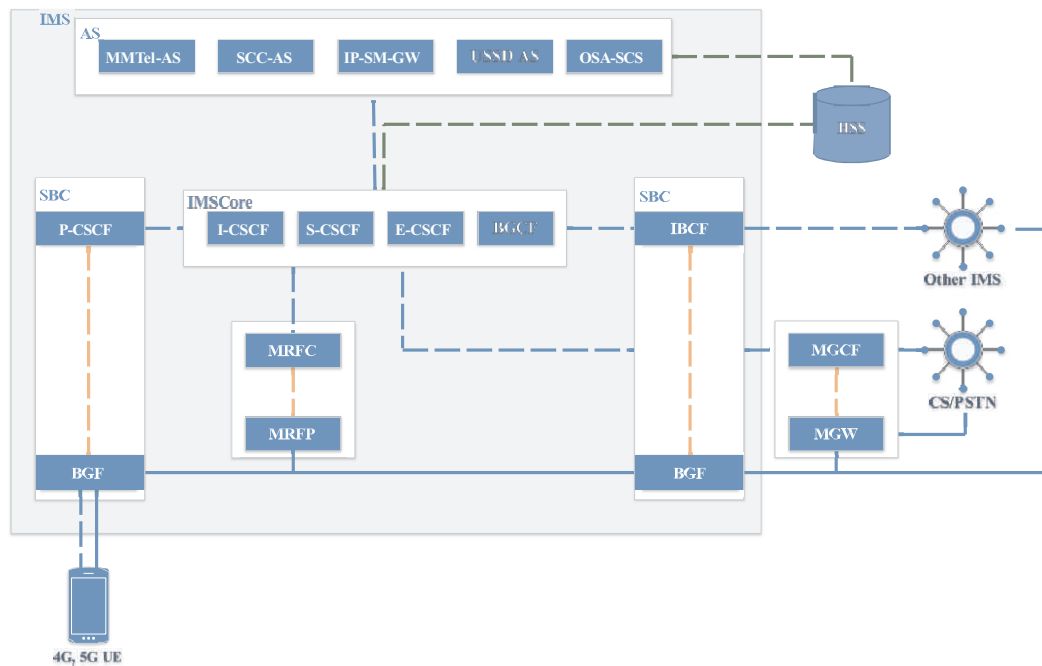
Main characteristic of UTL 5G Core and IMS:

✔ Microservices and Cloud Native Function (CNF) based architecture.
✔ Native run on Docker, Kubernetes, VMs and x86 based servers.
✔ Management and Orchestration functions (MANO).
✔ Network Function Virtualization (NFV).
✔ Network slicing using NSSF.
✔ Interoperability with other 5G Core Network.
✔ Support VoLTE, VONR, Data, SMS/ service.
✔ EMS with GUI interface.

3.1 Network Infrastructure

- 5G NR (New Radio) technology.

- Multi-access Edge Computing (MEC) for localized data processing.

- High-capacity backhaul for reliable connectivity.

The network infrastructure will be finalised based on the requirement of the client.

3.2 Security Measures

- End-to-end encryption.

- Secure Authentication and Authorization.

- Intrusion Detection and Prevention Systems (IDPS).

3.3 Scalability and Flexibility

Our solution is designed to scale with the evolving needs of Smart Cities. Whether you are expanding your IoT ecosystem or introducing new applications, our Private 5G Solution can adapt to meet your requirements.

4. Customization and Deployment

4.1 Tailored Solutions for Smart City Needs
We understand that each city has unique challenges and requirements. Our team will work closely with you to tailor   the Private 5G Solution to address the specific needs of your Smart City.

4.2 Deployment Process

- Site survey and assessment.

- Customized network design and planning.

- Installation and configuration.

- Comprehensive testing and optimization.

4.3 Training and Support

Our team will provide thorough training to ensure your staff is well-equipped to manage and maintain the Private 5G Solution. Additionally, our support services guarantee prompt assistance in case of any issues or inquiries.

5. Pricing and Terms

The total cost may vary based on requirement between Rs 10 to Rs 20 Crores

5.1 Cost Breakdown

SNO	Item Description	Estimated Cost
01	Site Survey	30 Lakhs
02	Network Design (HLD,LLD)	20 Lakhs
03	Enterprise control 5GP full set (gNodeB, 5G Core, MEC)	12 Cr
04	End IOT devices, Network Elements (switches, Rack, UPS and Servers)	2 Cr
05	Civil and Electrical Infra (towers etc)	1 cr
06	Installation and Commissioning	1.5 cr
07	Transportation, Insurance etc	50 Lakhs
08	Training and Operations for 1 Years	50 Cr
09	Maintenance cost per year	50 lakhs

5.2 Payment Schedule

The payment schedule will be finalised as per mutual discussion with the prospective client.

5.3 Terms and Conditions

The above Include terms related to warranty, maintenance, and any other relevant contractual details. However, the   proposal will be finalised on need base of the customer

6. Other Partners

VoICE has multiple players who can be part of complete end to end 5G CNPN solution. Once in principle, go ahead signal is available, further details can be worked out.

7. Lead Implementor

UTL has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VoICE CNPN PROJECT 24
Enterprise Solution in Railways & Mining

Contents

1.   **Scope**

The purpose of this document is to explore the appropriate approach for presenting solutions that Resonous can offer for enterprises like Railways, Mining, etc. Plan to work in VOICE consortium of vendors for CPEs, IMS, MCX, etc.

2.   **About Us**

Resonous technologies founded in 2014, is a Bangalore based start-up with strong R&D focus in wireless technologies. Resonous Technologies provide Wireless 4G and 5G Broadband equipment

FOR Asian and African countries.

Resonous offering the complete LTE network end-to-end, deployable solutions for enterprises, government agencies and ISPs. The company's expertise and flexibility in customization of LTE and 5G NR products (E-NodeB, EPC, HSS, PCRF and NMS) enables enterprises to achieve business objectives and attain increased competitiveness.

Resonous offer solutions of 5G Network for carriers and enterprises. Products comprise of Integrated RAN, 0-RU and carrier grade core.

2.1.   **Products**

2.1.1. **4G**

Base station – Micro base station supporting B1, B28 with 2x2 configurations for 20W and 40W per port. Enterprise Core – MME, SGW, PGW, PCRF, HSS, etc

2.1.2. **5G**

Integrated Base station – Integrated solution supporting N78, 4x4 and 1W and 8W solutions per port
O-RAN Base station – Resonous provides O-RU. In collaboration with Sooktha, we will provide complete O-RAN network including O-CU and O-DU
Carrier grade Core – AMF, SMF, PCF, UDM, UDR, etc.

3.   **Solutions**

3.1.   **4G**

Offered solution is a single and compact Integrated RAN and Core. These solutions are useful for different use cases like Education, Healthcare, Mining, etc
The system has a starting capacity of 128 users and a 2x2 configuration.

3.1.1. **Network architecture**
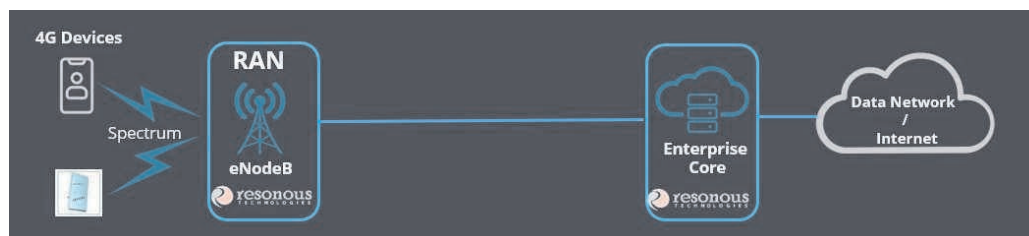
3.2.   **5G**

Offered solution is a single and compact Integrated RAN or O-RAN and Core. These solutions are useful

for different use cases like Education, Healthcare, Mining, etc

Integrated BS system has a starting capacity of 128 users and a 4x4 configuration. As the capacity needs grow, it can be easily expanded to accommodate over 512+ users and an 8x8 configuration. This scalability is achieved by configuring a single unit to adapt to different deployment scenarios, providing flexibility and cost-efficiency for enterprises.

3.2.1. Network architecture
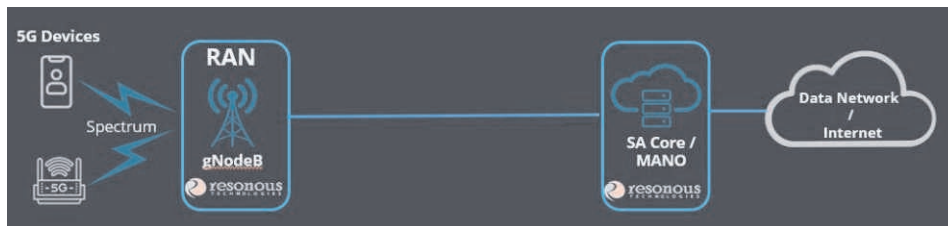
3.2.2. Use cases
3.2.2.1. Railways
3.2.2.1.1. Block diagram

Figure 1: KAVACH SCHEMATIC
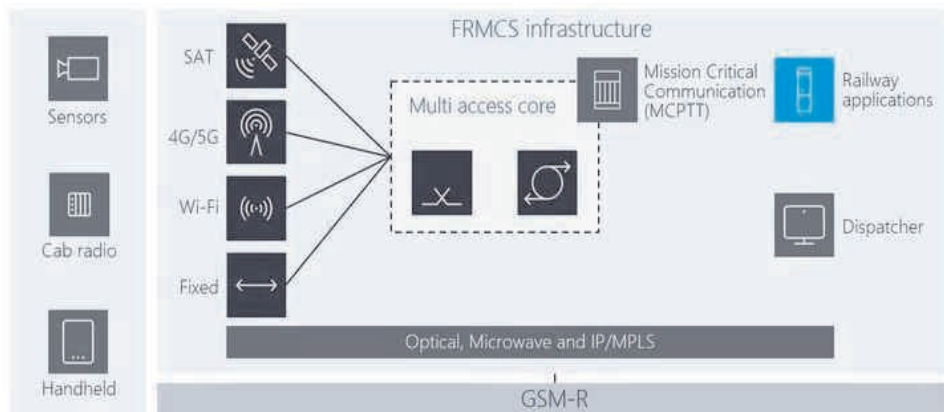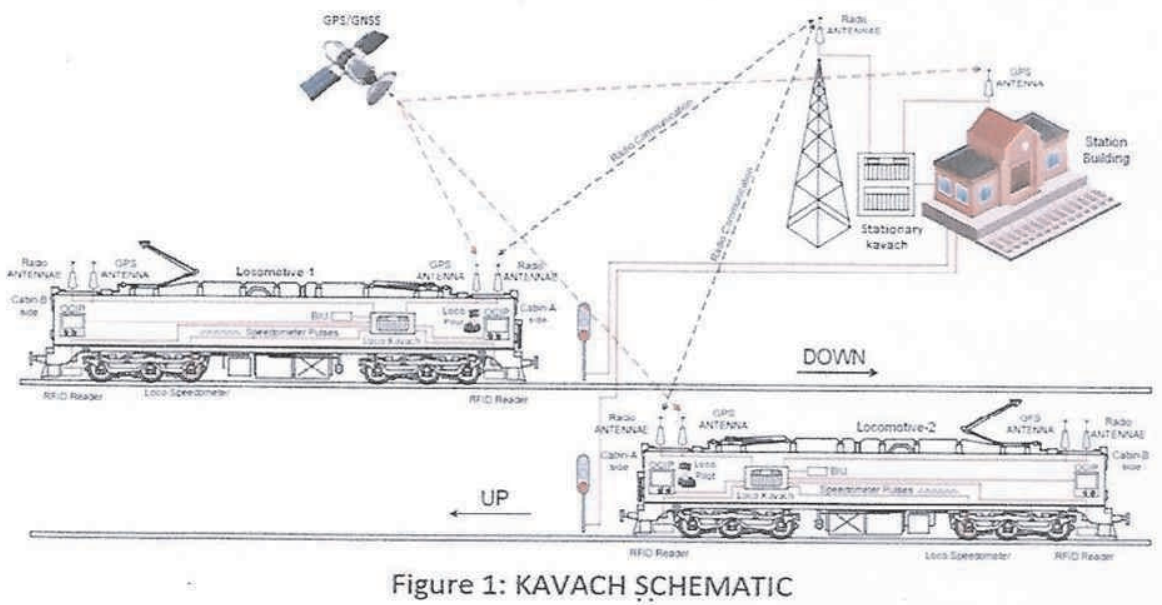
3.2.2.1.2. O-RAN distributed network
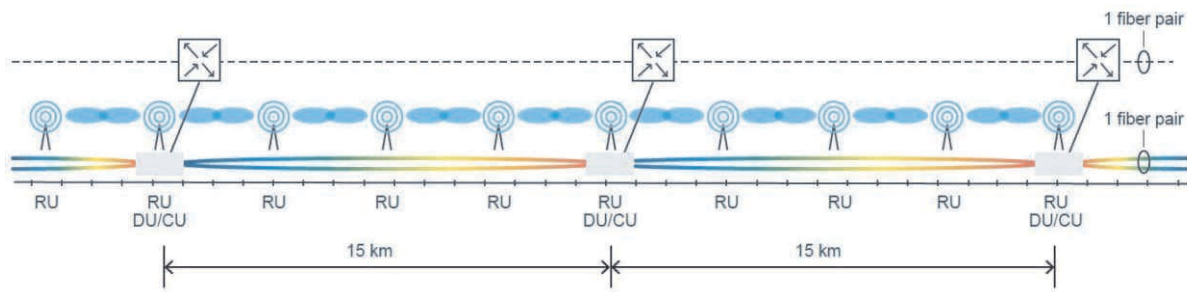
3.2.2.1.3. Integrated base station
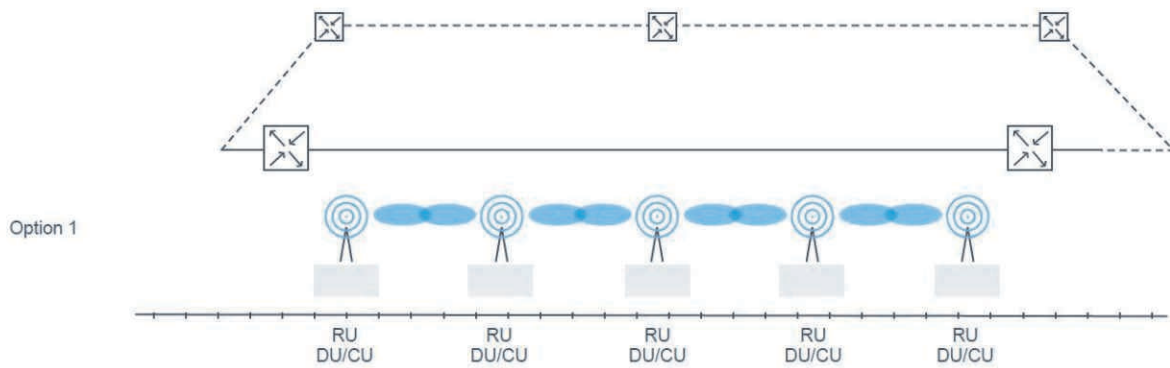
3.2.2.1.4. Services offered
a. Networks
- Track side
- Tunnel
- Station

b. Applications

a. Signaling – 4G and 5G solutions with available spectrum can provide required signaling for drivers, and controllers of the network using

b. Entertainment – 5G network using CNPN license can provide significant throughputs, hence application like voice, Video, browsing can be provided to Railway personal and on board passengers.

3.2.2.2. Mining

3.2.2.2.1. Applications

- Underground Connectivity for Personnel and Equipment Tracking
- Remote Operation of Drilling and Blasting
- Geological Survey and Mapping with Drones
- Automated Haulage Systems
- Real-Time Video Monitoring for Safety and Security
- Sensor-based Ore Grading and Quality Control
- Enhanced Underground Communication Systems
- Wearable Safety Devices for Miners

3.2.3. Pilot creation

3.2.4. Railways - Signaling

3.2.4.1. 4G LTE

- Spectrum – B28 – 700 MHz

- Equipment – 4G LTE Base station, 4G core, NMS, CPEs
- Integration – With Kavach, Core from C-DOT and other control equipment
- Size of the pilot – It can cover 5 KM line to 50Km line, independently or with other VOICE member infrastructure equipment
- Budget – Up to 5 Crore

3.2.4.2.   5G NR

- Spectrum – N28 – 700 MHz
- Equipment – 5G NR Base station, 5G core, NMS
- Integration – With Kavach, Core from C-DOT and other control equipment
- Size of the pilot – It can cover 5 KM line to 50Km line, independently or with other VOICE member infrastructure equipment
- Budget – Up to 5 Crore

3.2.5. Mining

3.2.5.1.   5G NR

- Spectrum – N78 – 3.5 GHz
- Equipment – 5G NR Base station, 5G core, NMS, CPE, Drones, AR/VR equipment
- Integration – Can provide complete End to End network or associate with other VOICE members
- Size of the pilot – We can cover one or more mines
- Budget – aUp to 1 to 2 Crore per mine with different applications of mining.

Other Partners

VoICE has multiple players who can be part of complete end to end 5G CNPN solution. Once in principle, go ahead signal is available, further details can be worked out.

Lead Implementor

Resonous has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VoICE CNPN PROJECT 25
5G LABS

REBACA will be lead Implementor in partnership with Lekha Wireless. DG, VoICE will coordinate for the Project on behalf of VoICE stakeholders in the Project. Costing and other details will be shared as per client's requirements.

Webel 5G Lab Objective: Encourage 5G Application development & validation and 5G knowledge building

Challenges with off-the-shelf 5G solution

➢ Readymade 5G Core solutions involve managing and maintaining the 5G Core components, dealing with new software release upgrades for 3GPP compliances, long wait cycle for any custom modifications, interoperability between 5G network components.

➢ Cost of custom or special purpose H/w and networking equipment needed for the 5G solution.

➢ Identifying integration issues between network functions and coordinating with the vendors.

➢ Access to 5G knowledgeable resources for Lab maintenance and resolving Application interoperability issues.

Solution:

➢ Standard RAN from Lekha + ABot Core. The CPE interacts with the RAN in a standard manner using 3GPP compliant Call Flows.

➢ The Application Server interacts with Client App. over standard 5G network interfaces & messages

➢ The 5G spec. related details and compliance issues are abstracted from the App. Developer and Lab owner.

Outcome:

➢ 5G Lab can be built and maintained using COTS affordable H/w and with low maintenance overhead.
➢ 5G Lab Option 2 enables on-going application development experimentation even without the necessary RAN Phy. layer support.
➢ Developers can test without detail 5G knowledge.
➢ ABot Analytics provides root case failure analysis for faster 5G solution development.

Feature:

Lekha gNB enables standard compliant App. development with physical RF layer support Fully functional 5G Core running on a Baremetal or Cloud. Completely software-based integrated 5G Core

Pre-configured Lekha RAN + ABot 5G Core is low maintenance and supports current known use cases
Supports 3GPP Release 15 and 16 procedures on the N1+N2 interfaces Capable of supporting currently known applications and use-cases

HARDWARE AND SOFWARE

S.No.	Component	Vendor	HW/SW	Remarks
1	CU-DU Stack	Lekha	Software	Runs on a standard Intel Xeon COTS Server
2	RU	Lekha	Hardware	Lekha's proprietary hardware
3	5G Core	Rebaca Technologies	Software	
4	Gigabit Switch	COTS	Hardware	
5	Intel Xeon Server	COTS	Hardware	Required for running CU-DU Stack. Server should have FEC Accelerator Card and 10G NIC card.
6	Intel Xeon Server	COTS	Hardware	Required for running the 5G Core. CU-DU and 5G Core can run on a single server or separate servers.
7	5G Devices	COTS	Hardware	5G Devices can be COTS 5G Mobile, 5G CPE etc

NETWORK TOPOLOGY
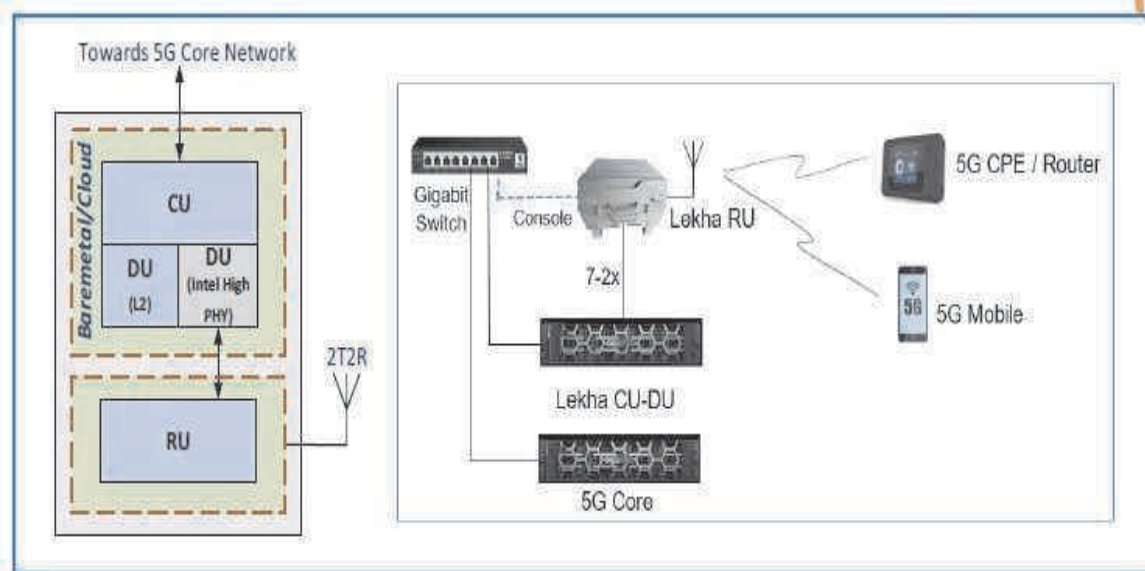
Other Partners

VoICE has multiple players who can be part of complete end to end 5G CNPN solution. Once in principle, go ahead signal is available, further details can be worked out.

Lead Implementor

Rebaca has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VOICE CNPN PROJECT 26

5G Model Village

Introduction

Signaltron is an Indian original equipment manufacturer of Wired and Wireless communications systems established in 2019 with the vision of building complete end to end technology ownership within India in ubiquitous networking devices. Founders of Signaltron have spent many years developing solutions to some of the most complex problems in networking, computation, wired and wireless communication domains. Signaltron specializes in providing radio access network solutions for 5G and LTE.

Signaltron envisages the setting up of a 5G model village which provides end to end digital infrastructure. Smart villages represent a transformative approach to rural development, leveraging technology and innovation to enhance the quality of life for residents. Unlike traditional villages, smart villages integrate cutting-edge technologies, sustainable practices, and community engagement to create a more efficient, connected, and resilient living environment.

Figure 1: Smart Village concept

One key aspect of smart villages is the deployment of advanced infrastructure and digital connectivity. High-speed internet and communication networks form the backbone, enabling residents to access information, education, and healthcare services remotely. This connectivity also facilitates the implementation of smart energy grids, optimizing energy consumption and promoting the use of renewable sources. As a result, smart villages often showcase reduced environmental impact and increased energy efficiency.

In the realm of agriculture, smart villages leverage precision farming techniques, incorporating

sensors, drones, and data analytics to optimize crop management. This not only increases agricultural productivity but also promotes sustainable farming practices. Farmers can access real-time data on weather conditions, soil health, and crop performance, enabling informed decision-making and resource optimization.

As example of this is illustrated below where image based weight and health analysis of cattle through
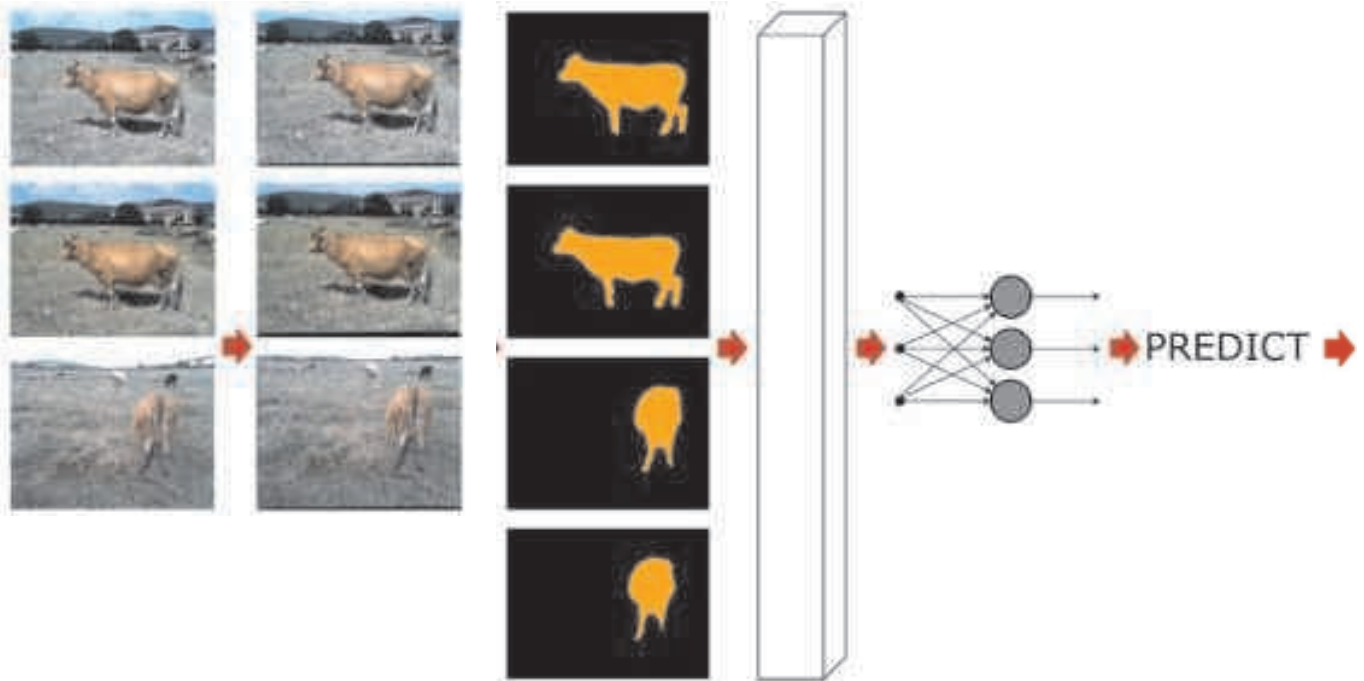
Figure 2: Smart AI based Cattle health monitoring system

the use of 5G based cameras and data analytics. This enables cattle farmers to monitor the health, weight, birthing information, get timely information on the feeding patterns and the impact of the weather on the cattle and interventions can be introduced to enhance their productivity

Education and healthcare in smart villages benefit from technology-driven solutions as well. Telemedicine services connect residents with healthcare professionals, overcoming geographical barriers and ensuring timely medical assistance. Educational initiatives leverage online platforms and digital resources, offering residents access to quality education regardless of their location.

SMART CANTEEN
- WiFi
- Digital Wallet / Payment
- Capacity Monitoring
- Digital Student ID
- Health/Allergy Notification

SMART WEATHER

SMART SECURITY
- Notifications
- Alerts
- CCTV
- Facial Recognition

SMART HEALTH
- Notifications
- Alerts
- Digital Health ID

SMART BUILDING/ INFRASTRUCTURE
- Cost Saving Through Smart Lights
- Smart HVAC
- Controlled Access Areas
- Energy Efficient KPIs
- Building Automation

SMART BUSES
- Bus Route Notification
- Capacity
- Facial Recognition
- Fleet Diagnostics
- Safety Compliance

SMART CLASSROOM
- Interactive Boards
- Language Translation
- Beacons / Communication
- Connected Devices
- Remote Students/Faculty

SMART WAYFINDING
- Location Tracker
- Interactive Map
- Find Me Location
- ETA
- Emergency / Help

SMART WEARABLES
- Student Tracker
- Auto Attendance
- GPS
- Wayfinding
- Digital ID
- Event Passes (Shared Revenue)

SMART PARKING
- Reserve Parking
- Shared Revenue
- Smart Lights
- CCTV

SMART DOOR SYSTEM
- Control Locks
- Alerts / Notifications
- Lock Down
- Emergencies
- Gun Shot Detection

DATA CENTER
- Central Hub
- Monitoring Security
- All Devices / Alerts
- CCTV

SMART LIBRARY
- CCTV
- Facial Recognition
- Smart Check Out
- Digital Form

SMART TRAFFIC

Community engagement plays a pivotal role in the success of smart villages. The use of technology enhances participatory governance, where residents actively contribute to decision-making processes, fosters a sense of ownership and inclusivity. Local businesses can thrive through e-commerce platforms, expanding market reach and boosting economic growth.

In conclusion, smart villages represent a holistic and sustainable approach to rural development. By integrating technology, connectivity, and community engagement, these villages strive to create a more inclusive, resilient, and prosperous environment for their residents. As the world embraces the digital era, smart villages stand as beacons of innovation, demonstrating that rural areas can harness technology to address contemporary challenges and improve the overall well-being of their communities.

The end to end implementation of the project can be facilitated through the Voice Consortium of partners and Signaltron Systems in collaboration with all the partners can execute the project by taking up the responsibility as a lead system integrator.
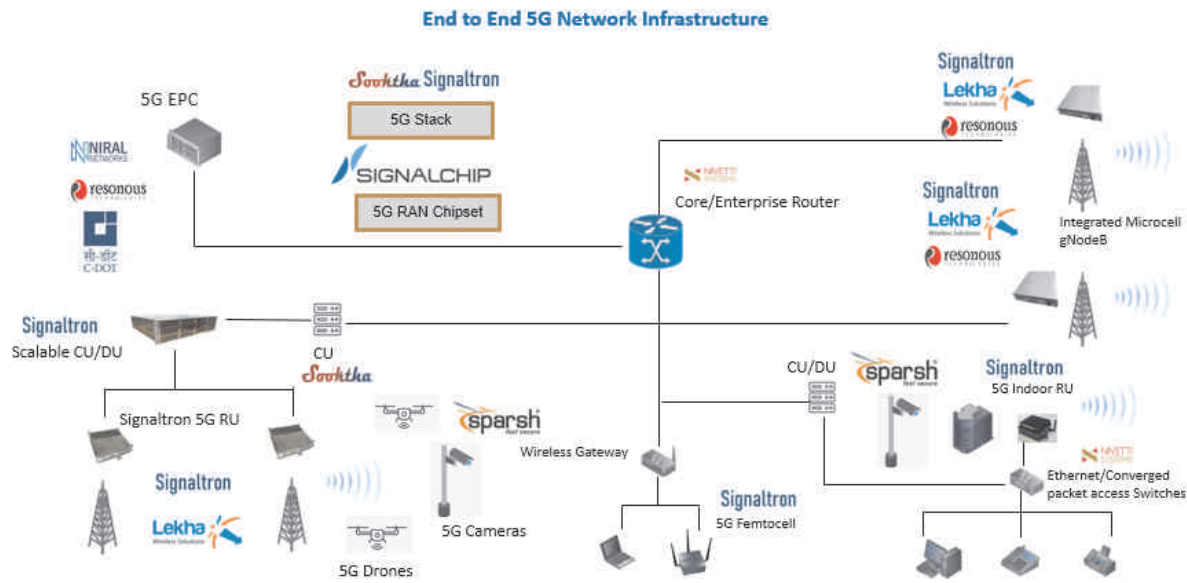
Figure 1: End to End Infrastructure by Voice member

* The figure above is representational only and not all the members of Voice and their solutions are represented

Challenges:
1) Allocation of Spectrum for setting up of the 5G
2) Facilitation of permissions from Villages to set up the infrastructure
3) Provide Technical support and training for the maintenance of sophisticated critical infrastructure

Expectations from DoT:
1) Facilitate the allocation of spectrum to provide the 5G services
2) Provide right of way permissions from Village Panchayats in model villages for setting up of digital infrastructure.
3) Facilitate training and support facilities for Villagers and end users to handle and use high end sophisticated equipment

Other Partners

VoICE has multiple players who can be part of complete end to end 5G CNPN solution. Once in principle, go ahead signal is available, further details can be worked out.

Lead Implementor

Signaltron has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ensuring that all stakeholders in the project can work as a team for the success of the project.

VOICE CNPN Project 27
5G private networks solution using secure E-band radio

Objective

Build a secured private network over E-band as a backhaul, which is a non-jammable, agnostic and high throughput network solution.

GigaMesh (!strome's E -band Radio) is an innovative wireless backhaul solution, based on patented millimetre wave (mmWave) communication technology. At the center of this solution is a mmWave radio system with an electronically steerable and flexible narrow beam architecture. This is an ideal solution for urban telecommunication networks, rural broadband networks, enterprise networks (Private networks), and military applications.

The integral part of the requirement is to provide a 5G solution within the enterprise network or private network. For this requirement, E-band Radio is used as backhaul which transports the 5G data securely to the destination network. The destination E-band Radio is connected over to the 5G Radio which acts as a fronthall connecting to the end devices. E-band radio is network agnostic acting like a wireless fiber without having an effect over the type of data being transported.

Customers

Defense, Government, Telecommunication OEM's, Oil and Gas firms, Mining agencies

Solution

Enterprises today are extremely large with multiple offices in the same regions. However, they prefer having private enterprise networks for continuity of operations and increased security and resilience. Very often, these enterprises operate on databases maintained at remote locations. The requirement can also be of a High speed, low latency secured network.

GigaMesh can facilitate such enterprise networks with ease, ensuring security and direct connectivity of all their offices and databases. Such a network can also be implemented in Smart Cities for connected government projects.
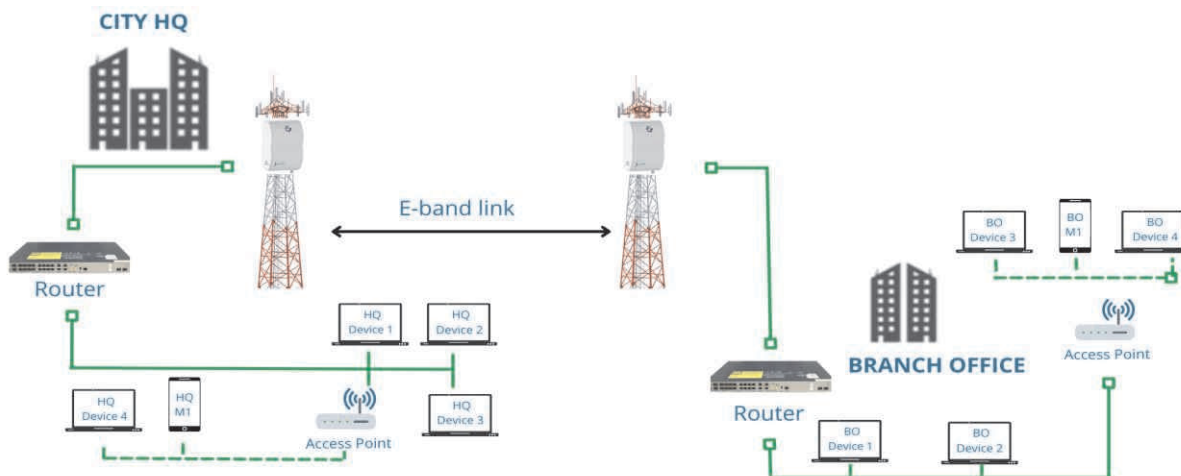
Figure 1: GigaMesh for 5G Enterprise Connectivity

Figure 1, shows the generic use case of connecting a Central office to a branch office which is collocated in the same city, within a few kilometers proximity. They can be connected securely over the E -band link as shown.

Use cases:

5G backhaul connectivity: The number of cell sites have increased in 4G and will increase multifold on the onset of 5G deployments. To cater to the demand of backhaul capacity at all cell sites, there is a need for wireless backhaul technologies that will complement fiber. E -band devices serve this need by distributing capacity from a fibre-connected tower to multiple surrounding towers with the least number of devices.

As a result, the fronthaul can connect all of their sites wirelessly with fiber -like capacity at much lower cost than fiber.

High speed internet connectivity:

A GigaMesh device connects to the OLT (Optical Line Terminal)/ONT of the existing fibre network and wirelessly distributes the fibre capacity to the E-band radio placed at the remote site of the enterprise.

This E-band radio at a remote site is connected to the Access point/ router which can be connected to the end devices to transfer high throughputs securely over the air.

As a part of this Pilot project, Astrome will be connecting several sites to a central location in a city/ town. The use cases can be finalized on the requirement basis.

Project Timeline

The project is estimated to be executed in a time period of 4-6 months.

Budget Estimate

Estimated budget of the project is INR 6 crores for Pilot (connecting several sites/ locations to the central site in a city/ town).

Implementers and Partners

Astrome Technologies Private Ltd., will be the System Integrator for this project. We will be collaborating with our partner for 5G radio. We will request the support and cooperation of the Director General, VoICE ensuring that all stakeholders in the project can work as a team for the success of the project.

VOICE CNPN PROJECT 27

5G based Communication Infrastructure for Strategic Communications and Disaster recovery and Management

Introduction

Signaltron is an Indian original equipment manufacturer of Wired and Wireless communications systems established in 2019 with the vision of building complete end to end technology ownership within India in ubiquitous networking devices. Founders of Signaltron have spent many years developing solutions to some of the most complex problems in networking, computation, wired and wireless communication domains. Signaltron specializes in providing radio access network solutions for 5G and LTE.

Signaltron envisages the setting up a Modern 5G based communication Infrastructure for Strategic Communications and Disaster Management and recovery.

Figure 2: NDRF is operations during a disaster recovery operation.

In the solution proposed by Signaltron, we can quickly establish 5G cellular connectivity in an environment where mobile infrastructure is either absent for eg in High altitude, forest or desert locations or in an are which has been subject to natural or man made disasters. The ability to quickly establish communication is a critical part of the operational requirements.

Figure 3: Mobile infrastructure destroyed in a disaster

Setting up mobile infrastructure in disaster areas is crucial for providing communication, coordination, and emergency services. The quick setting up of a 5G mobile infrastructure to establish communications can play a crucial role in planning, assessment, and delivery of services. Disaster recovery refers to the processes, procedures, and policies put in place to protect an area from the effects of unexpected events. Such events include natural disasters like earthquakes, floods, hurricanes, tornadoes, or human -made disasters. Disaster recovery plans aim to minimize the impact of such events by ensuring that operations continue in event of a disaster and can quickly recover from any damage or loss caused by the disaster. A disaster recovery plan should be comprehensive and outline the processes and procedures to be followed in the event of a disaster. It should be designed to minimize the potential for loss and ensure continuity of operations. The plan should be regularly updated and tested to ensure it remains effective and relevant. The National Disaster Response Force (NDRF) is an Indian specialized force constituted for the purpose of special response to a threatening disaster situation or disaster under the Disaster Management Act in 2005

5G networks support the massive connectivity required for the Internet of Things (IoT) devices, enabling seamless communication between various military assets, including vehicles, drones, and soldiers. This high-speed, low-latency communication network is particularly crucial for mission -critical applications, such as remote-controlled weapon systems and autonomous vehicles, Smart sensors have become integral components in modern military operations. These sensors are capable of collecting, analysing, and transmitting data in real-time, providing commanders with valuable insights into the battlefield environment. In the army, smart sensors are employed across a wide range of appl ications, including surveillance, reconnaissance, and threat detection. Miniaturized sensors can be deployed on unmanned aerial vehicles (UAVs) and ground vehicles, gathering intelligence without putting human lives at risk. This not only enhances the safety of military personnel but also allows for more strategic and precise decision -making.
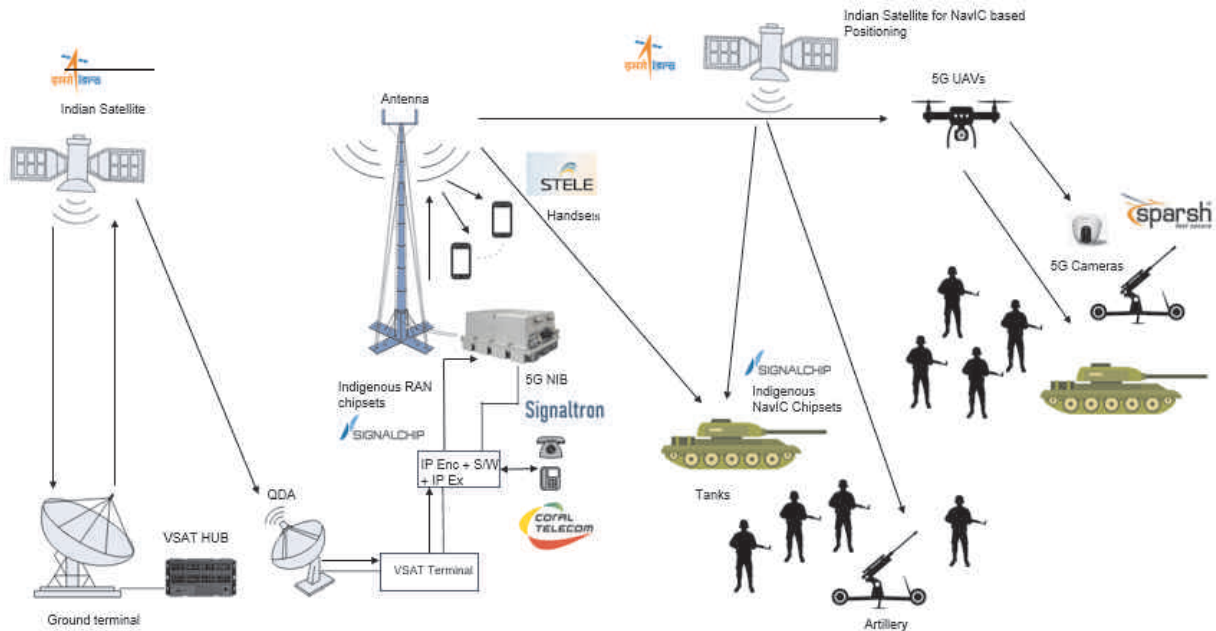
Figure 4: Communication Infrastructure for Strategic Communications and Disaster Management by the Voice Consortium members
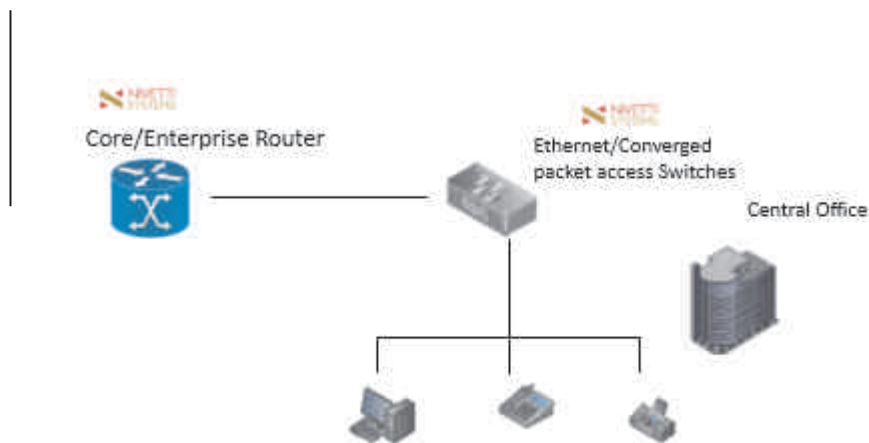
The end to end implementation of the project can be facilitated through the Voice Consortium of partners and Signaltron Systems in collaboration with all the partners can execute the project by taking up the responsibility as a lead system integrator.

Challenges
1) Understanding the key requirements and challenges faced by the Strategic forces
2) Provide for a scope that is in line with the capabilities and solutions with features available and offered by Indigenous Indian OEM
3) Implementation of solutions by actually Indigenously Designed Developed and Manufactured by Indian OEMs.
4) Realistic goals on the certification and military ruggedisation inline with the production volumes

Expectations from DoT:

1) Facilitate a consultation to address the requirements for Strategic communications where the inputs provided by Indian OEMs are given due priority and consideration.

2) Provide funding through DCIS/TTDF for critical communication infrastructure for defence esp eciallly to address requirements such as over the air security, indigenously designed and developed VSAT terminals and Hubs, Military grade Smart sensors, cameras, Medical equipment etc.

Lead Implementor

SIGNALTRON has forwarded the Project and it is proposed that they can lead the Project as System Integrator. Director General, VoICE will provide full support for the Project and coordinate for ens uring that all stakeholders in the project can work as a team for the success of the project.

M Gmail   **RK Bhatnagar <rkbhatnagar.dg.voice@gmail.com>**

Fwd: 5G CNPN network- end to end solution.

25 January 2024 at 08:17

To: robert.ravi@gov.in
Cc: Deepak Pathak <dirsri1-dot@gov.in>, Suresh Kumar <dirsri2-dot@gov.in>, A Alex Vikas <alex.vikas17@gov.in>, Jitendra Bhoi <jitendra.bhoi@gov.in>, Deepa Maheshwari<deepa.maheshwari92@gov.in>, ddgic-dot@gov.in, "Mr. Anurag Vibhuti" <anurag@tcoe.in>, Neetu Singh <neetu@tcoe.in>, Gyanendra Singh Tcoe India <gyanendra@tcoe.in>,sarat sahoo <sarat@tcoe.in>, Pankaj Yadav <pankaj@tcoe.in>, ddgir-dot@nic.in, mosc-office@gov.in, Shri Ashwini Vaishnaw <moc-office@gov.in>, Neeraj Mittal <secy-dot@nic.in>
Bcc: Additional Secretary Telecom <ast-dot@gov.in>, ddgir-dot@nic.in, membert-dot@nic.in, memberf-dot@nic.in, jst-dot@gov.in, members-dot@nic.in, Administrator USOF DoT<usadmn.dot@nic.in>, srddg.tec@gov.in, Kishore Babu <kishore.ygsc@gov.in>

Dear Shri Robert Ravi ji,

Thanks for the DoT communication dated 15 January 2024 as below. The VoICE team has worked to ensure that we are in a position to submit 28Projects on CNPN Projects covering a very wide range of Projects covering almost all possible VERTICALs in a CONSORTIUM Mode. The CNPN End to EndProjects cover the following and each Project will have multiple VoICE members participating for its successful completion.

VOICE CNPN Projects covering 5G End to End Solutions

1. TETRA Substitution in METRO Networks

2. NWR Test Bed Project

3. Mobile Mesh Network with Network in Box

4. Power Grid

5. Mining 1

6. Mining 2

7. Rural ecosystem Enablement

8. Drone based Network Radio Frequency exposure

9. Enabling Innovation in IOT M2M

10. Enabling Smart Farming

11. Smart Refinery

12. Smart Villages

13. Ocean Floating Telecom Tower

14. Gram Panchayat

15. Captive Network for PSUs & Enterprises

16. Wireless Access Network & Network Manager

17. Oil & Gas

18. Multiple Vertical Use Cases through Niral 5G Core

19. Bank on Wheel

20. Major Dam & Irrigation

21. Coal Mines

22. Solution for Ports

23. Smart City

24. Solution for Railways and Mining

25. Lab Proposal

26. Model Village

27. Captive non-public Network with E-Band

28. Strategic & Disaster Management

These Projects can be shared with Potential Investors for which I understand that you are organizing a meeting on 30th January 2024.

I also understand that on 2nd February 2024, Hon'ble MOSC will have a one hour VC session with Communication Ministers of 10 ASEAN countries andDDG(IR) will be part meeting physically at the ASEAN meeting venue. Some of the Projects can be offered for ASEAN countries. India possibly canannounce support on setting up Digital Transformation Centres in ASEAN countries on the lines of 100 Test Labs and can be equipped as a TrainingCentre also. ASEAN Line of Credit revival can be another option. Addl. Secy. had chaired a meeting some time back on this issue in which MEA, EXIMBank, Finance Ministry also had participated. This was based on submission of a VoICE Note to the Government. As peer the decision, DoT was toorganise a Workshop meeting with ASEAN and G20 Ambassadors at Hotel Shangrila but eventually it could not take place as AST got promotion,previous Secretary retired, JS(T) got shifted to USA, Mr. Pathak retired and Kishore Babu went to ITU Regional office at Jakarta. The VoICE team wasready with the Presentations for the Ambassador's Workshop.

📄 **VOICE CNPN PROJECT 18 5G Multiple INDUSTRY ...**

📄 **VOICE CNPN PROJECT 18 5G Multiple INDUSTRY ...**

Further, I understand that on 29th and 30th January 2024, many countries will be part of Bharat Telecom event in Delhi and many of these 5G CNPNProjects could be useful for potential export options also.

VoICE had shared details for RIP and Replacement Program in USA and Europe with the Government and these were included during Hon'blePrime Minister's US visit and even during G20 event.

I am trying to consolidate all these Projects into a Booklet and should be ready for sharing on 29th January 2024. The VoICE team is acting as a supportto the Government on Hon'ble Prime Minister's vision of Indian Global leadership covering 5G, 6G and other new technology areas. VoICE team supportwill be available for Bharatnet Phase 3 Project also that will ensure delivery of latest technology developments to 6,40,000 villages.

As the time deadline was there from my side, some more Projects could not meet the deadline of submission.

VoICE has 100+ members who all would like to contribute for better communication infrastructure across the country. Two of the VoICE members hadensured that communication facilities at Ayodhya Ram temple including hundreds of 4G Security Cameras were providing support to the Temple trust andthat too partly on donation basis.

28 Word Files for these 28 CNPN 5G Projects are attached. I will come out with a Booklet covering all these by 29th January 2024 and share as printing153 Pages will be challenging. Booklet will include VoICE White Paper on CNPN Spectrum Issues based on Schedule 1 of the recent The Telecom act.

We are open to share any additional details or meetings as may be required.

With Regards.

Rakesh Kumar Bhatnagar, ITS 1975
Director General, VoICE
9350836103
rkbhatnagar.dg.voice@gmail.com

On Mon, 15 Jan 2024 at 16:52, Pankaj Yadav <pankaj@tcoe.in> wrote:
[Quoted text hidden]

---

27 attachments

📄 **VoICE CNPN Project 1 5G TETRA Substitution in METRO Networks.docx**
1432K

📄 **VoICE CNPN Project 2 5G NWR Test Bed Project.docx**
254K

📄 **VoICE CNPN Project 3 5G Mobile MESH Network with NIBs.docx**
533K

📄 **VoICE CNPN Project 4 5G Power Grid.docx**
30K

📄 **VoICE CNPN Project 5 5G Mining.docx**
29K

📄 **VoICE CNPN Project 6 5G Mining.docx**
32K

📄 **VoICE CNPN Project 7   5G Rural Ecosystem Enablement.docx**
39K

VoICE CNPN Project 8 5G Drone Based Network Radio Frequency Exposure.docx
206K

VoICE CNPN Project 9 5G Enabling Innovation in IoT M2M Connectivity.docx
288K

VoICE CNPN Project 10 5G Enabled Smart Farming Use Cases.docx
2099K

VoICE CNPN PROJECT 11 5G Smart Refinery.docx
1554K

VOICE CNPN PROJECT 12   5G Smart Villages.docx
1060K

VoICE CNPN Project 13   5G Ocean Floating Telecom Tower.docx
1482K

VoICE CNPN Project 14 5G Gram Panchayatt.docx
24K

VOICE CNPN Project 15 Captive Networks for PSU and Enterprises.docx
68K

VoICE CNPN PROJECT 16   5G Wireless Access Network & Network Manager.docx
1418K

VoICE CNPN PROJECT 17 5G Oil and Gas.docx
40K

VoICE CNPN PROJECT 19 5G BANK ON WHEELs.docx
579K

VoICE CNPN PROJECT 20 5G Major Dam and Irrigation.docx
1085K

VoICE CNPN Project 21 5G at Coal Mines.docx
26K

VoICE CNPN Project 22 5G Soluition for Ports.docx
46K

VoICE CNPN PROJECT 23 5G for Smart Cities.docx
797K

VoICE CNPN PROJECT 24 Resonous   5G Solutions Railways & Mining.docx
665K

VoICE CNPN Project 25 on 5G Lab Proposal.docx
141K

VoICE CNPN PROJECT 26   5G Model Village.docx
1020K

VoICE CNPN Project 27 5G Captive Non Public Network solution with E-Band.docx
264K

VoICE CNPN PROJECT 28 Strategic and Diaster Management.docx
787K

VOICE OF INDIAN COMMUNICATION TECHNOLOGY ENTERPRISES