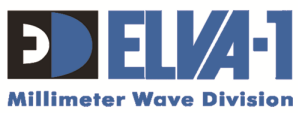


# 10 Gbps Wireless Urban-Scale Mesh Network

E-band mesh network on mm-wave links and EDGE routers



For 5G, Safe City and Smart City projects

Metro area  
10 to 100\* Gbps  
wireless backhaul

## BENEFITS OF E-BAND WIRELESS URBAN-SCALE MESH NETWORKS



### Business advantages

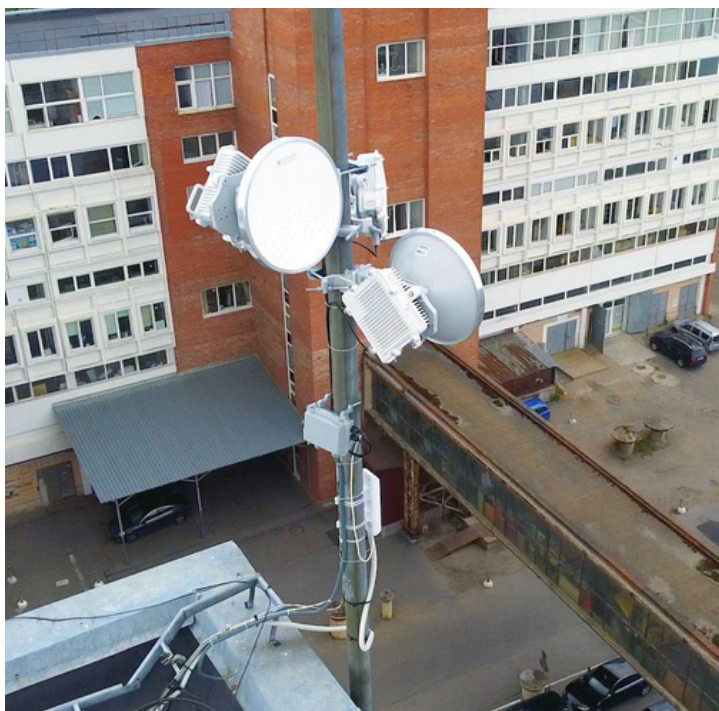
- The cost of wireless solutions is dropping, while the cost of fibre work is rising;
- 10 to 40 Gbps wireless solutions have reached optical line speeds and exceeded them in reliability, which means business stability for the network operator;
- Elimination of license costs (open-source software);
- The minimal configuration of each node ensures a lower cost of ownership.



### Technological advantages

- The reliability (availability) level of the network is up to 99.999%, corresponding to the carrier class.
- (\*) Total network capacity is determined by the number of alternate 10-40 Gbps wireless routes from one network node to another, reaching 100 Gbit/s and more.
- The decentralized wireless network is resistant to the failure of any elements in the network and has multiple alternative routes for traffic.
- Automatic linking of nodes is available along the best route with dynamic realignment.
- There is no need to reconfigure the network (servers) when adding new nodes.
- The addition of new nodes increases network throughput as new routes for traffic appear.
- Traffic is evenly distributed across the network, reducing the chance of a bottleneck effect.
- Redundancy (central nodes have connectivity in 3 directions, edge nodes have connectivity in 2 directions) provides network resilience to vandalism and bad weather conditions.
- Peer-to-peer node redundancy allows for higher recovery SLAs, as traffic will follow an alternate route.
- Implementation through multiple nodes, with no "administrative" central node, increases the security of the system as a whole; there is no single point of vulnerability in the network that can be attacked.
- If the server is shut down, the network will continue to run on the last configuration to rebuild routes.

## 10+ GBPS MESH NETWORK NODE IN 70-80 GHZ E-BAND



### Mesh network node

- Located on a roof or mast, consists of several 10 Gigabit radio links connected to a single EDGE router

### Public connectivity servers (routers)

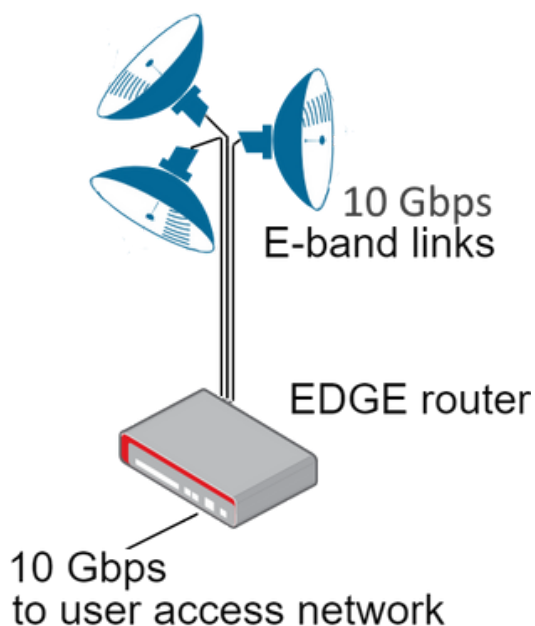
- Located in nodes connected by a fibre connection to a central node or ISP data center

### SDN network management servers

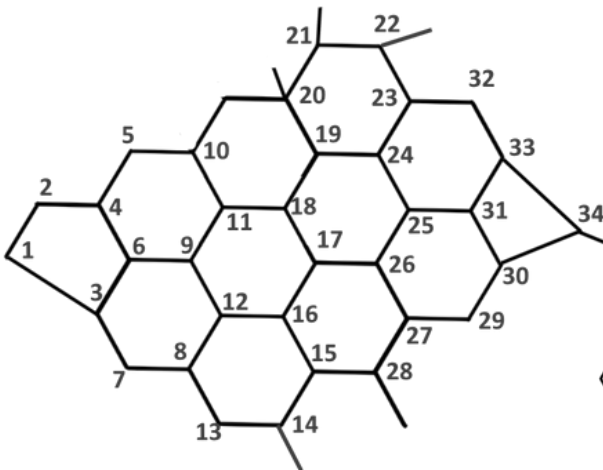
- Located in several nodes (in fact, the management server is one, but is duplicated in several nodes)

### Typical 10Gbit MESH network communication node:

- 10 Gbps (optionally 20-40 Gbps) radios for connectivity to 3x neighboring nodes
- EDGE router



## MESH NETWORK SERVICE CAPABILITIES



MESH network is a data transmission network consisting of peer nodes that have multiple connections to each other. Traffic is automatically distributed across the nodes of the network by algorithmically finding optimal routes.

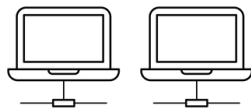
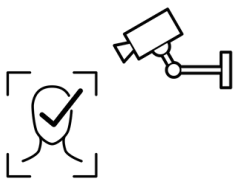
The principle of modern mesh networks is a new generation architecture, which takes into account all the shortcomings of classical data networks.



- The transmission speed in a conventional Wi-Fi or Wi-Gig network degrades when transmitting sequentially over several spans (hops).
- In the mm-wave solution, the **transmission speed is kept constant**, regardless of the number of hops used on the route.

An example of a project of mesh network:

- Metro area wireless 10-40 Gpbs backbone network (orange)
- Access network (yellow), shown in limited area



### Mesh network services

- Provide isolated services over the network
  - Access the public internet
  - Surveillance networks with face recognition
  - Dedicated local area networks
  - Smart devices networks and urban-scale IoT connectivity
- Manage traffic on your network by any rules
- Authorize users (devices), control access to the network via Web and API level applications
- Assign users rights to manage their virtual networks (e.g., police manage their own camera network)

## MESH NETWORK NODE / EDGE ROUTERS



Mesh network node routers (EDGE routers) are located in close proximity to radios and are used to manage routes, bandwidth, QoS, etc. Unlike classic network routers, they are less expensive, compact, cooler, and use less electricity.

EDGE router solutions are based on NXP platforms running open-source Linux software, enabling the required functionality at a lower installation and ownership cost than classic routers.

Service provisioning nodes are located in different parts of the MESH network for stability and even distribution of traffic. These nodes include internet traffic routers, data processing and storage servers (e.g., video data storage or smart city sensor data).

### Advantages of EDGE routers

- Support both dynamic routing protocols (ISIS, OSPF, BGP) and MESH routing (BATMAN)
- Compact size and passive cooling
- Ability to be placed in cabinets directly next to the antennas
- Support of all NMS (Network Management System), both classic (Zabbix) and specialized (Telegraf+Grafana)
- The openness of Linux allows you to develop your own APIs, systems and control protocols.

### Linux-based firmware

Linux-based software firmware enables rich functionality:

- Support for dynamic routing protocols (ISIS, OSPF, BGP protocols) and MESH routing (BATMAN protocol);
- Support for all NMS (Network Management System), both classic (Zabbix), and specialized (Telegraf+rafana) systems of remote control and monitoring;
- The openness of Linux allows to develop own APIs, systems and control protocols

### List of E-band wireless mesh advantages over Wi-Fi and Wi-Gig networks

- PPC-10G-E 70-80 GHz equipment is full-duplex, so each link is capable of transmitting up to 10 Gbps (20 or 40 Gbps with 2+0 models) in both directions. Wi-Fi or Wi-Gig technologies are half-duplex, which means the capacity of such a channel will be distributed between uplink and downlink directions.
- The mesh backbone network is capable of working with Sync-E synchronization protocols and PTP 1588v2 timing protocols, the presence of which is a mandatory requirement for carrier-grade equipment. Wi-Fi and Wi-Gig technologies are not adapted for such services due to the half-duplex channel.
- The total packet propagation delay over several hops of the backbone network created with this equipment will be significantly lower than over a similar number of Wi-Fi or Wi-Gig hops. This is due to two reasons: the full-duplex nature of mm-wave links and the high transmission speed on each link.



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