

# Private 5G Networks: **Driving the Next Wave of Digital Transformation**

## Unlocking the True Potential of Private 5G Deployment Across the Enterprise Segment

With extraordinary data speeds, unparalleled latency and augmented capacities, it may not be incorrect to say that the fifth-generation network technology is taking the world by a storm. While the battle for best speeds in public 5G networks is being played out through carrier TV advertising, private 5G networks are promising a whole new era of digital transformation across the enterprise segment.

This whitepaper attempts to present a brief overview of the emerging 5G applications, key challenges for enterprises to design and implement private 5G, and potential approaches to reduce the complexity of deploying different industrialized applications of private LTE/5G network.



## Private Network Background

According to a study by Polaris Market Research, the global private 5G network market is estimated to grow at a compounded annual growth rate ([CAGR](#)) of **40.9%**, and is projected to reach USD 13.92 billion by 2028. In the short timespan since its introduction in 2019, private 5G networks have enabled many industries to boost their connectivity, productivity, and operational flexibility by harnessing new-age technologies, such as Artificial Intelligence (AI) and Internet of Things (IoT).

Essentially, private 5G is like a Local Area Network (LAN) but instead of using Wi-Fi or Ethernet for server and device connections, 5G private network relies on a 5G capable spectrum to provide a dedicated bandwidth and infrastructure for the enterprise. Built with the dedicated micro towers and small cells of the enterprise, private 5G provides the simplicity of Wi-Fi, but delivers better reliability, speeds, mobility, and robustness in wireless technology. For the enterprise sector, private 5G also enables the creation of high-performing infrastructure for emerging technologies, including robotics, drones, sensor technology, heavy machinery automation, and many more.

Some of the other catalysts that have made the case for deploying private 5G networks for enterprises are:

- *Availability of Software Define Network (SDN) and open Commercial Off The Shelf (COTS) servers to run software:* These have reduced the need for specialized expensive hardware offered by very few incumbent network equipment providers.
- *Evolution of network virtualization and cloud-native platforms:* These can help drive improved economics and increased flexibility in the Core & Radio Access Network (RAN).

## Why Private Network Is a Key Driver for Digital Transformation

Regardless of sector or industry, efficient connectivity and real-time data-based decision making are some of the most critical requirements for driving digital transformation in businesses. To achieve this, organizations need feature-rich applications that work best with reliable networks, higher bandwidths, low latency, and multiple-access technologies. Hence it comes as no surprise that there is a rising trend of private network adoption across the enterprise sector. According to Global mobile Suppliers Association (GSA), [over 370 companies](#) globally have invested in private mobile networks with 5G deployments beginning to gain momentum.

Despite a number of complexities of independently managing in-house 5G networks, the benefits far outweigh the expenses. This includes dedicated bandwidth, homogenous coverage, network slicing, Quality of Service (QoS), ultra-low latency, enhanced privacy and security, and superior analytical insights. Moreover, private 5G networks offer the flexibility to customize the network as

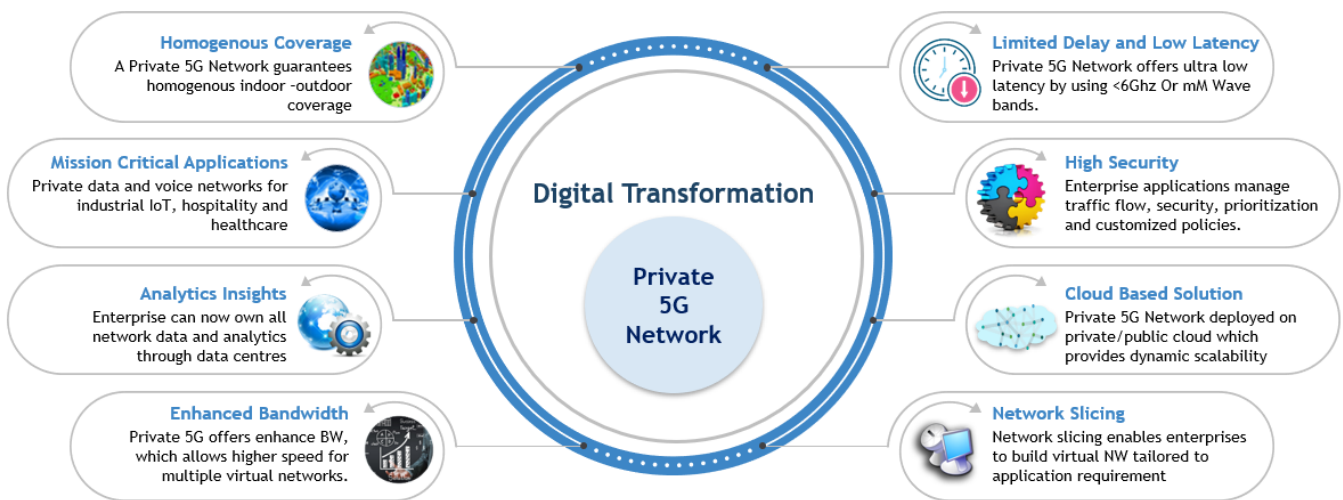
per enterprise requirements and access the control networks, such as applying configurations and features that public networks do not support. In fact, there is no doubt that private 5G network can be a cornerstone of digital transformation in the enterprise sector, including industrial, commercial and retail.

3GPP Release 16 has specifically released a number of technical specifications that will enable multiple industrial use cases for Private Network, which can be summarized briefly as:

- Power-saving features to improve battery life for massive Machine Type Communications
- Multi Input Multi Output (MIMO) improvements to enable more users and better link reliability
- Ultra reliable low latency communication network (URLLCN) for Improved reliability
- Integrating Integrated Access Backhaul (IAB) to eliminate the use of any wired backhaul
- Using Time Sensitive Networking (TSN) for timely delivery of data packets across the network
- Cellular vehicle to everything (C-V2X) enabling connections between cars and pedestrians

Interestingly, private network use cases are now being developed as per enterprise requirement. For example, in the manufacturing sector, private 5G network has the potential to transform current factory practices by embedding real-time data in machine learning models. With the use of artificial intelligence (AI), such enterprises can build smart warehouses, efficient production lines and smart workplaces, including real-time tracking of inventory, people movement, and workforce productivity.

## DIGITAL TRANSFORMATION THROUGH PRIVATE 5G NETWORK



There has been a lot of interest in “private networks” in recent times due to Industry 4.0 deployments and the “idea” of using mobile networks for “wire-free” integration of applications from factories, warehousing, logistics, autonomous machine deployments, materials processing, and so on. While 5G private networks have the potential to transform industries, there are some challenges that are hindering the adoption of private wireless networks.

## Factors Hindering Adoption of Private Wireless Networks

### 1. Design Complexities

The introduction of 5G with 3GPP compliance and ORAN solutions has provided a range of affordable infrastructure vendors. However, it has also led to added complexities in solution designing and establishing proof of concept for industrial use cases. No matter which type of spectrum is in play (licensed, shared or unlicensed), enterprises find it difficult and tedious to identify the perfect network deployment model that is scalable and cost-effective. It is also tough to find service providers, equipment vendors, and system integrators who can address the end-to-end requirements of private network deployment.

In the current scenario (Legacy Model), MNOs extend their coverage footprint to enterprises on request as per their business requirement. All resources involved are on a shared basis (public infrastructure), despite the primary use being for the benefit of the enterprise (e.g. extending coverage to mines or factory premise where public network is not available).

Enterprises looking to deploy a private LTE/5G network can choose from various models including a stand alone private network, a hybrid model or a cloud based model as per their cost strategy, spectrum availability, and security requirements.

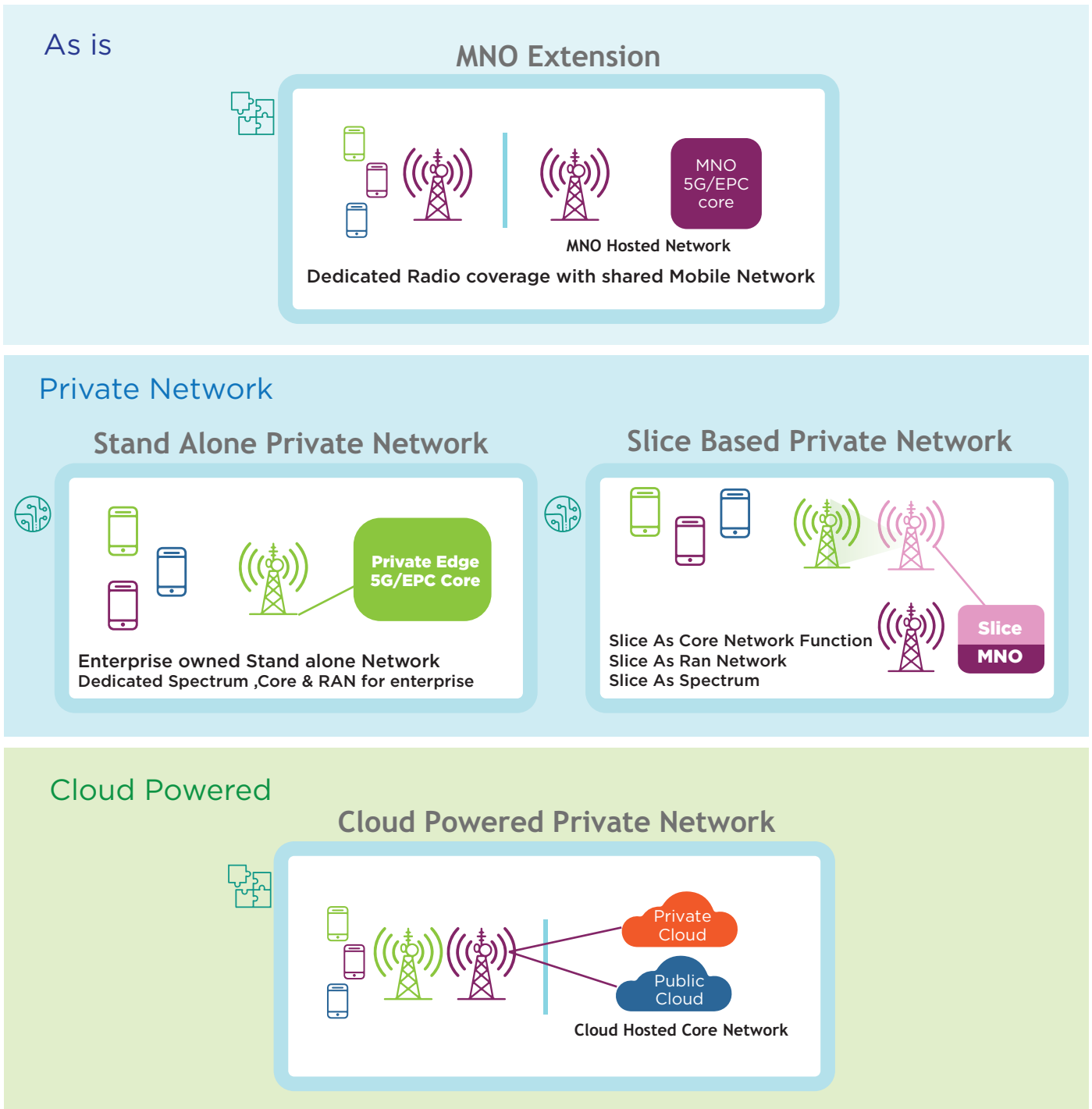
The stand alone private network involves an on-premises dedicated network where a dedicated network with the entire hardware and software stack is on their premises (radio access network and core). This can be purpose-built for the sole use of the enterprise and can deploy their resources on edges as per use case.

In the Hybrid Network Model, the network is based on a combination of public mobile network components and dedicated on-premise elements. Different components of the MNO network can be sliced and implemented in combination with the on-premise elements. For example, a slice of the public radio network may be combined with a dedicated on-premises core network. The Slice of network implemented can also be from different public network components. It could have multiple combinations of dedicated spectrum slices or RAN slice or Core slice from MNO based on the solution requirement.

The Cloud Based Network Model is the most recent and increasingly visible model where most of the network stack is in cloud. It can be self-built or can be readily available from Hyperscalers. Enterprises can deploy this in a plug and play mode thereby significantly reducing the deployment time.

Irrespective of the model chosen, SI integrators will play a large role in the ecosystem. They are also critical for implementing interoperability of different models where user devices from different models roam in between different networks as per business requirement.

Private Network Deployment Model



Plug & Play    
 Custom Set-Up    
 ■ Private Network    
 ■ MNO    
 ■ Public Cloud    
 ■ Private Cloud

Different 5G Use case requirements are different as per industry vertical and by enterprise size, and many businesses need bespoke solutions. It is difficult for Enterprises to understand and establish the right balance between cost and complexity to deploy the private 5G network solutions and find solution providers, system integrator and equipment vendor to address all requirement such as Developing scalable solutions to establish a solution which is viable as per cost model. It is important to engage the right advisor with expertise in telecom processes to help identify the right implementation model.

## 2 Complexity of Spectrum

Spectrum is one of the most crucial components of building a wireless network. Enabling a Private Network may require three technological pillars – mMTC, eMBB & uRLLC. These require significant wireless spectrum in the appropriate frequency bands to cater to different traffic requirement as per the application ecosystem.

- **mMTC:** Massive IoT type network generally uses low frequency bands to deliver good coverage at moderate data rates.
- **eMBB:** Known to deliver high throughput, they need significant spectrum range, at either sub-6GHz or millimetre-wave frequencies.
- **uRLLC:** Critical Network connectivity demands less interfered spectrum bands to achieve a highly synchronized network that can achieve end-to-end latencies of less than 5ms.

A 5G solution is expected to almost all the three requirements and the same can be catered through different spectrum slices to optimize the outcome and resources. This requires strong competency and understanding of different frequency behaviour to deliver the right outcome for the use cases and application at hand.

## 3. Lack of Skill Set for Establishing or Deploying Industrial Use Case

Private wireless networks bring in efficiencies that support push-to-talk, voice and video applications, as well as the remote monitoring and control of heavy equipment. However, industries such as transport and manufacturing who were the early adopters of private 5G networks are not exactly specialized in the wireless domain. They do not have the necessary skill set for designing, deploying or integrating the networks. In fact, it is almost impossible for any organization to have a multi-domain skill set from Telecom, Enterprise network, Cyber security and Cloud Infrastructure, and to understand the different deployment models and design networks on the basis of use case requirement. The

maintenance of such network also requires the multi skillset.

It is important to secure resources (either inhouse or externally) with multi-domain & multi-tech capability to be able to effectively deploy the industrial use cases optimally.

## 4. Multi RAN strategy

LTE and 5G are not answer to all use cases. They are suitable for broadband communications and provide the best solutions for mission critical and delay sensitive communications and applications. Enterprises may need a detailed study and analysis of the use case to decide which network strategy is the most cost-effective and reliable for deployment. While a multi-RAN can potentially lower the OPEX and CAPEX requirement, it would increase the network complexity significantly as there will be a combination of different telecommunication modules such as 3GPP and non-3GPP (O-RAN/LORA/Zigbee). This will require extensive understanding of telecom domain to implement and maintain.

## 5. Integration Challenge

Whether the decision is to create a private network and managing it (self or qualified third-party), or source the entire mobile provisioning as a service, both options come with their own set of challenges.

- Possessing and running own network inevitably requires some LTE/5G, spectrum and networking knowledge, and necessarily involve a CAPEX model.
- Sourcing as a service will allow an OPEX model and involve management of the agreed Key Performance Indicators (KPIs) and service level, but may not need intrinsic knowledge of mobile networks.

In either scenario, the enterprise gets involved with different partners and has to deal with different skill sets within one's own organization.

## 6. Cost-Effectiveness of the Private Network

A deciding factor in the deployment of private wireless networks is their cost. Industries have been looking for a cost-effective model that satisfies the use cases without breaking the bank. Enterprises usually do not have the capacity to invest in CAPEX like MNOs and often end up searching for low-cost solutions for their use cases. The availability of affordable networking equipment like small cells and Single Network Box Solution from network infra providers along with its integration within the existing or new IT infrastructure is a primary concern for deploying a private network.

### Recommendations

Whether it is traditional and specialist network equipment providers (NEPs), public cloud providers, or systems integrators and operators, everyone is building propositions for private LTE/5G networks. In fact, every provider is trying to overcome significant design, standardization and engineering challenges to deliver networks that are both reliable and can provide cost effective solutions.

The reality is that enterprises may have a broad choice of suppliers, yet it is difficult to find a single service provider delivering a holistic solution. Enterprises have also realized that such a fragmented ecosystem brings challenges, as well as opportunities to reduce the deployment and maintenance costs of private wireless networks. Which is why they could choose one out of these two options

- Go with incumbent network equipment providers who promise single box solutions. However, that could lead to dependence on a single vendor and the applications may be limited to their use case compatibility.
- Use multiple equipment vendors where the enterprises can bring their own use cases. This would eliminate dependency on a single vendor, while also allowing them to reduce the supply chain complexities.

In the second option, the enterprise will need to do most of the heavy lifting, which may not be a viable option in itself. It is recommended to secure the services of an experienced service provider with expertise in deploying the complete E2E ecosystem of a private 5G network for effective execution. This will help the enterprise in adopting a cost-effective model that is affordable, easy-to-deploy, and practical for business.



Tata Communications and Transformation Services (TCTS) offerings for private 5G

**Design, Plan, Build & Deploy**

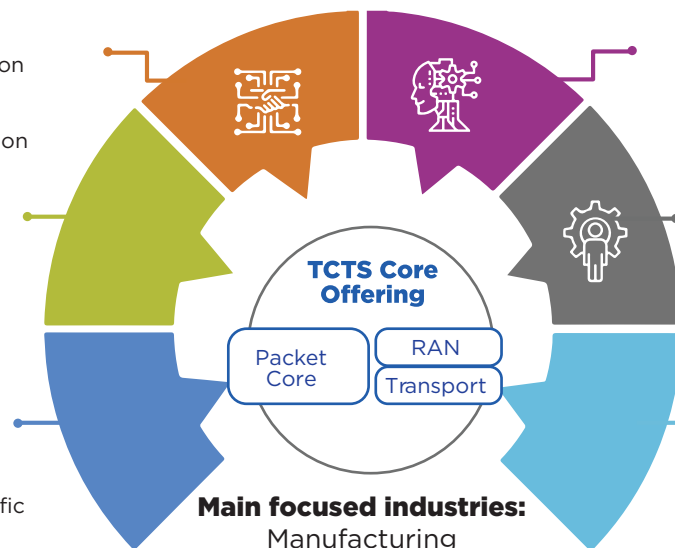
- Architecture Designing
- Specifications & Configuration
- Transport Design
- OSS/BSS Platform
- Deployment & Implementation

**Business Case Development**

- Use Case/Scenario
- ROI/Investment analysis (traditional vs Open)
- Monetization Strategies

**Integration & Testing**

- Design validation & policy deployment
- Configuration Setting & Traffic Loading
- Automation Testing



**Main focused industries:**  
 Manufacturing  
 Healthcare  
 Transportation  
 Energy  
 Neutral Host  
 Public Sector

**Mobile Private Network**

**Program Management**

- Supervise E2E Life cycle
- Multi-vendor Comms & Benchmark
- Production & Quality Control
- Operating Model

**Managed Services**

- Network / Service Operations
- RAN Network Optimization
- Maintenance / Fault Management
- Vendor/Partner Governance

**Next Gen Services**

- NFV / Cloud Infrastructure Creation
- Virtualization Platform Integration
- End to End Security Services
- IoT Service Development & Management

**Key Differentiators:**

- End to end - Complete lifecycle management
- Multi vendor – Multi tech skillsets
- Best-in-class frameworks & practices
- Digital Empowerment: Hyper automation, RPA, predictive and AI/ML,
- Ready-to-use platforms & tools and framework
- Flexible Engagement & Pricing Model



**DEMONSTRATED USE CASES | TCTS EXPERIENCE**

**1 Digital Twin**



**Digital Twin**

- AR running on HoloLens
- 3D Digital twin
- Live video streams
- Realtime AI

**2 3 AI Based - Realtime Video Analytics**



**Smart warehouse**

- Track people movement in real-time
- Count People in specific areas in real-time
- Monitor PPE Compliance in real-time
- Manage and Track inventory



**Smart Agriculture**

- Physical monitoring of the farm against damage
- Tracking and monitoring of animal movements
- Intrusion alerts
- Realtime analytics with AI

**4 Digitally Enabled Future- Connected Worker**



**Smart Workplace**

- Face Mask compliance
- Track people movement
- Count People in specific areas
- Monitor Worker Productivity

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## About Authors



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The CoE provides end to end network plan, design, deploy and manage services for all technologies including 5G, 4G, UMTS, GSM, IIoT, and WiFi 6 for telecommunications service providers.

Ashish is currently spearheading the wireless lab at TCTS which would enable end to end functionality testing and interoperability across all the network elements in a multi-vendor environment. He has experience working with telcos & enterprise customers playing a vital role in their digital transformation journey. He also has extensive experience in network planning, design and optimization extending to service engineering, service development & management.



### Prosenjeet Singh

Private Network Solution Architect at Tata Communications Transformation Services (TCTS)

He has over 13 years of experience in telecom around Network Operations, RF Planning & Optimization and Tool Support. He also has extensive experience in RF, RAN, MSS & BSS Profile along with Inbuilding, Small Cell Design & Optimization.



## About Tata Communications Transformation Services (TCTS)

Tata Communications Transformation Services (TCTS), a 100% subsidiary of Tata Communications Ltd, provides leading business transformation, managed network operations, network outsourcing and consultancy services to telecommunication companies around the world. TCTS delivers operational efficiency, cost transformation and revenue acceleration solutions for all the stages of the carrier process lifecycle including but not limited to network engineering and design, optimization, implementation, and operations. TCTS planned, designed, and deployed the world's largest LoRA WAN IoT (Internet of Things) network and is running successfully.

TCTS is a part of the Tata group which comprises of over 100 operating companies in seven business sectors. TCTS leverages the market expertise of Tata group's global telecom operation capabilities and globally established IT, process and consulting skills. It carries the rich traditions and business ethics of the Tata companies.

TCTS is headquartered in Mumbai, India with global offices in Europe, North America and the Middle East. TCTS offers a flexible delivery model and has two world-class India delivery centres in Pune and Chennai. These facilities operate entirely independent from its parent affiliate, preserving full confidentiality in managing all customers' business processes. For more details on TCTS and how we can help your company build, operate and transform, please contact us at [tcts.contactus@tatacommunications.com](mailto:tcts.contactus@tatacommunications.com) or visit [www.tatacommunications-ts.com](http://www.tatacommunications-ts.com) To hear more from TCTS experts, join us on LinkedIn and follow us on Twitter



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