Exentric Tunnel Network™

Exentric™

ROUGH LIGHTNING FOR HARSH ENVIRONMENTS

1. Introduction

The Exentric Tunnel Network is a robust, redundant, and thoroughly tested communication network developed specifically for demanding tunnel environments during excavation, rehabilitation, and installation. The system ensures stable communication throughout the entire tunnel, even in the event of power outages or failures in individual base stations, and is optimized for both wired and wireless traffic.

2. Redundancy and availability

2.1 Redundancy

- A minimum of three independent communication paths through the network.
- Up to two simultaneous cable or WiFi link failures in the same area shall not result in loss of network connectivity. (Figures 1–4)
- Additional redundancy can be established via fiber between base stations in tunnel bore 2 to increase capacity.
- Four independent Internet connections, of which two are active simultaneously (load balancing) and two are used as automatic backup. Distributed across two connections at each end of the tunnel. (Figure 5)
- One active DHCP server with one automatic backup.

2.2 Automatic Network Recovery (Self-healing)

- The network automatically detects faults and interruptions and reroutes traffic via alternative paths without manual intervention.

2.3 Battery Operation

- Minimum 5 hours of battery operation in the event of a power outage.

3. Performance and capacity

- See technical data sheet.

4. Installation and operation

4.1 Plug and play

- All units are fully preconfigured during production.
- Detailed installation instructions enable a local electrical contractor to install the system without network expertise.

4.2 Easy troubleshooting

- Base stations are equipped with indicator lights for internet status, battery operation, and 230 V mains operation.
- Dedicated SSIDs per base station enable simple local testing.

4.3 Easy repair

- Preconfigured spare units can be stored on site.
- These units are plug-and-play and automatically assume the correct position in the network.

4.4 Base station placement

- Base stations are installed at 500 m intervals on straight sections with good signal conditions.
- 250 m spacing in curves or areas with poorer signal conditions.

5. Cabling and physical design

- Military-grade optical fiber cable with connectors at both ends is used between base stations in tunnel bore 1. Delivered on field reels.
- Cat5e/Cat6 cable is used in cross passages between tunnel bores 1 and 2.
- The units are enclosed in impact-resistant and waterproof enclosures (IK10 / IP65) with internal, protected antennas.

6. Security

6.1 VLAN

- VLAN segmentation for e.g. normal traffic, technical network, emergency network and administration.

6.2 WiFi

- WPA2/WPA3 encryption, VLANs and passwords.

6.3 Firewall and internet access control

- The network is protected by a stateful firewall that blocks unauthorized connections and does not allow incoming traffic from the Internet.
- Only traffic initiated from within the network is permitted.
- Internet access can be regulated by segmenting the network into separate zones (VLANs), where different devices and services can be granted full, limited, or no Internet access.
- Traffic prioritization and bandwidth control are used to ensure that critical services such as voice, video, and operational communication are prioritized under high load.

7. Administration and alerts

- The Remote Management System (RMS) provides an overview of the status and location of units in the tunnel.
- Automatic email alerts in the event of critical faults or incidents.

8. Network functions

- QoS (Quality of Service) for prioritization of voice, video, and other real-time traffic.
- IPv4 and IPv6 support, DHCP server, and reserved ranges for static addresses (IoT, etc.).
- Ethernet ports with PoE for external devices such as IP cameras.

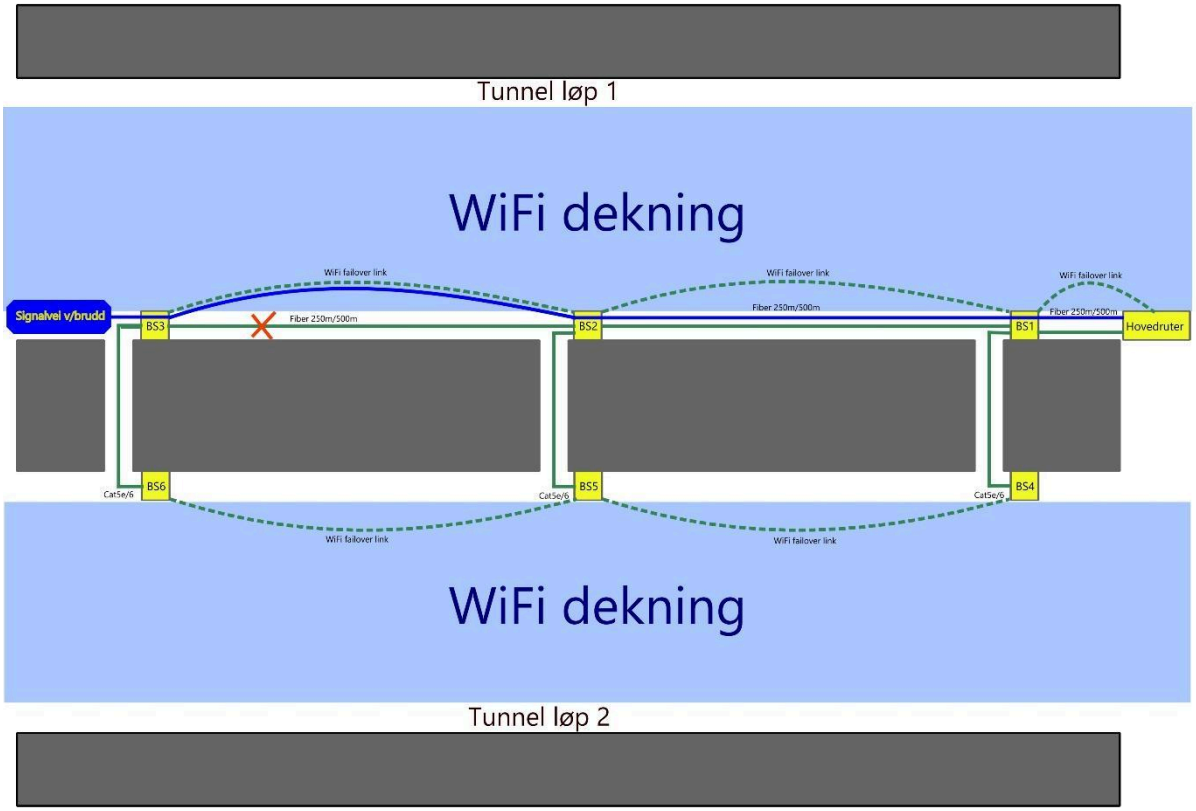

Figure 1: Signal path in the event of a fiber break

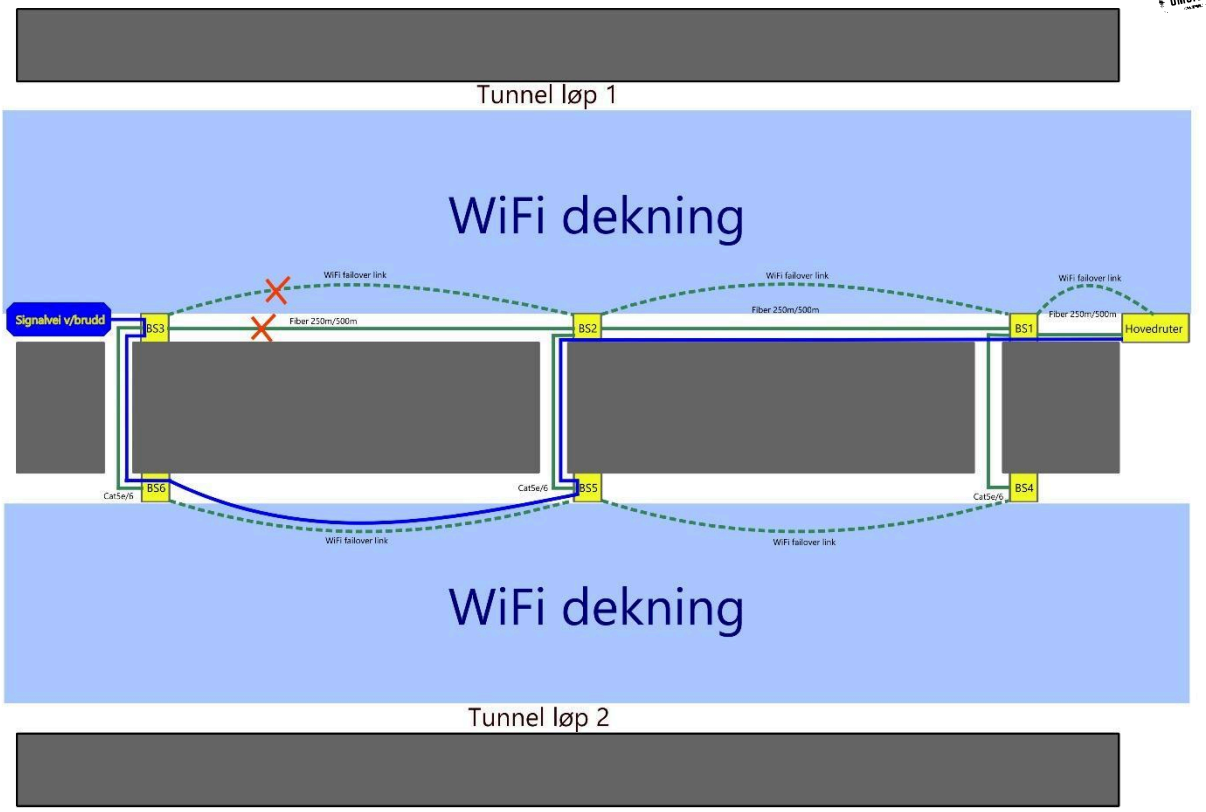

Figure 2: Signal path in the event of both a fiber break and a WiFi failover link break

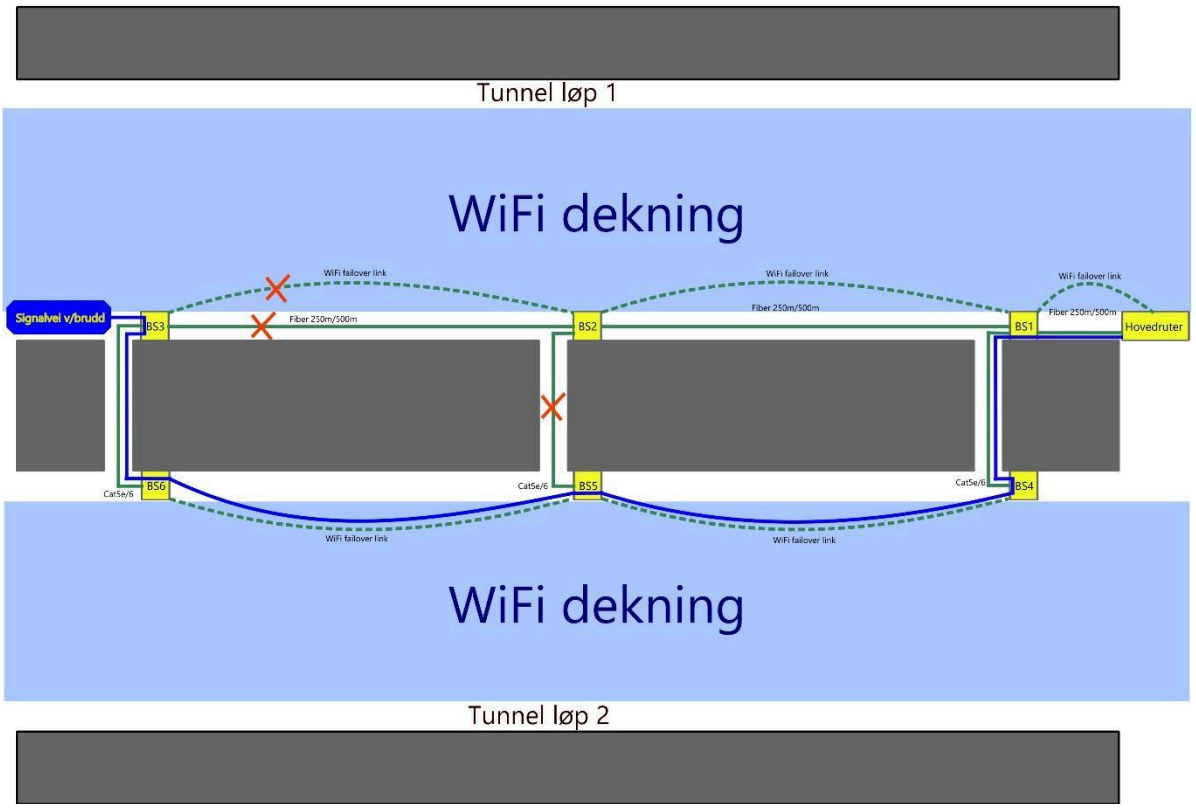

Figure 3: Signal path in the event of three breaks

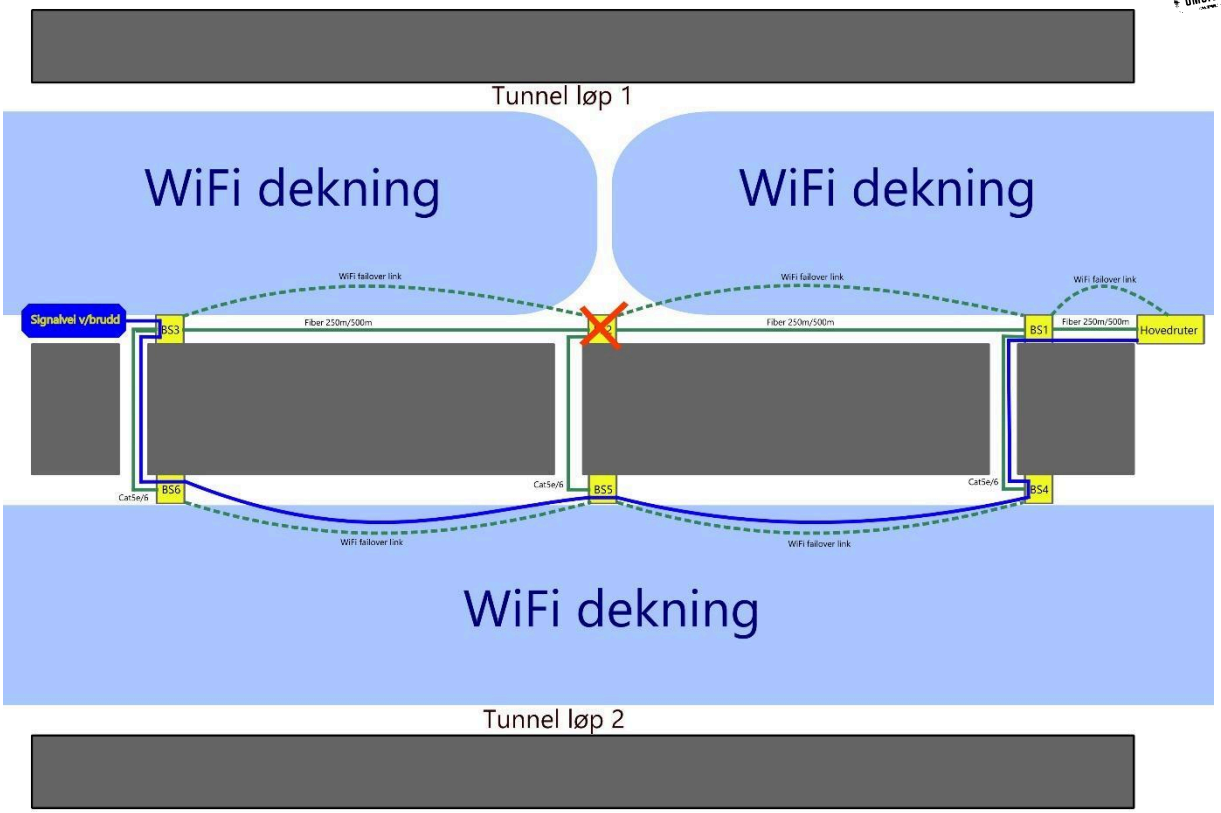

Figure 4: Signal path in the event of equipment failure

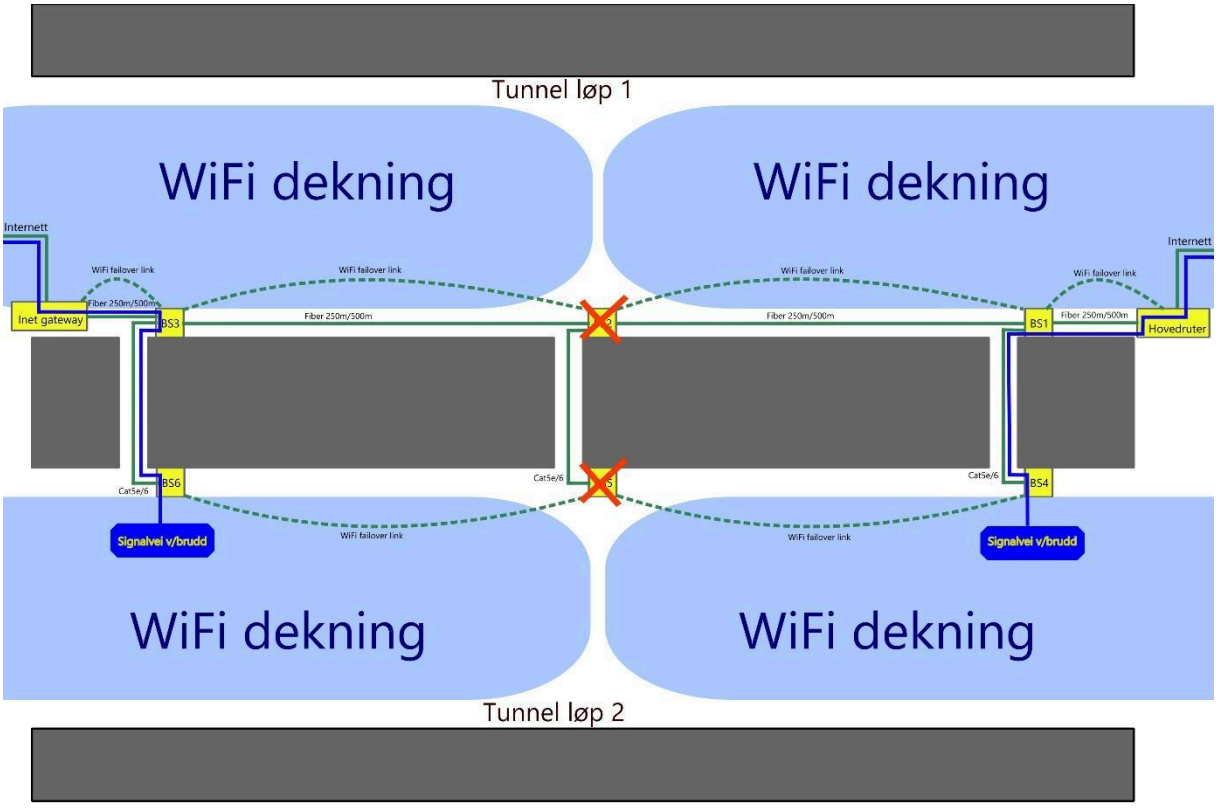

Figure 5: Signal path in the event of equipment failure in both routes at the same location