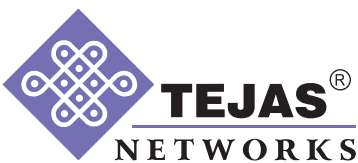


Ethernet Switching: Key to scalable smart city architecture



Efficient, reliable and secure implementation of Smart City applications

With the rise in urbanization, smart city applications have gained significant importance in today's world. A smart city is built on the foundation of high performance and reliable communication networks which also needs to satisfy the application wise service level requirements like high bandwidth, availability, low latency and security. This application note describes how Tejas Ethernet switch network is the best fit for smart city applications like video surveillance, municipal WiFi, Smart Parking, Smart Metering, and Smart Lighting.

White Paper

Introduction

In recent years, increasing number of smart city applications like smart lighting, smart transportation, smart meters, smart parking and municipal WiFi have been proposed for smart city development. UN has forecasted that with the continuing urbanization, around 68% of human population will be living in urban areas by 2050 thus adding an additional 2.5 billion people in cities. 90% of this increase will be taking place in Asia and Africa. This demographic shift and growing digitalization is resulting in the emergence of smart, connected cities across the world.

According to technopedia, "A smart city is a designation given to a city that incorporates information and communication technologies (ICT) to enhance the quality and performance of urban services such as energy, transportation and utilities in order to reduce resource consumption, wastage and overall costs".

A smart city collects information using sensors and citizen inputs, transfers information through reliable wired and wireless networks for processing and analyzes this data to enhance the live-ability, workability and sustainability. Figure - 1 shows the typical layers of a smart city. The concept of a smart city would not be possible without an efficient underlying infrastructure with features like secured, high-bandwidth and low-latency network. E-Governance layer formulates the policies and rules for the smart cities. Depending upon the infrastructure and policies formulated, various smart city services will be offered to stakeholders. Individual smart city application demands specific Service Level Agreements (SLA) which should be handled by the network infrastructure.

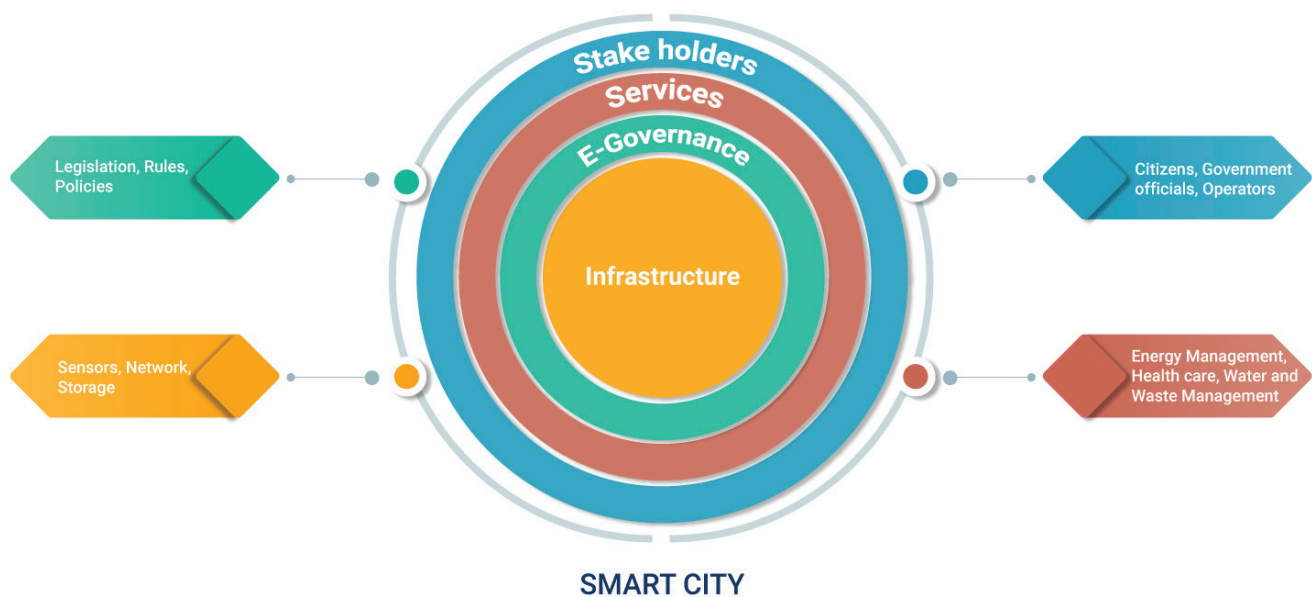


Figure 1 : Different layers of Smart City Network

Traditionally, individual city departments were functioning independently, sharing limited information with other departments. ICT technologies and infrastructure that are in place in departments only focuses on its own operation. This setup creates lot of chaos and delays the process in implementing or executing a service. Citizens face hardships where information from multiple departments is required. Similarly, in case of disaster, reaction time of departments where mutual communication and coordination is required gets much slower. Resource planning on the basis of real time data is not possible. This architecture focuses on sharing information not only across departments but also offer data services to other interested parties via open data model.

The purpose of a Smart City is to achieve efficient management of the entire city thus satisfying the needs of its citizens. At the same time, it must be aligned with the principles of sustainable development and taking technological innovation and cooperation between economic and social agents as the main drivers of change. Figure-2 shows the typical use cases of a smart city

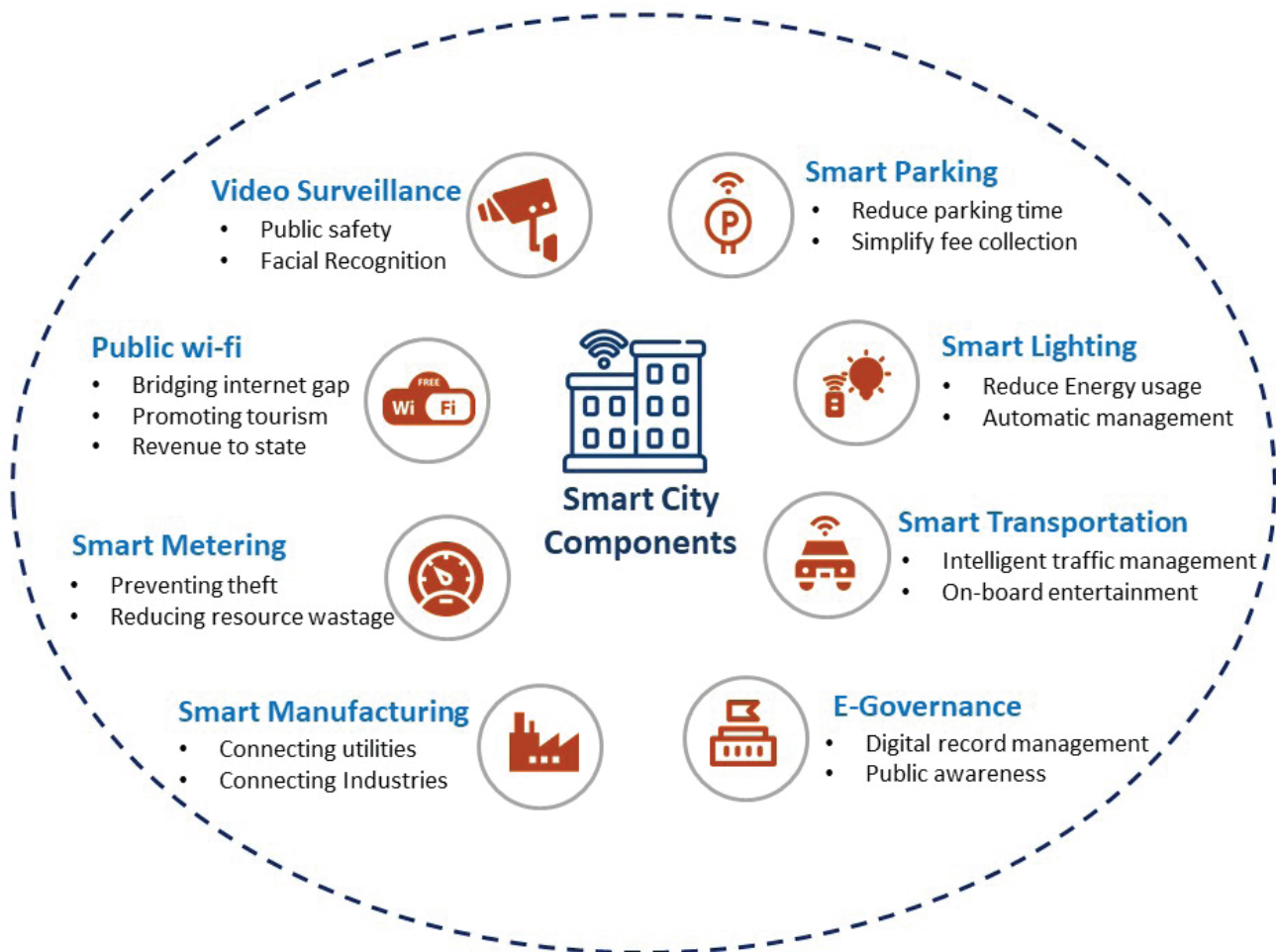


Figure 2 : Smart City use cases

Key drivers for a smart city network

Key features of a state-of-the-art network that can handle the connectivity requirements for all these applications are:-

- **Scalable:** The network should be flexible in terms of supporting dynamic bandwidth needs, number of end devices, multicast flows and number of applications. The network should be able to handle the performance and SLA requirements of different applications.
- **Intelligent:** The network can be configured with QoS (Quality of services) to prioritize different application traffic based on the requirements
- **Secure:** The network should have adequate security features to ensure protection against hackers and DDoS attacks.
- **Fault tolerant and resilient:** Critical systems cannot afford downtime and requires very high availability. Some applications carrying mission-critical traffic demands 99.999% availability without any single point of failure. These applications require sub 50ms protection switching to ensure that the five 9s availability is ensured.
- **Environmental Ruggedness and Low-power Operation:** The network elements should be able to work in extreme temperatures and environmental conditions (rains, moisture, heat, dust) in outdoor installations and also consume low-power.

- **Centralized Management:** Administrator should be able to manage the entire network remotely from a centralized management system.
- **Interoperability:** All products can be open standard based and should be interoperable with different vendor's products. Smart city architecture is characterized by heterogeneity of networks, applications, devices and platforms.

Tejas Ethernet switches in Smart City infrastructure

Network Architecture

The smart city applications connected to Managed Ethernet Switches will realize the seamless communication between devices. Tejas provides a wide range of Ethernet switches, which are an ideal fit for smart city networks. In smart city, massive amount of data generated across the city will make availability, scalability and efficiency a critical challenge.

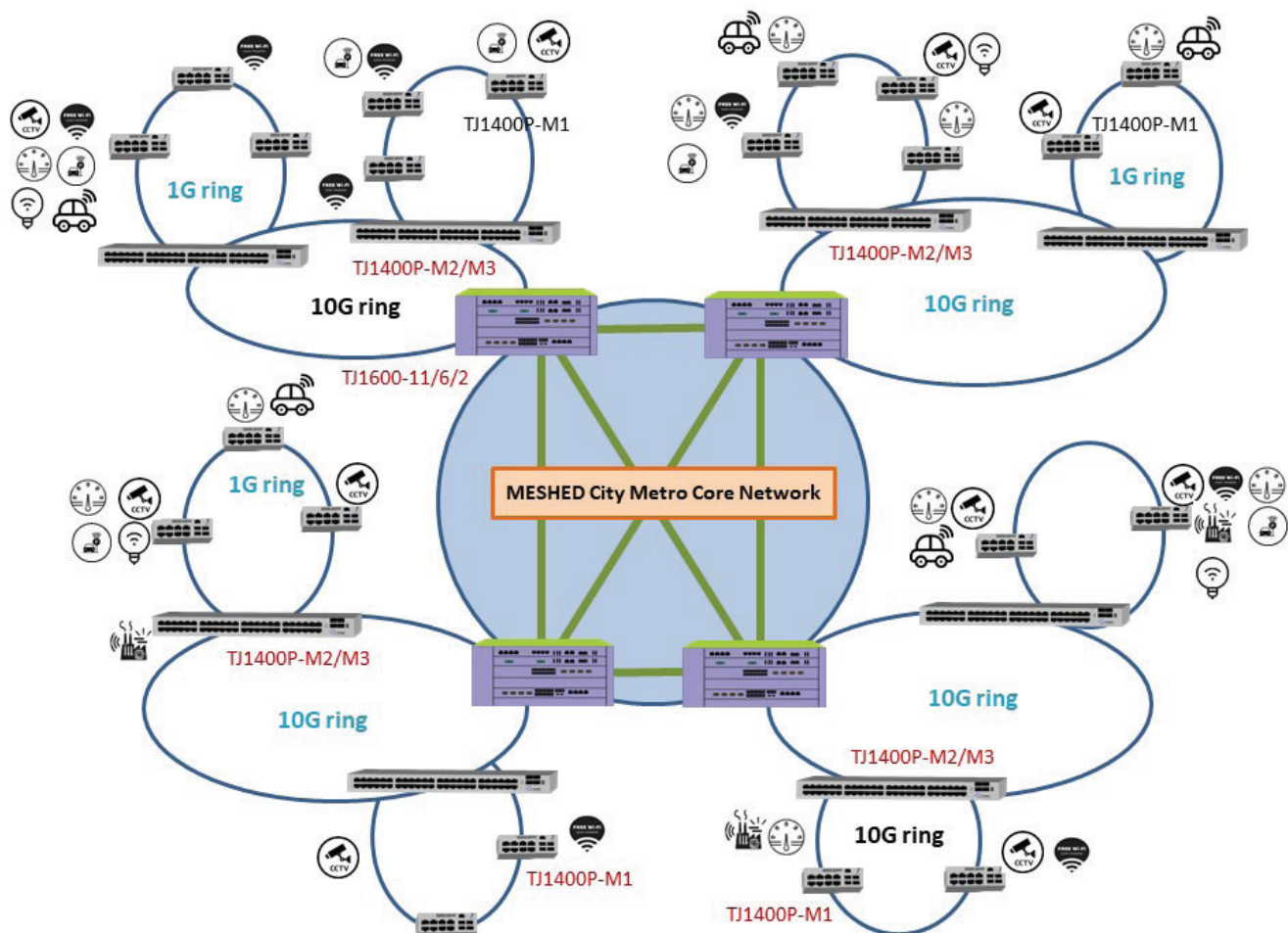


Figure 3 : Positioning of Tejas Ethernet switches in Smart City networks

Figure – 3 shows a typical smart city infrastructure using Tejas Ethernet switches. In this multi-layered network architecture, each layer backhauls traffic from the layer below it. TJ1400P-M1 switch is located at the street level (at smart / street poles). The traffic from multiple TJ1400P-M1 access switches is aggregated to TJ1400P-M2 aggregation/ TJ1400P-M3 stackable switch which in turn are aggregated to metro aggregation network. The entire series of Tejas switches can be centrally managed using Tejas NMS/ EMS management system.

Tejas switches have PoE+ capability and can act as the Power Source Equipment (PSE) to power end devices. TJ1400P-M1 industrial switch with features like ERPS, routing and DHCP server capability support secure deployment. It is a ruggedized switch which can operate in extreme environmental conditions. It also supports a comprehensive set of security features like authentication, authorization & accounting, DHCP snooping and Dynamic ARP inspection. TJ1400P-M2 aggregation and TJ1400P-M3 core switches have a wide coverage in terms of port-configurations, capacities, feature scalability and provide a rich palette for smart city network. The switches support line-rate, non-blocking architecture for predictable performance. TJ1400P-M3 supports two dedicated, 100G stacking ports, thus provide 400Gbps of stackable bandwidth.

Smart City high level architecture with applications

Figure - 4 shows a pictorial representation of Smart City Core Network. It also covers future extension of network for "Safe Cities" and includes environmental sensors, Smart lights and ITMS. In the diagram, DC/DR and CCC (command control centre) are shown as separate entity. Based on the final design, CCC and DC can be co-located and DR may go to cloud based on the requirements.

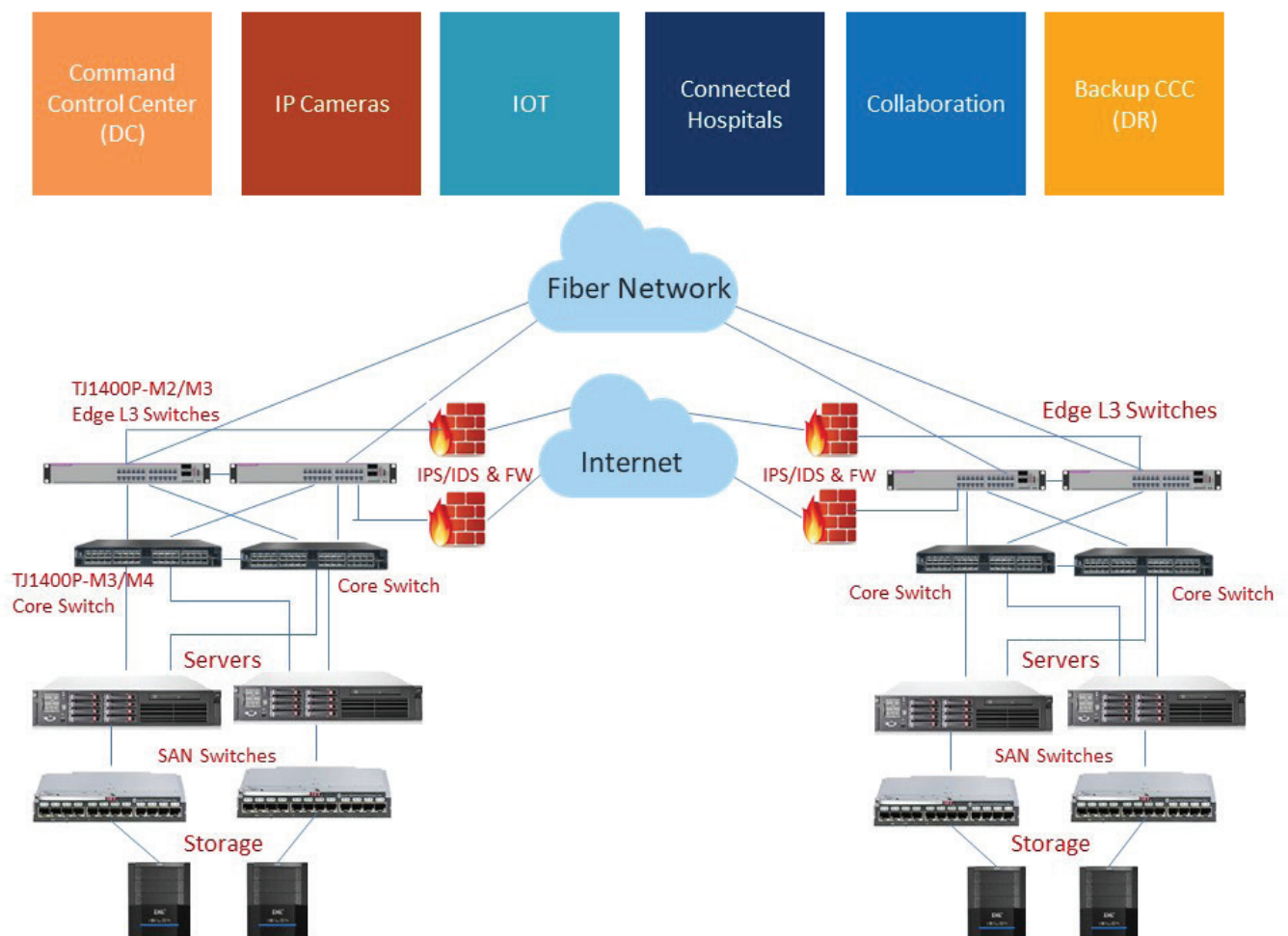


Figure 4 : Smart City core network architecture

Tejas products – Differentiators

Availability	<ul style="list-style-type: none"> Carrier Ethernet feature brings Ethernet OAM along with 50-ms ring protection (ERPS) Switches support dual power supply with AC/DC options
Multi tenancy support and end-to-end solution	<ul style="list-style-type: none"> Tejas can provide an end-to-end solution from access to metro to core With multi-layered architecture, same network can handle diverse set of applications and easily accept new applications and end-devices Interoperable with metro and core network equipment from other vendors Can segment the network based on the requirement.
Scalability & Reliability	<ul style="list-style-type: none"> Support for redundant, field replaceable, hot-swap power supplies and fan modules Support for line-rate, non-blocking switching for predictable performance IPv4 and IPv6 are supported at the data, control and management layers Plug-and-play capabilities for communications, collaboration, and engagement deployments, and advanced QoS capabilities
Security	<ul style="list-style-type: none"> DHCP snooping and ARP inspection features to prevent spoofing Features like Access-Control List, Storm-control and control plane protection AAA, Logging and Alarm management
Environmental Ruggedness and Low-power Operation	<ul style="list-style-type: none"> Deliver 15W / 30W / 60W of power to connected Powered Devices (PD). Schedule the powering of the connected devices based on requirement M1 switches are extremely rugged and can withstand extreme temperature and moisture (-40 degC to 75 degC) with tolerance to high vibration, shock, EMI/EMC, and surge
Centralized Management	<ul style="list-style-type: none"> Monitoring and visualizing your network with Tejas EMS suite Requiring little or no IT knowledge, EMS allows users to monitor alarms, bandwidth utilization, and availability GUI based FCAPS through EMS/NMS simplifies troubleshooting

Tejas Ethernet Switch product portfolio

Tejas Ethernet Switch products

Tejas TJ1400P Enterprise Switch series is a set of Layer 2/Carrier Ethernet/Layer3 switches designed to provide a wide range of capabilities to meet diverse deployment requirements. The comprehensive Layer 2 and Carrier Ethernet feature set and management capabilities provide excellent price/performance benefit. Tejas portfolio of Managed switches has a wide coverage in terms of port-configurations, capacities, feature scalability and provide a rich palette to realize your network vision.

	Industrial TJ1400P-M1	Commercial TJ1400P-M1	TJ1400P-M2	TJ1400P-M3	TJ1400P-M4
Surveillance	4/8 port POE+		Fiber Aggr	Fiber Aggr	
Retail WiFi/ Security		4/8 port PoE	24 port PoE		
Small Biz		All-in-One	All-in-One	All-in-One	
Medium Biz		24/48 PoE for Voice/Data/WiFi	24 port	Core Switch	
Enterprise		24/48 PoE for Voice/Data/WiFi	24 port	24/48 port	Data Center
e-Gov		8/24/48 port	24 port	24/48 port	Data Center
Metro Rail	4/8 port POE+	8/24/48 port	Fiber Aggr	IT, Fiber Aggregation	
Smart City	4/8 port POE+ (with GPON ONT)	8/24/48 port	Fiber Aggregation	24/48 port	Data Center

- TJ1400P-M1 portfolio of Layer2+ switches is suited for realizing an efficient access layer for enterprise, campus and industrial networks, support <50 ms convergence.
- TJ1400P M2 switches are enterprise-plus class L2/L3 Switches with Carrier Ethernet features specifically optimized for LAN applications and Metro Applications, support <50 ms convergence.
- TJ1400P M3 switching family is similar to M2 switching family but has advanced L3-features and stacking which make this a versatile product for the core of a network, support, 50 ms convergence.
- TJ1400P-M4 Series of switches are top-of-rack (ToR) switches specifically designed for Data Center and Cloud Deployments.

Tejas EMS for Switches

Tejas EMS for Switches is a state-of-the-art centralized management system offering FCAPS functionalities with capability of configuring EMS in HA mode. Few functionalities of Tejas EMS system are illustrated below.

- Network Topology View ensures the topology & connectivity to be shown in a graphical representation.
- Monitoring View enables user at NOC to have a holistic view of the network.
- Services View enables the services to be depicted in a graphical representation.
- Inventory View enables to keep a record of the network inventory

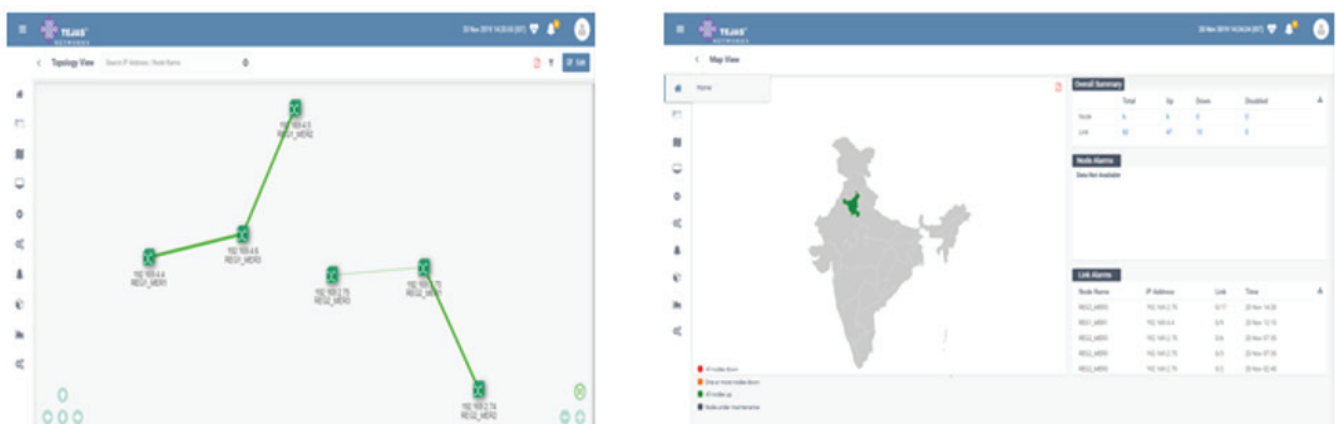


Figure 5 : Tejas EMS: Network topology and monitoring window view

Conclusion

As Network connectivity plays a major role enabling interoperable access and interconnection among various elements and applications in smart cities. Ethernet switches are a proven technology widely used for supporting diverse applications as in the case of smart cities. Tejas Networks provide a wide range of Layer 2 & Layer 3 managed switches which are well suited for building smart cities, strategic and nationwide networks. Tejas "state of the art" Management system ensures user friendly management from centralized location which helps in remote and user friendly management of entire network.



Software Enabled Transformation

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