Transforming NRD's Transmission Network for Future Broadband and Broadcasting Services

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MBT ASSOCIATION CONFERENCE
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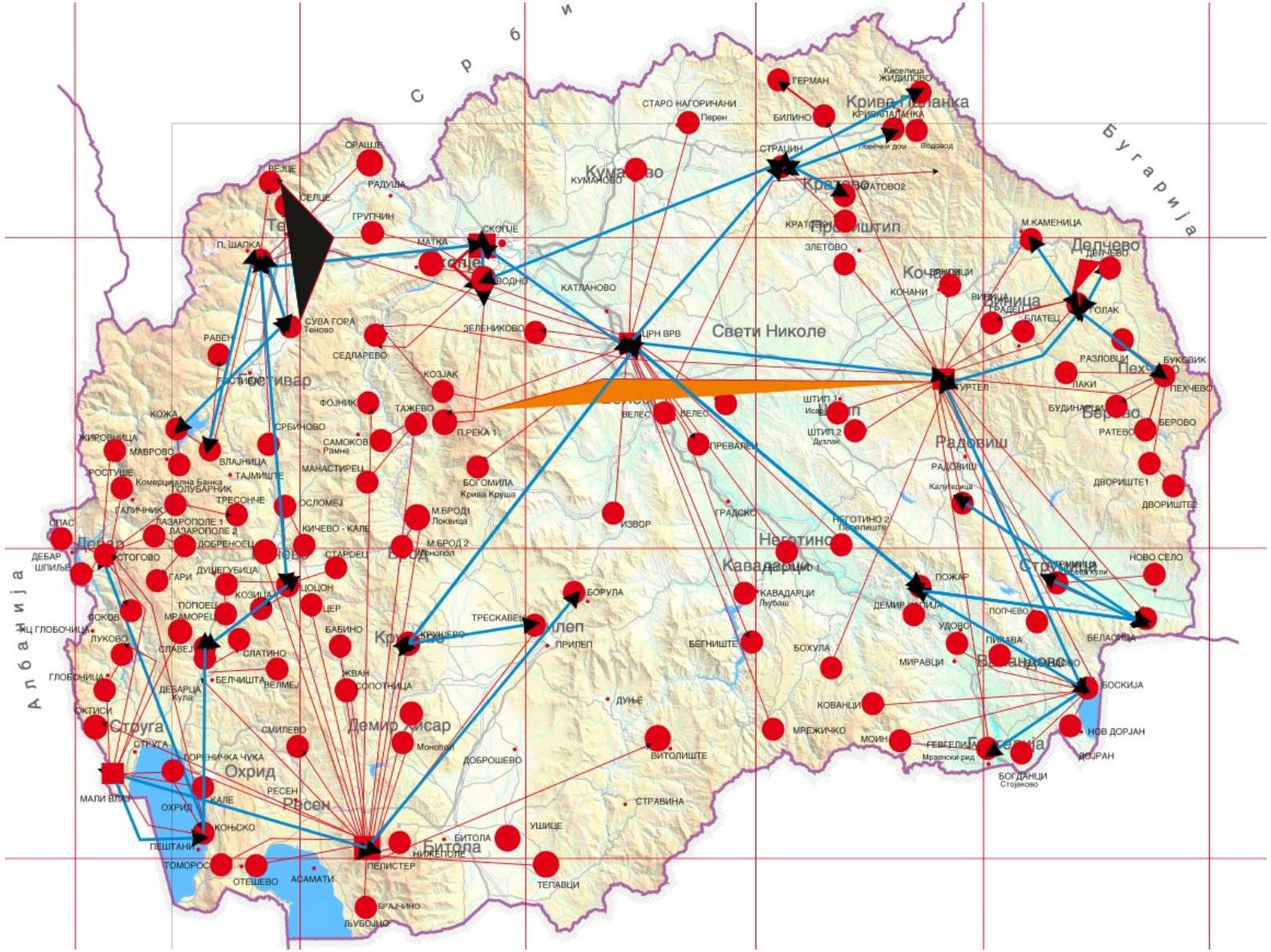
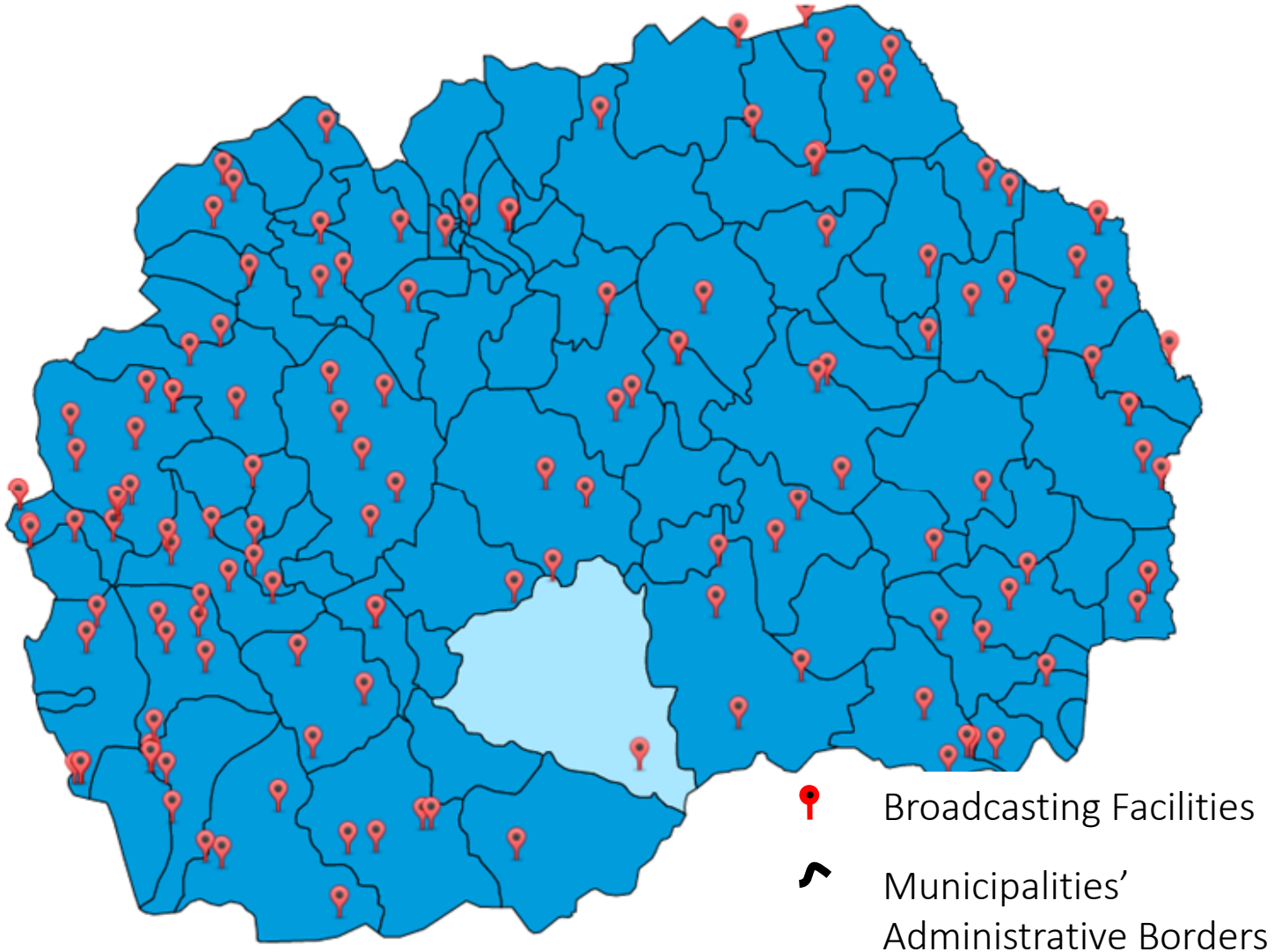
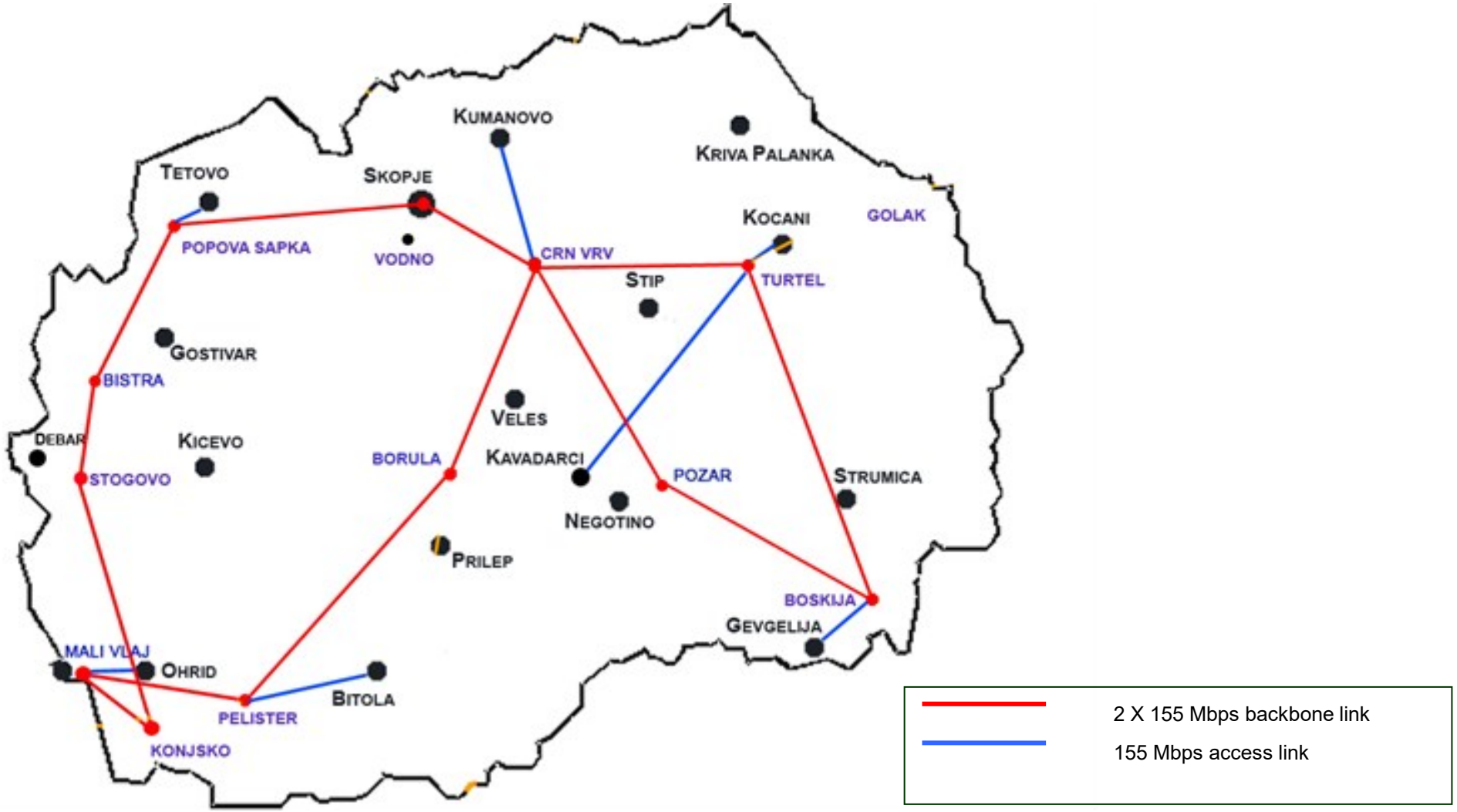
NRD’s Broadcasting Facilities



NRD’s Broadcasting Facilities

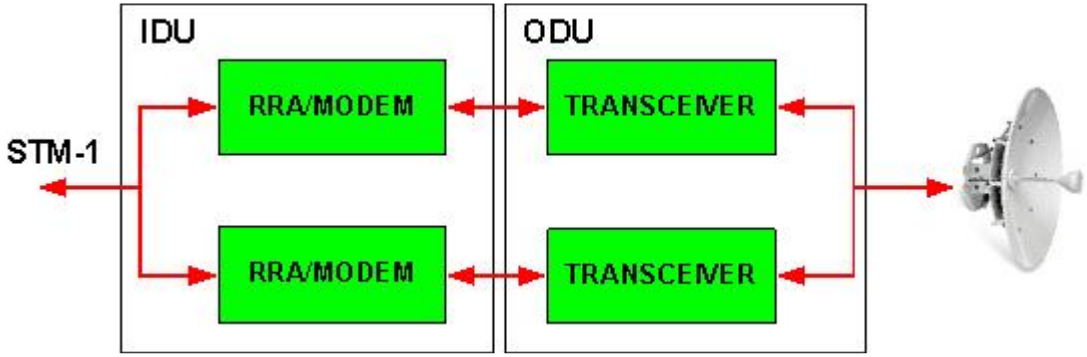


Topology of NRD's microwave communication network

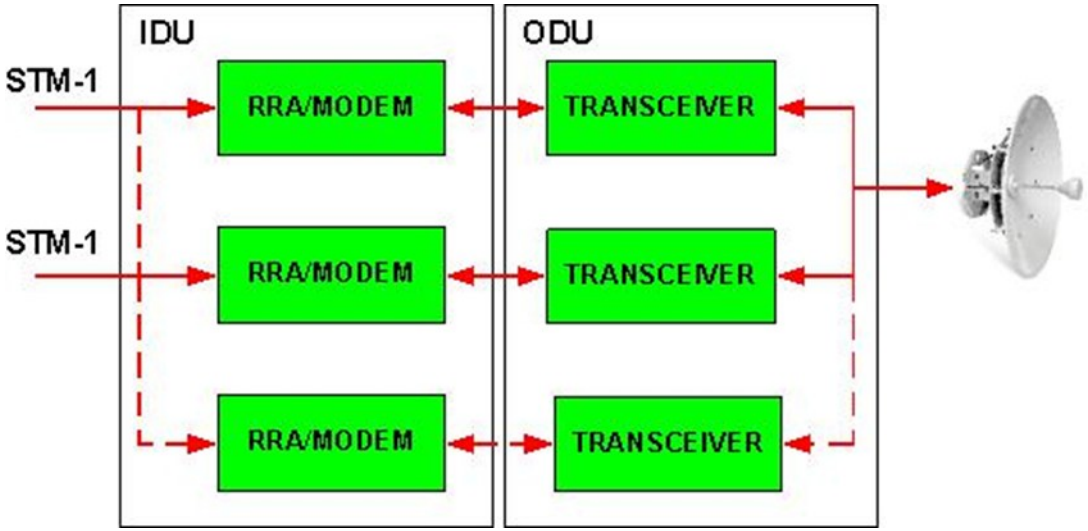


Equipment configuration for microwave links

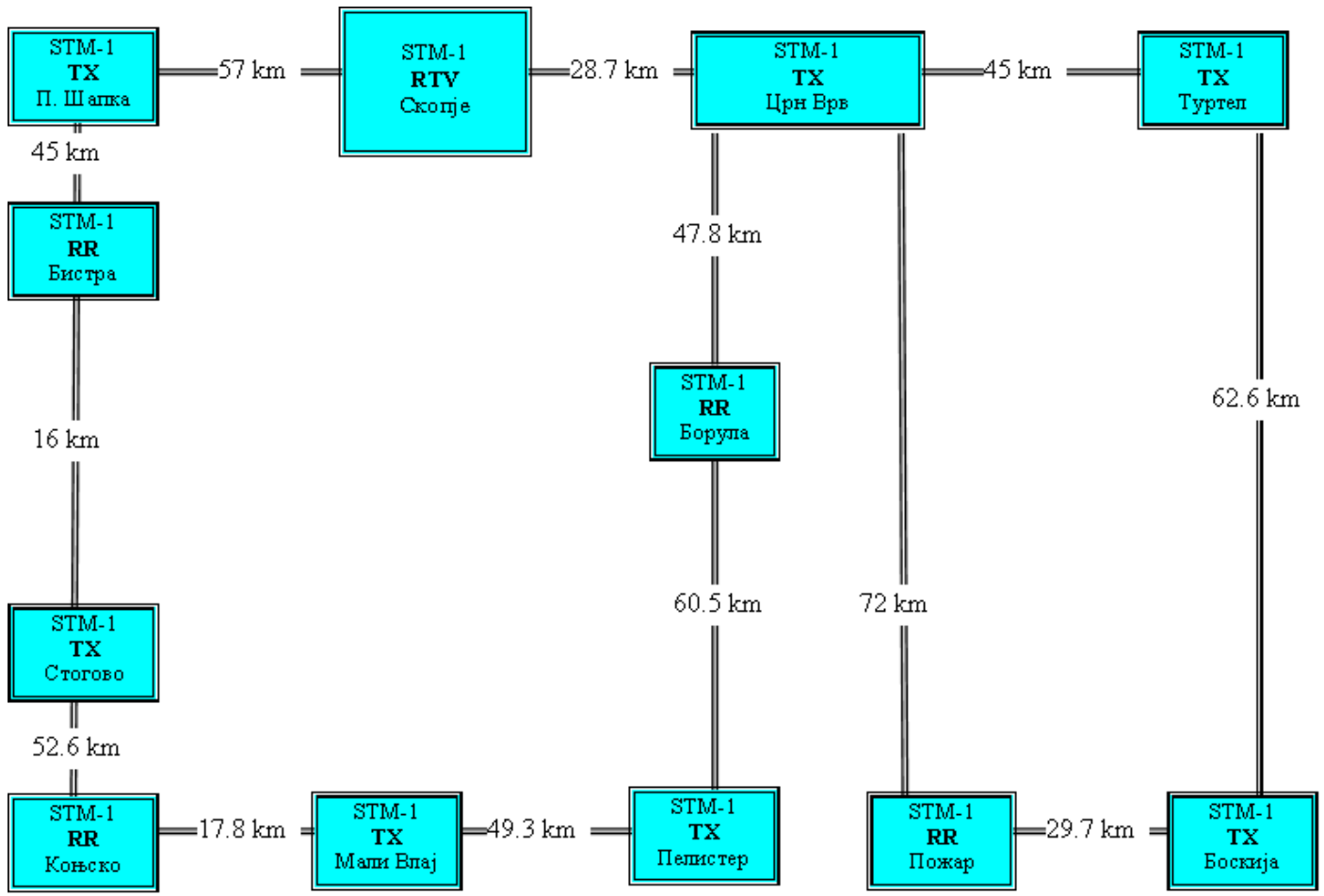
1+1 radio equipment configuration



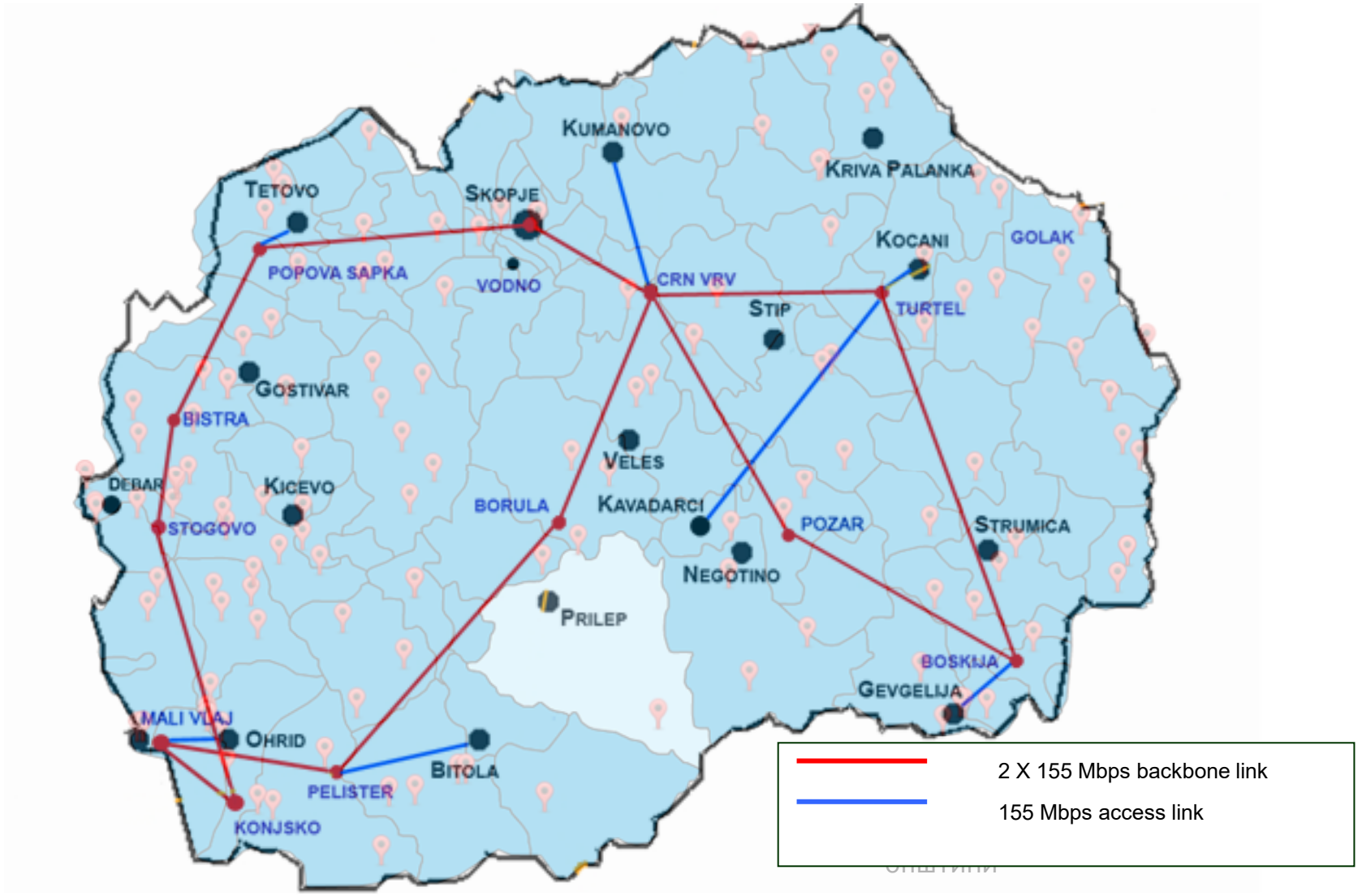
2+1 radio equipment configuration



Logical topology of NRD’s backbone network



NRD's Broadcasting Facilities



Capacity and number of TV streams for DVB-T and DVB-T2 with 8 MHz RF channel

Multiplex capacity for 8 MHz radio channel

Standard	Modulation	Capacity
DVB-T	64QAM 8k 2/3	~24 Mbps
DVB-T	64QAM 8k 3/4	~27 Mbps
DVB-T2	256QAM 32k 2/3	~40 Mbps
DVB-T2	256QAM 32k 3/4	~45–50 Mbps

TV Channel bitrate

Resolution	MPEG-2	H.264/AVC	H.265/HEVC
SD (576i)	3–5 Mbps	1.5–3 Mbps	0.8–1.5 Mbps
HD (720p/1080i)	8–15 Mbps	4–8 Mbps	2–4 Mbps
Full HD (1080p)	X	8–12 Mbps	4–8 Mbps

Number of TV streams in 8 MHz channel

Standard	Number of TV streams
DVB-T (MPEG-2)	4-8 SD streams
DVB-T (H.264)	8–10 SD or 3–4 HD
DVB-T2 (H.264)	6–8 HD or 4-6 FHD
DVB-T2 (HEVC)	8–15 HD or 6–10 FHD

National Broadband Targets

- By the end of **2023**, at **least one city** should be covered with a **5G signal**.
- By the end of **2025**, the **main transport corridors** should be covered with **continuous 5G signal**.
- By the end of **2027**, **all cities** in the country should be covered with **continuous 5G signal**.
- By the end of **2029**, **everyone** should have the possibility to access the **internet via 5G** with a **minimum** access speed of at least **100 Mbps**.
- By the end of **2029**, **at least 50%** of the total number of **household subscription** contracts across the country should have **internet access with speeds of at least 100 Mbps**.
- By the end of **2029**, **all households should have access, at an affordable price**, to a network that enables **download speeds of at least 100 Mbps**, with the possibility of upgrading to gigabit speeds.
- By the end of **2029**, **all public institutions** (schools, universities, research centers and other educational institutions, healthcare institutions, ministries, courts, local self-governments, and other state bodies and authorities) should have **symmetrical internet access with speeds of at least 1 Gbps**.

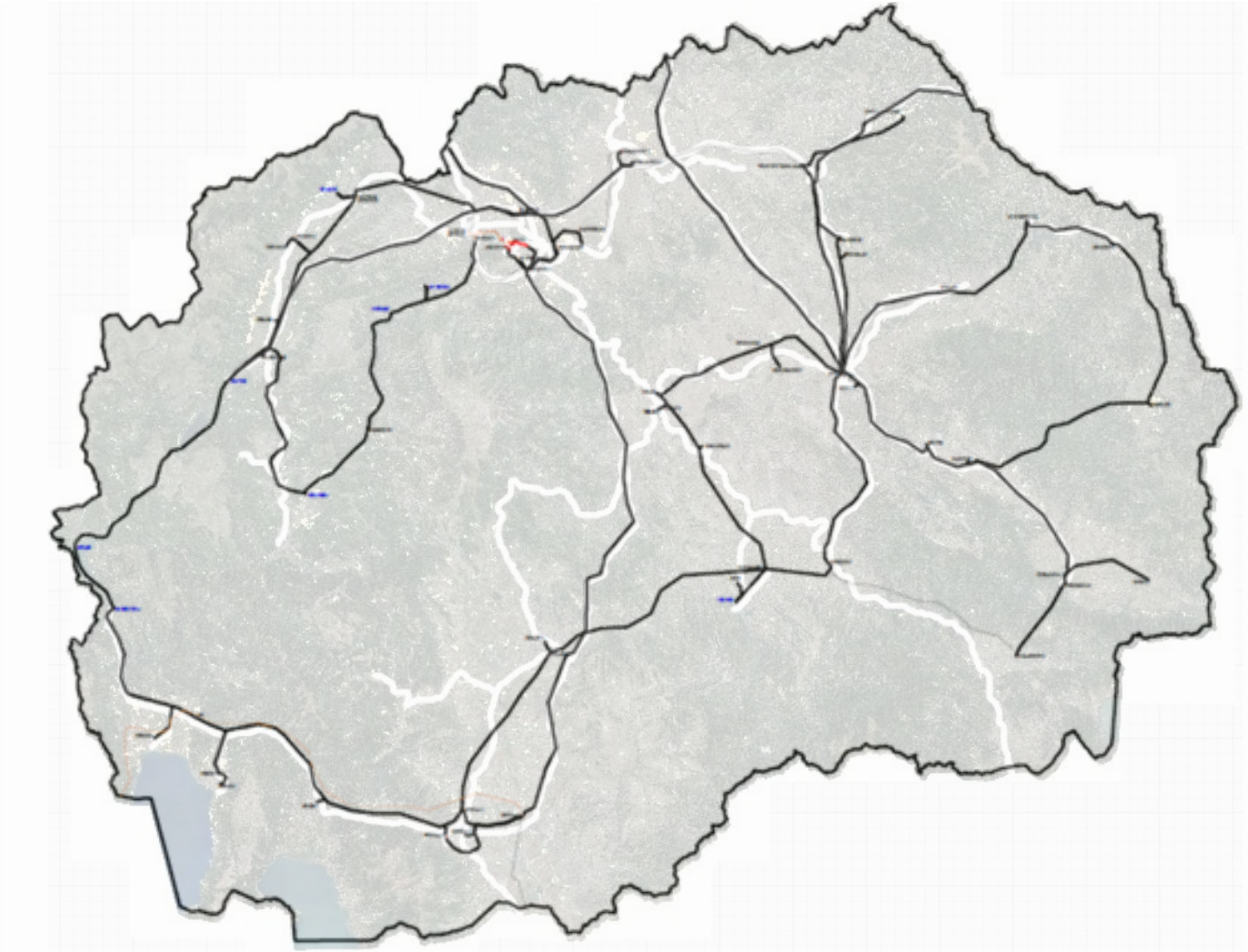
NRD & National Broadband Plan

from **National Operational Broadband Plan**:

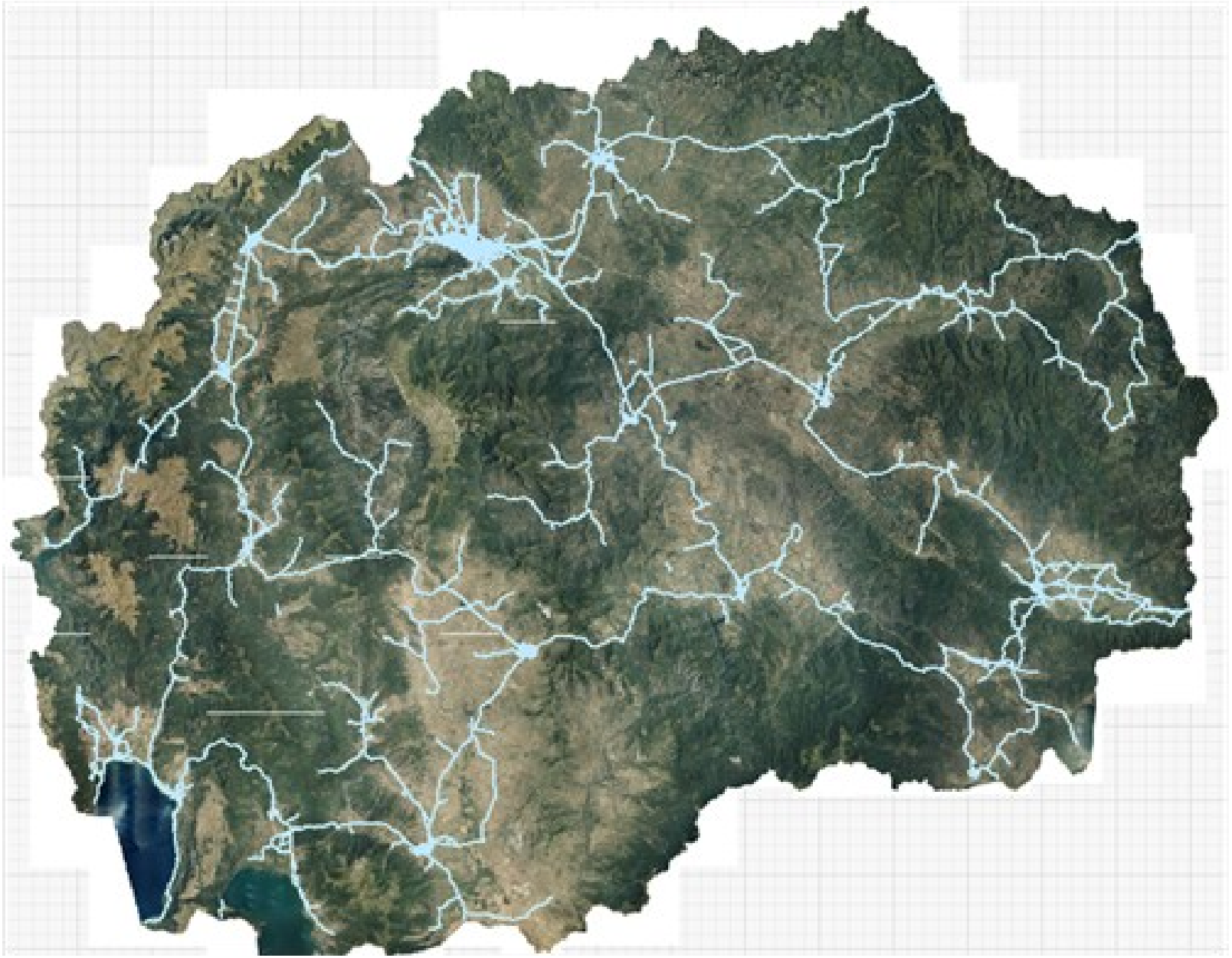
"... a **public body that will be responsible for the implementation** of the state aid scheme, i.e. that **will build and manage broadband infrastructure which will subsequently be made available to operators** under non-discriminatory and transparent conditions, in accordance with this National Operational Broadband Plan (NOBP), **shall be the PE Macedonian Broadcasting (PE MB - NRD)**, whose competences are defined by the Law on the Establishment of the PE Macedonian Broadcasting. The decision to designate PE MB is based on the following:

- the financial resources required from the State Budget for the expansion/transformation of the competences of PE MB are lower compared to the establishment of an entirely new institution;
- the existing experience of PE MB in the field of telecommunications (especially wireless technology), in the maintenance of telecommunications facilities/infrastructure, and its familiarity with the terrain throughout the country;
- the short deadlines established under the national broadband targets;
- the existing human, technical, and spatial capacities, etc."

Existing optical network built with public funds by Public Companies (Railways, MEPSO)

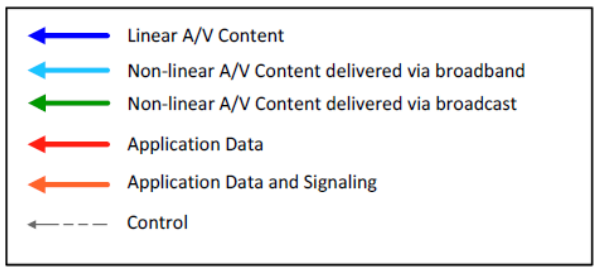


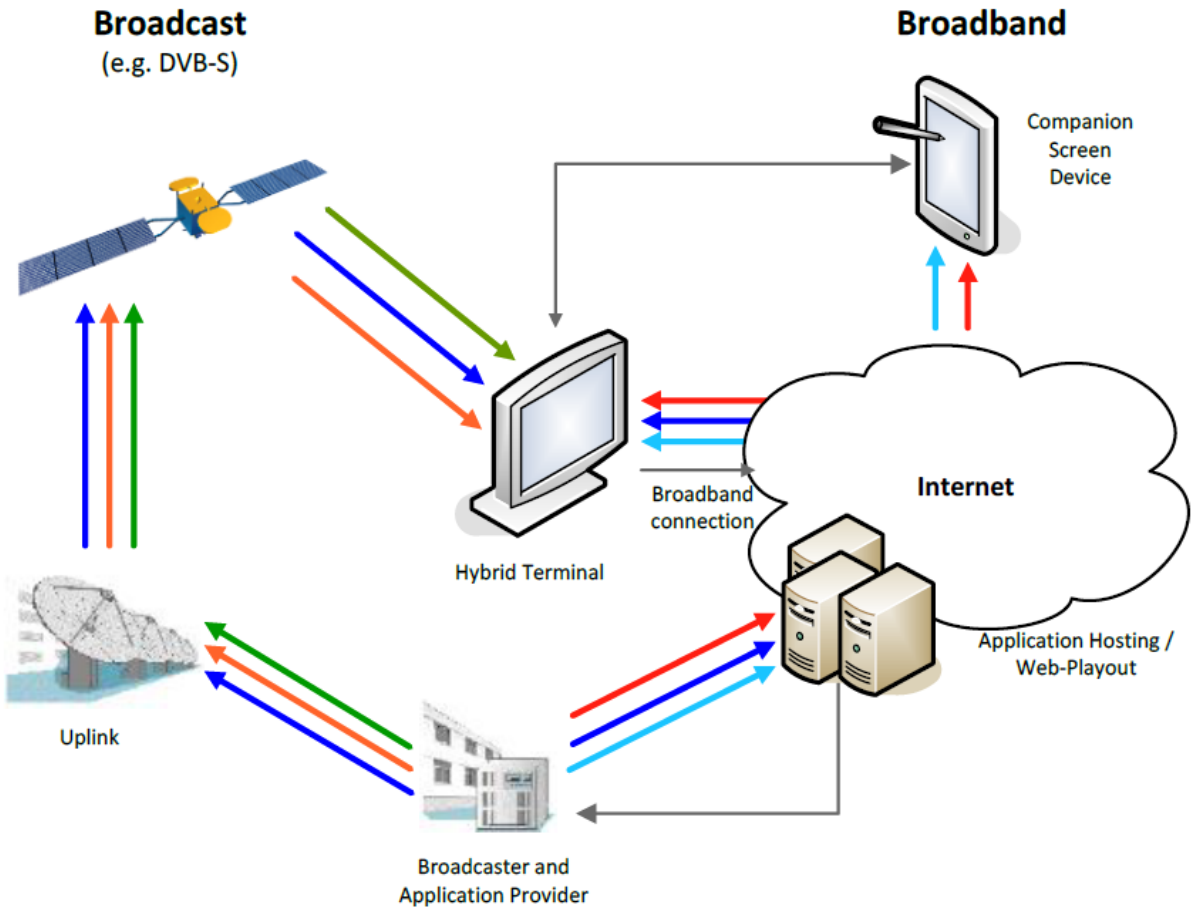
Optical infrastructure of private telecom providers



New trends in DVB/DAB+

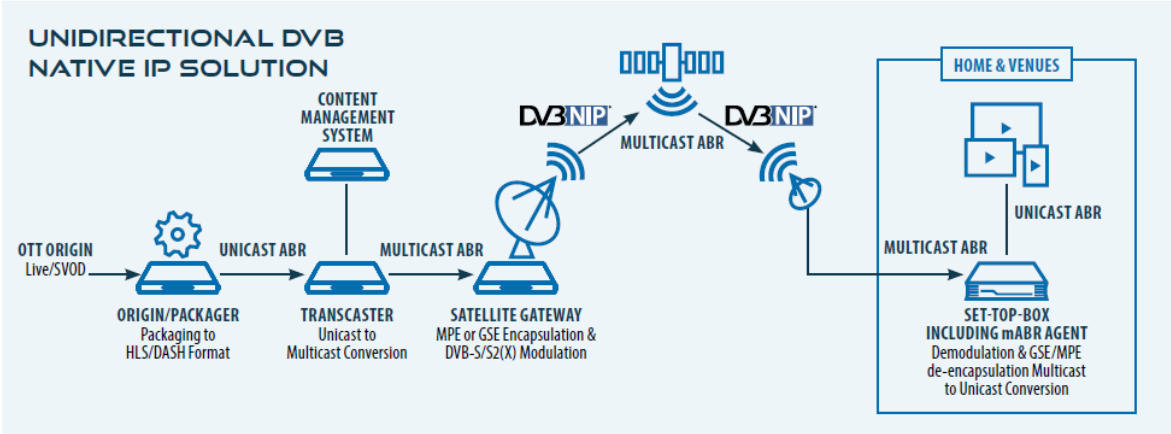
- **Hybrid TV (HbbTV – Broadcast + Internet)**
  - Combines DVB-T2 broadcast + broadband internet
  - Enables:
    - *Catch-up TV*
    - *Video-on-Demand (VoD)*
    - *Interactive apps*
    - *Targeted advertising*
- **UHDTV and HDR broadcasting**

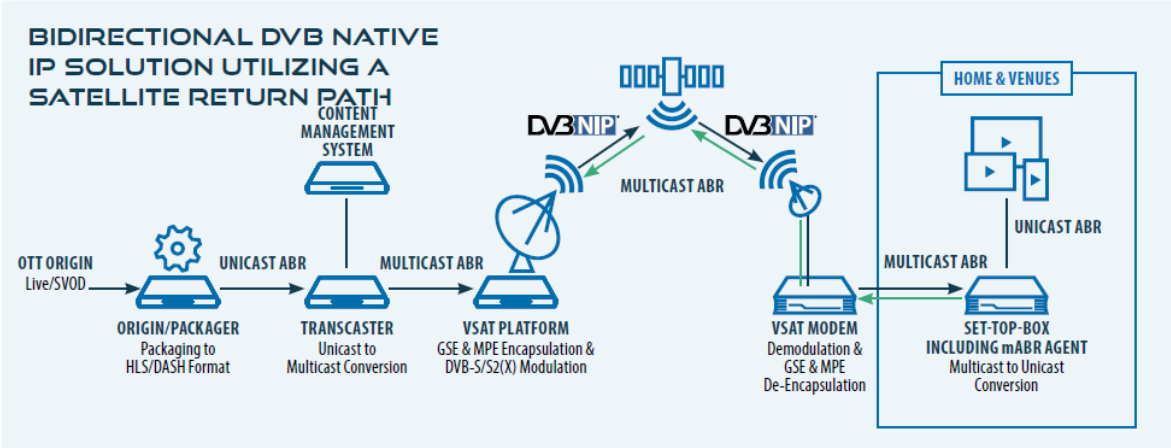




New trends in DVB/DAB+

- **IP-based broadcasting (DVB-I, DVB-NIP)**
  - DVB-I = TV delivered over the internet but using DVB service model
  - DVB-NIP = native IP broadcast over RF
  - Makes TV:
    - *Device-independent (TV, phone, tablet)*
    - *On-demand + live unified service*
- **Mobile TV (DVB-T2 Lite)**
- **Integration with 5G Broadcast**
- **AI-driven and adaptive networks**
- **Personalized services and advertising**
- **Public safety**





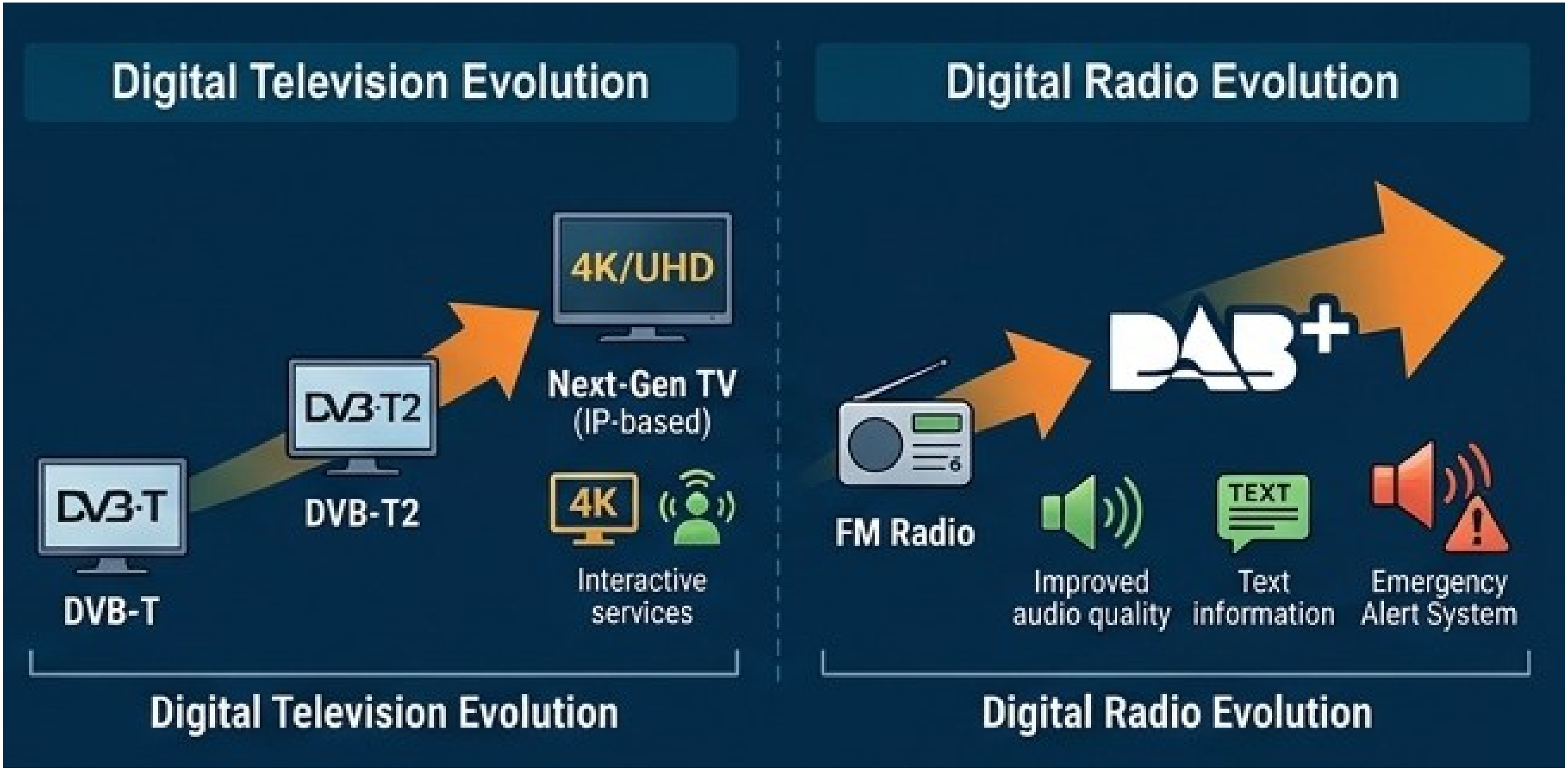
New trends in DVB/DAB+

- The Rise of 5G Broadcast
  - **Native IP-based broadcasting** directly to mobile devices (smartphones, automotive)
  - **Completely independent of mobile operators**—no SIM card or cellular subscription
  - **Utilizes existing HPHT (High-Power High-Tower) infrastructure** for massive population coverage.
- HbbTV & The Hybrid Ecosystem
  - Seamless **blending of linear** DTT (Terrestrial) and interactive Broadband (Internet)
  - Enables **catch-up TV, Video-on-Demand (VoD), and targeted advertisements**
  - Vital **tool for traditional broadcasters to retain viewers against pure OTT platforms**
- Next-Gen Media Formats & Advanced Compression
  - Transition from standard **HD to UHD/4K enhanced with High Dynamic Range (HDR)**
  - HDR delivers superior contrast and color depth, maximizing visual impact for viewers
  - **Shift to HEVC (H.265) and VVC (H.266)** to slash bandwidth requirements by up to 50%


Hybrid Broadcast Broadband TV (HbbTV)
LIVE
5G
Broadcast
Catch-Up TV
Menu
Red Button
Interactive functions
HbbTV on-screen elements
Synced content

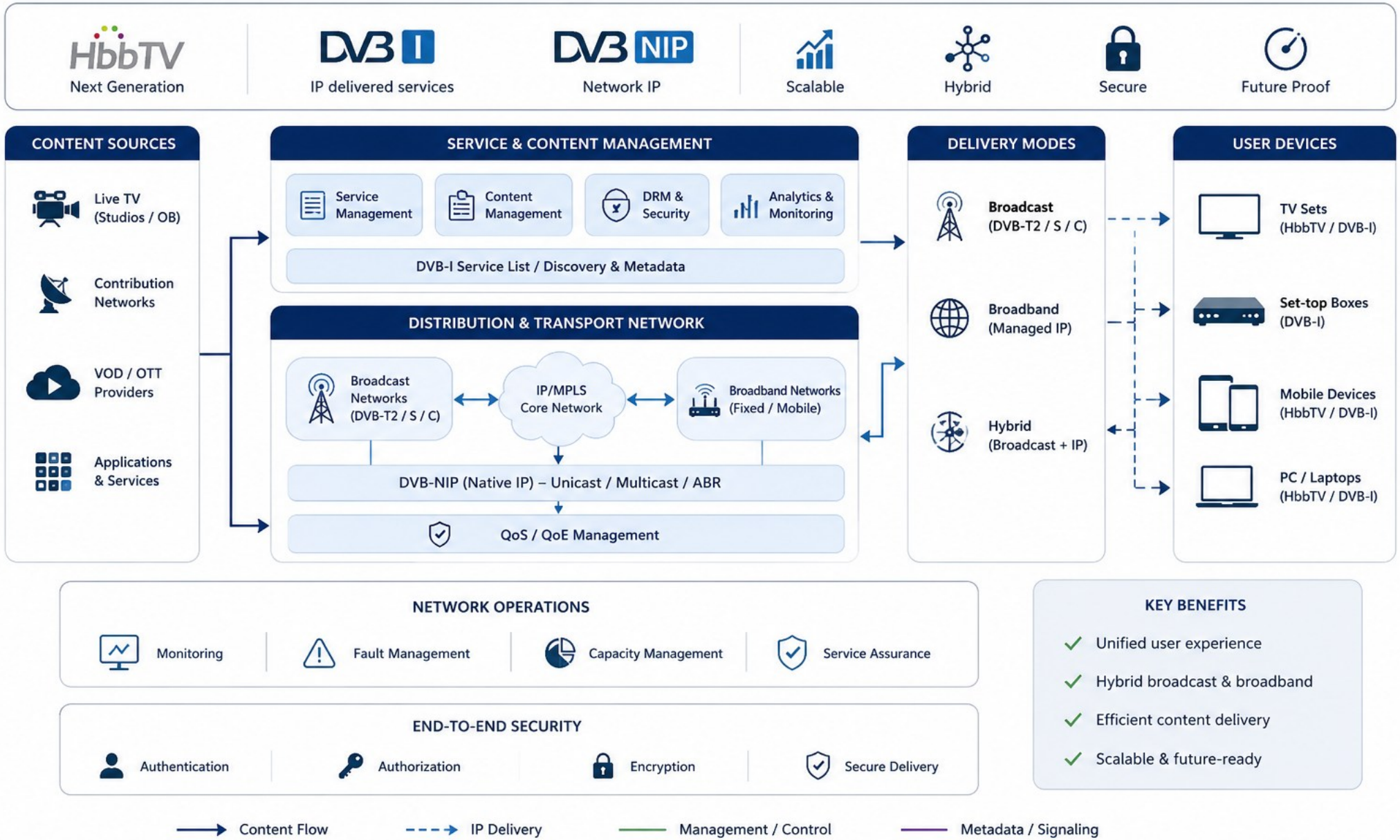
Next Generation TV and DVB/DAB

- **Next-Generation TV & Unified Delivery**
  - Architectural **shift toward native IP-based television standards** (e.g., ATSC 3.0 / DVB-I)
  - **DVB-I integration creates a unified electronic program guide (EPG)** combining OTA and internet streams
  - Enables **highly localized emergency alerts and advanced interactive content**
- **DAB+ Radio Digitalization**
  - Full transition from legacy **analog FM to highly efficient DAB+ networks**
  - **High spectral efficiency**: up to 18 stereo channels broadcasted on a single RF multiplex
  - Dramatic **reduction in per-station energy consumption and transmitter operating costs**
- **Public Safety & Resilient Broadcasting**
  - Broadcasters as a core pillar of national defense and emergency communications
  - DAB+ Automatic Safety Alert (ASA) system can wake up standby devices during disasters
  - High-power terrestrial infrastructure provides robust backup when cellular networks fail


Digital Television Evolution
4K/UHD
Next-Gen TV
(IP-based)
DVB-T2
DVB-T2
DVB-T
DVB-T
4K
Interactive
services
Digital Radio Evolution
DAB+
FM Radio
Improved
audio quality
TEXT
Text
information
Emergency
Alert System
Digital Television Evolution
Digital Radio Evolution

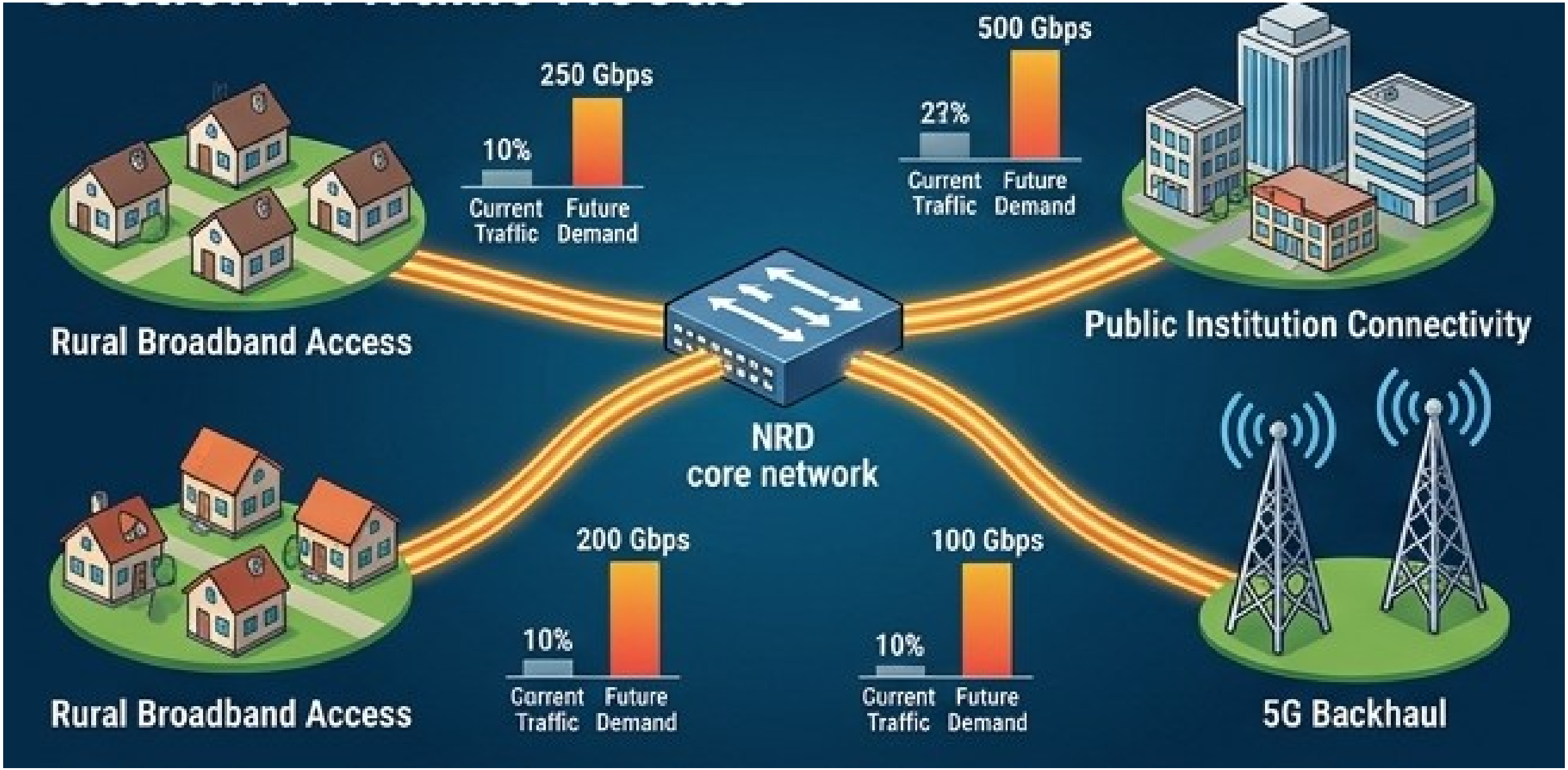
Next Generation HbbTV, DVB-I, DVB-NIP

Transport Network Architecture



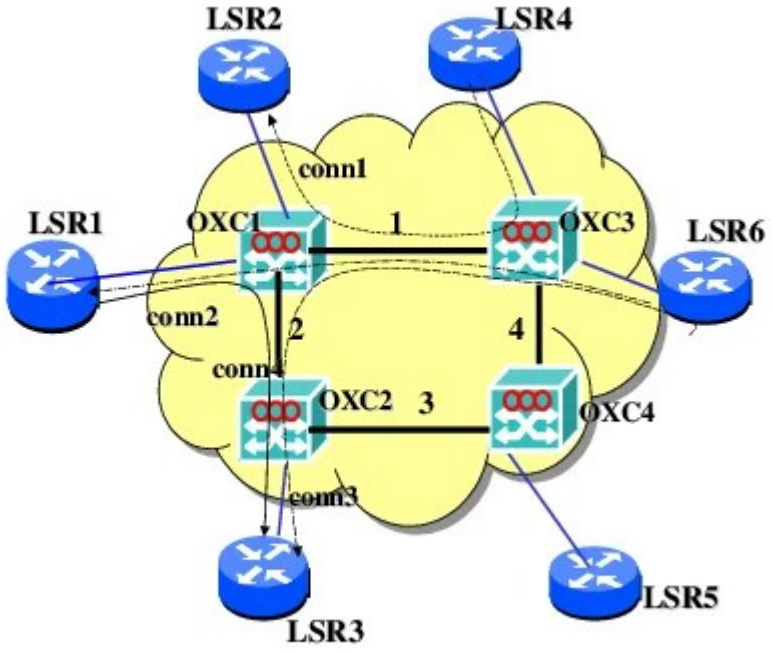
Traffic Needs for the NRD's Next-Generation Optical Network

- Driving Factors for Transport Capacity
  - **Core microwave backhaul hitting physical throughput limits** due to surging data demands
  - **High-bitrate contribution feeds required** for multi-channel DVB-T2 UHD/4K streams
  - **Aggregation** of multiple regional and national DAB+ audio multiplexes **into core hubs**
- Supporting the National Broadband Plan
  - **NRD's mandate to bridge the digital divide in rural "white zones"**
  - Transformation of **broadcasting hubs into open-access wholesale backhaul points**
  - Transporting **e-government, institutional, and public internet data alongside media**
- Commercial Co-location & 5G Telecom Backhaul
  - **Tower infrastructure** acting as **primary macro-cells** and **edge computing sites** for mobile operators
  - Handling **multi-tenant traffic backhaul demands** with strict SLA guarantees
  - Requirements move **from Mbps to hundreds of Gbps with ultra-low latency**


250 Gbps
10%
Current Traffic
Future Demand
500 Gbps
23%
Current Traffic
Future Demand
Rural Broadband Access
Public Institution Connectivity
NRD
core network
200 Gbps
10%
Current Traffic
Future Demand
100 Gbps
10%
Current Traffic
Future Demand
Rural Broadband Access
5G Backhaul

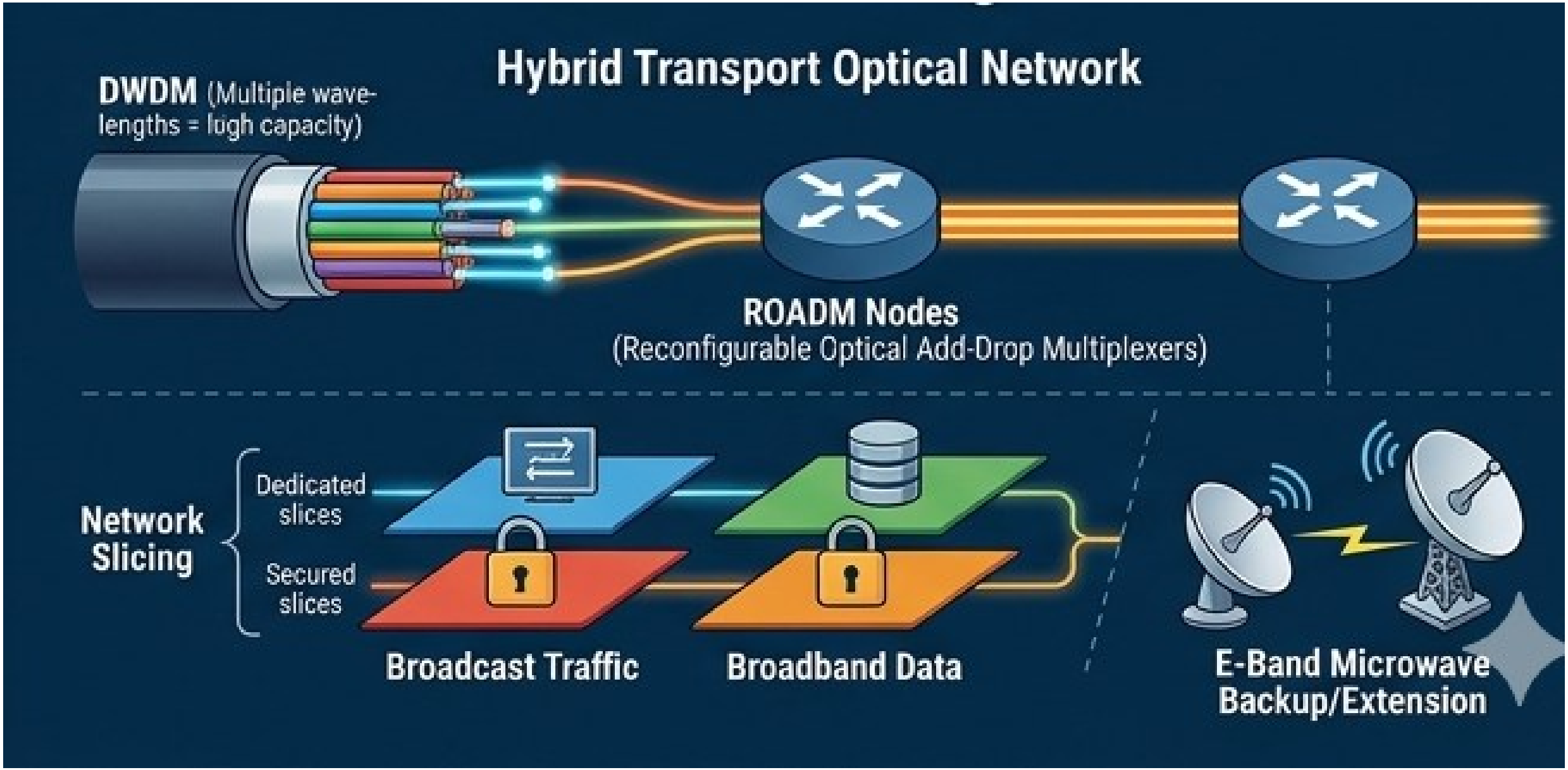
Technologies for the NRD's Future Optical Network

- Optical Fiber Backbone (Primary Infrastructure)
  - DWDM and Optical Transport Network
    - *OXCs (Optical Cross-Connect)*
    - *LSRs (Label Switched Router)*
- IP MPLS/Segment Routing
- DVB-T / DVB-T2 Distribution Technologies
  - IP multicast transport
  - SMPTE/ST 2110 or MPEG-TS over IP
  - SFN synchronization over IP

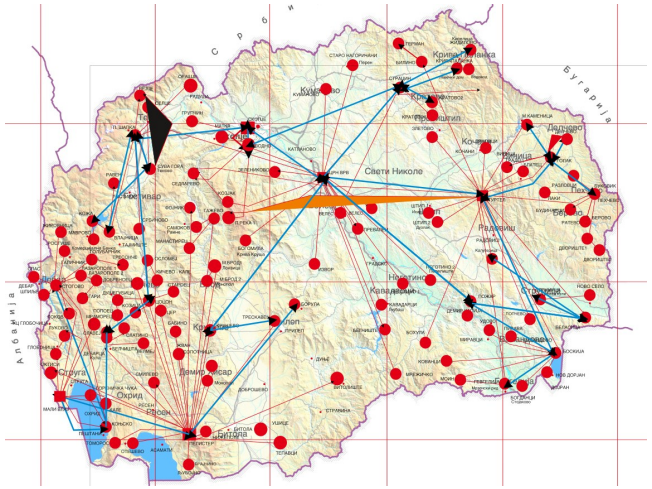


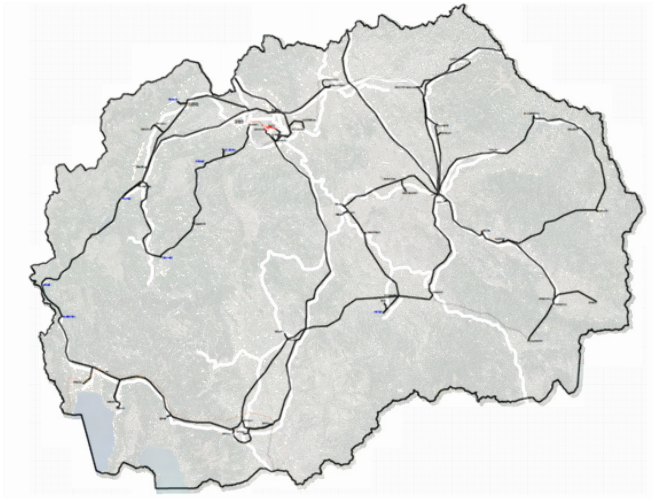
Technologies for the NRD's Future Optical Network

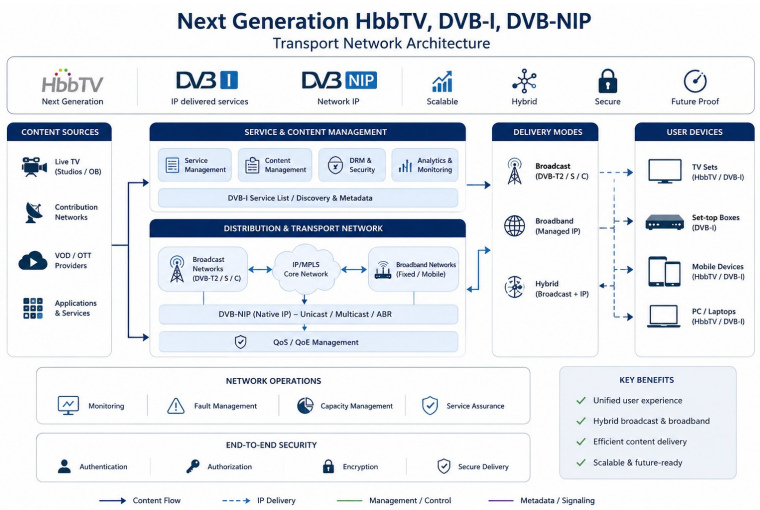
- Optical Layer - DWDM and ROADM
  - DWDM to scale fiber capacity to 100G/400G+ per wavelength
  - ROADM functionality allows remote, dynamic wavelength routing across the country
  - Automated software-defined restoration during fiber cuts
- Packet Layer - SRv6 and Network Slicing
  - Segment Routing over IPv6 (SRv6) for highly simplified, deterministic traffic engineering
  - Network Slicing isolates mission-critical broadcast streams from public internet traffic
  - Guarantees QoS and low latencies for real-time services
- Physical Fiber Deployments & Hybrid Alternatives
  - Utilization of OPGW (Optical Ground Wire) on high-voltage lines and ADSS for aerial mountain runs
  - Strategic mix of proprietary builds and leasing dark fiber loops for path redundancy
  - High-capacity E-Band microwave (70/80 GHz) as a 10-20 Gbps hybrid extension where fiber cannot reach

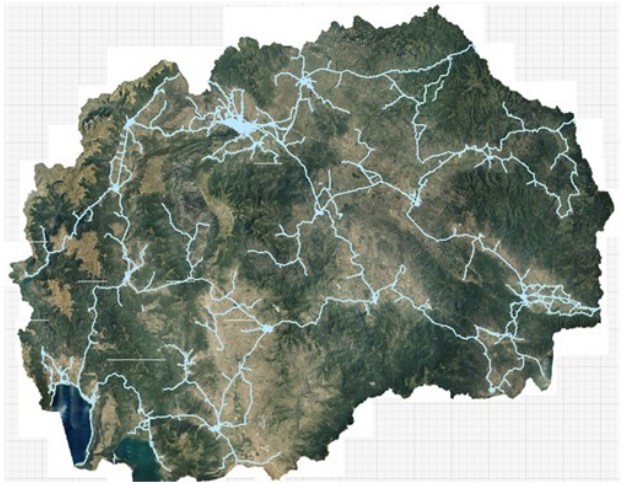

Hybrid Transport Optical Network
DWDM (Multiple wave-lengths = lugh capacity)
ROADM Nodes
(Reconfigurable Optical Add-Drop Multiplexers)
Network Slicing
Dedicated slices
Secured slices
Broadcast Traffic
Broadband Data
E-Band Microwave Backup/Extension

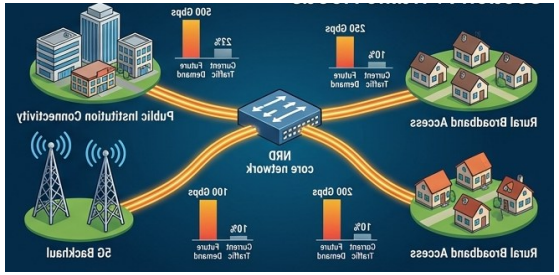
How to design and build NRD's Next Generation Transmission Network?

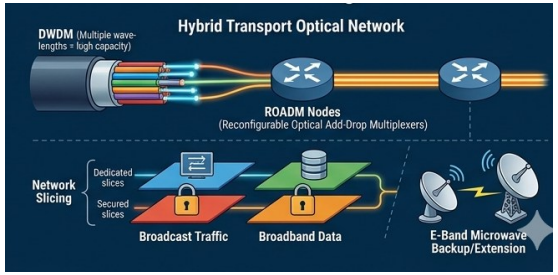












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Thank you!

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