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5G era for Digital Private Networks

Built -in 5G tech features for DPN evolution.

5G as a technology has evolved to be a revolutionary technology representing a Digital transformative approach in the world of hitherto known specialized telecommunication network solutions, distinct from the broad public networks. This is driven by the inherent features and functionalities of 5G network architectural standards like the following:

- **Availability of Wider RF Channel and large Quantum of Spectrum:** 5G Technology has the support in Mid and High Band spectrums thus having the availability of per channel bandwidths ranging from n*40 MHz to n*100 MHz to n*200 MHz to n*400 MHz , Such large chunks of RF channel widths and quantum of the spectrum would enable and drive the applications demanding higher BWs application like video surveillance, HD video content delivery, online interactive education, telemedicine, robotic surgery, Industrial Robotic application including Automatic Guided Vehicles and Drones all having bandwidth requirements ranging from 20 to 100Mbps and latency of the order of 2 to 5ms.
- **Softwarisation and Cloudification:** The 5G technology is inherently architected and evolved towards softwarisation and cloudification era of networking. Software defined networking is a result of softwarisation and virtualization of hitherto used and deployed physical telecom network elements. The traditional RAN has evolved and led to distributed functions in the RAN layer resulting in vRAN adoption, thus, BBU function of the RAN has become virtualized and softwarised as a stack and moved to the private cloud. Thus, the RAN has become an effective transmitter and a receiver with an Adaptive Antenna Unit (AAU) having more Air Interface efficiency w.r.t RF Tx power, Rx Sensitivity & Antenna gain.
- **Evolution of RAN Networks:** Private Network Architectural Revolution is taking place with Cloud driven RAN solutions like cRAN, vRAN, dRAN & oRAN. Digital transformation RAN is happening from the era of 2D-MIMO Passive Antenna Systems to Active Antennas Systems having the Radio Unit integrated with Antenna & 3D Beamforming supporting mMIMO Based Phased Arrays. There is significant enhancement in the Antenna technology with respect to radiation pattern from classical Omni/Sectoral pattern to 3D Beamforming Arrays which are highly directive and used to support multiple simultaneous users with enhanced capacity. Transition of passive antenna to active antenna has led towards a larger transceivers antenna counts in the order of 16TR, 32TR, 64TR… 256 TR.
- **Security:** Higher level of built-in security, privacy, encryption, and robust firewall protection with sophisticated intrusion detection systems.
- **Slicing:** The feature of slicing is envisioned and adapted in 5G network standard to enable private network to have dedicated network resources in every layer i.e. from RAN – Transmission – Core networks to suit the application and service needs with enforced policies of QoS and SLA.
- **Wider OEM Choice:** The flexibility of choosing the OEMs spanning across the RAN-Tx-Core segments of the network for deployment will have an added advantage in the Digital private network scenario where small and medium players can position their product portfolio fairly w.r.t the global leaders and provide the E2E solution for the same.

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Prerequisites for 5G Digital Private Networks

- Licensed spectrum in 5G band with minimum 40 to 100 MHz RF Channel.
- Available Optical fiber connectivity backhaul Network both of outdoor and indoor wireless deployments.
- Coverage area under scope for the specific DPN segments for enabling seamless wireless connectivity.
- Available and upgradable microwave backhaul links wherever fiber connectivity is not feasible.
- End user bandwidths requirements based on specific use cases of eMBB, mMTC and uRLLC.
- Total number of subscribers support on the DPN for Data and Voice connectivity.
- Any specific requirements for special services as required such as IIOT, C-V2X, MCS.

Drivers for 5G Digital Private Network Adoption

- **Exclusivity of Usage:** The very objective of a private network is to independently function without adhering to the policies of any sort of anchoring network and this will be successfully achieved by the Digital Private Networks using 5G and other complementary technologies around it which shall be deployed in an E2E standalone mode in a distinctive manner tailored to a particular segment/industry like the Oil & Gas, Electric Utility, Railway networks, Multi-Tenant Enterprise campuses or any other CUG networks, etc.
- **Controlled access for OAM:** The three aspects of Operation, Administration and Maintenance of the E2E DPN Infrastructure shall be tangible at all the points/nodes in the network and as well provide the access privileges to monitor the Access – Transmission – Core Networks independently for mitigating any sort of security breaches or data leaks adhering to the SLAs.
- **Dedicated purpose-built infrastructure:** The implementation of an E2E Digital Private Network involves positioning dedicated purpose-built infrastructure in RAN, Transmission, Core and Application Layers which shall be aimed at achieving value delivery potentials for propelling increased efficacy, optimal CAPEX investments, reduced OPEX workflows and overheads assuring performance benchmarking for the network.
- **Customized & Enhanced performance metrics, SLA, QoS and QoE:** The Key performance indicators of the 5G enhance the overall performance of the network by technologies like Slicing ,Policy Enforcement , Higher Order MIMO, Device to Device communication, with increased capacity of the data traffic, excellent data rates with consistency of confirming to Quality of Service by enabling ultra-low-latency, Ultra high reliability, high availability of robust connections and low power consumption.
- **Customized services and applications:** The introduction of 5G has been very crucial in realizing a digitally transformed wirelessly hyperconnected environment involving several IOT sensors, Automation, Drones, Robots, etc beyond just voice call and data services. The purpose built DPNs will be able to categorize and facilitate the required applications and services as per interested segments and thereby fulfil the SLAs with efficacy as never before.
- **Guaranteed availability of resources:** With the purpose-built infrastructure in place, the 5G DPNs shall be assuring the stakeholders, the availability of the resources always to improve service delivery seamlessly with improved MTBF metrics. Thus, the reliability of the 5G DPN network will justify the 99.99999% up time assurance.

- **Network attributes:** The below metrics shall constitute those attributes that define the performance of the 5G DPN networks in relation to various vantage points of the customer.
    - Size of the NW (No of nodes)
    - No of users/subscribers for data and voice
    - Support of varied applications based on varied bandwidth and latency requirements.
    - Support of varied user equipment & IOT devices
    - Traffic handling capability of the 5G Private Core
    - Optimal Coverage and Capacity dimensioning and build as you grow and expand as you grow.

Required Attributes for DPN Solution Provider - QuadGen Competency

Required Attributes	QuadGen Expertise
Exposure and Experience in Digital transformation initiatives in the era of Hyper-connected multi-services communication network	Designed and Architected Digital Private network for Electric Utility Network in USA, TFL Underground Railway Network, Multi-tenant smart campus networks, 5G Digital transformation network for PDO, Oman, Mission critical communication systems (MCCS) network proposal for Indian Army etc.
Domain Credentials in wireless , IP and optical networking segments considered essential to realize DPN architectures and Solutions.	Experience in managing and monitoring 50K 5G gNBs, 200K 4G eNBs, 20M Sq. Ft of IBS designs, 60+ Stadium designs, 30K SAR provisioning, 2K+ Routers provisioning, 10K+ GPON, Wi-Fi network with over 25k+ PoP locations, for US Tier 1 telcos, BSNL, Smart City network for G2C services, State Fiber Grid Networks of over 60K Kms of Fiber network deployment.
Product , Systems and Software knowledge in all related Technology, Operational, Industry Standard & Regulatory domains	A vendor agnostic technology & solution provider for all the Wireless, IP and optical networking segments with time tested partnerships for the same and introducing our own range of Product portfolio to serve all the DPN segments across RAN-TX-Core verticals of the network.
Trusted Partnerships with leading global OEMs from CT, OT, IT & ST Domains of Design & Engineer, Build & Deploy, Test & Integrate, Launch & Cut-over, Operate & Maintain, Migrate & Expand functions	Proven Credentials of having managed a regional Telecommunication network operations on MSP basis for RAN (Radio access network) of AT&T USA over a decade and having established global OEM support and partnerships with Cisco, CommScope, Nokia, Viettel, Dell, HP, Ciena etc.
Multi-Dimensional Certifications from the Safety, Security, Quality, Process & Project Management Verticals.	Adhering to the standards and having TL 9000, ISO 27001, ISO 14001, ISO 45001 certifications.
A Financially, Commercially & Operationally Stable company with a very Professional, Managerial and Leadership team.	QuadGen achieved cumulative revenue of US $ 190M in India till FY23 with a team of 600+ having competencies in 5G, IP-MPLS, optical network, 5G Core, Cloud data centres, Smart city and IOT networks.

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5G Digital Private Network Benefits

BENEFIT CATEGORY	DESCRIPTION	EXAMPLES ACROSS VERTICALS
COVERAGE	Broader range than Wi-Fi, excelling indoors and outdoors, and managing device handovers effectively.	1. Manufacturing plants covering extensive floor areas. 2. Hospitals encompassing large campuses. 3. Remote mining operations. 4. Campus Networks 5. Seaports 6. Airports
PERFORMANCE	Guaranteed quality service through controlled spectrum allocation and traffic prioritization.	1. Autonomous manufacturing facilities utilizing real-time M2M communication for synchronized operations. 2. Critical healthcare data transmission. 3. Logistics networks for real-time tracking. 4. Live event broadcasters require stable connections for streaming high-quality video
LATENCY AND CAPACITY	Predictable latency for real-time operations and ample capacity for numerous loT devices.	1. Precision machinery in manufacturing. 2. Smart grid management in energy and utilities. 3. Traffic management systems in smart cities. 4. High-frequency trading platforms
SECURITY AND PRIVACY	Default secure mode operation, with identification via eSIMs and encrypted traffic.	1. Proprietary design data in manufacturing. 2. Patient records in healthcare. 3. Secure communications in mining operations. 4. Law enforcement agencies need to maintain confidential communication channels during operations. 5. Research labs handling sensitive data, ensuring secure transfer and storage of proprietary research information.
RESILIENCY	Capability to switch to public cellular networks, ensuring operational continuity	1. Energy plants during network failures. 2. Hospitals in emergency situations. 3. Logistics operations during outages. 4. Emergency services during disasters.
PUBLIC-PRIVATE NETWORK MOBILITY	Seamless transition between private and public networks, enhancing user mobility	1. Transportation networks for vehicle tracking. 2. Agricultural equipment moving between fields. 3. Field activities in education and research.
TOTAL COST OF OWNERSHIP (TCO)	Potentially lower long-term costs due to fewer required radios and reduced operational expenses	1. Multi-facility manufacturing operations. 2. University campuses with extensive network needs. 3. Large-scale mining sites.
QUALITY OF SERVICE (QOS)	Ability to prioritize traffic, ensuring bandwidth for critical applications	1. Real-time process control in manufacturing. 2. Telemedicine applications in healthcare. 3. Critical communications in utilities management.