CASE STUDY

Communication network modernisation for Loiste

Loiste and Netcontrol work together to modernise utility communication network using All-IP communication architecture

THE UTILITY: LOISTE

Loiste Sähköverkko Oy (formerly E.ON Kainuu) is an electricity distribution company in north east of Finland and is part of Loiste Group. The distribution network consist mainly of 20 kV overhead lines. The distribution area is mainly rural with many small urban areas separated by vast areas of forest.

ISSUES WITH LOISTE'S OLD COMMUNICATION NETWORK

The SCADA and other systems of Loiste had a legacy communication infrastructure to the out-stations consisting of analogue radio links, PDH links, radio modems, copper wires and leased line connections – typically serial data communication. The network was built during tens of years using various technology. Many of the communication services were proprietary needing special skills, tools and spare parts. The technology was getting obsolete and spare parts and service hard to find or expensive to buy.

EVOLVING UTILITY COMMUNICATION NEEDS

As the network automation is increased also the need to improve data communication will increase – requiring fast communication, high availability data transfer and quality of service. The modern technology/services at the outstations and the smart grid require more capacity and connectivity. The move towards computerized resource management and electronic documentation need secure and reliable data communication in the field. Especially during power outages the field crew communication is important. At the same time the availability of operator mobile networks is poor – then a high availability private radio network is most valuable. Power quality and outage management need to be improved pushing the availability of the data communication services to new levels.

JOINT PLANNING WORKSHOPS

In 2008 Loiste and Netcontrol called to a work-shop to plan how to modernize and improve the communication network and how to consolidate/integrate many services in one common infra-

loiste

structure – a Netcon All-IP solution. The project was planned to span many years and divided into subprojects.

NETCON ALL-IP

Pure IP-based communcation with legacy migration capability

In Netcon All-IP, the data communication infra-structure is a pure IP-based network. Services running native IP-interfaces run as is, while legacy serial data is tunnelled over IP via gateway servers or other converters.

Quality of Service
Quality of Service for each service is controlled at the edges of the All-IP network by the Netcon gateways. Data is prioritized ranging from real-time to bulk data ensuring transfer of critical operational data in all conditions.

High Availability
High availability of the network is built by redundancy and by connecting the data communication network into ring/mesh topology with automatic routing.

DATA CONFIDENTIALITY AND INTEGRITY

Data confidentiality and integrity is managed by encapsulating sensitive data in end to end encrypted VPN tunnels and by network segmentation.

NETWORK ACCESS CONTROL

Network access and traffic is controlled by the Netcon Gateway firewalls. Netcon All-IP Manager monitors the network devices, connectivity and routing status. Abnormal states are alarmed. Operational data of the network is stored in logs and history for later analysis and reporting.

THE LOISTE ALL-IP PROJECT

### 1. All data communication needs identifed and classified

In the All-IP workshop the data communication needs were identified and classified. Existing data communication services to be moved/converted to the All-IP network was documented. New data communication services to be added to the All-IP network were listed and prioritized. Technology road map to be used in the All-IP project was studied. A business case of the All-IP project was crated and approved. The All-IP project gives the utility a fresh start for the utility operational communication technology infrastructure, skills and future opportunities. Legacy infrastructure is phased out in steps and replaced with All-IP services as the All-IP backbone gets available.

2. Limited pilot for the proof-of-concept
The All-IP project started in 2009 with a pilot POC project where the equipment's were selected, the services planned and the pilot system built and tested. After the successful POC the All-IP project backbone network started. The project
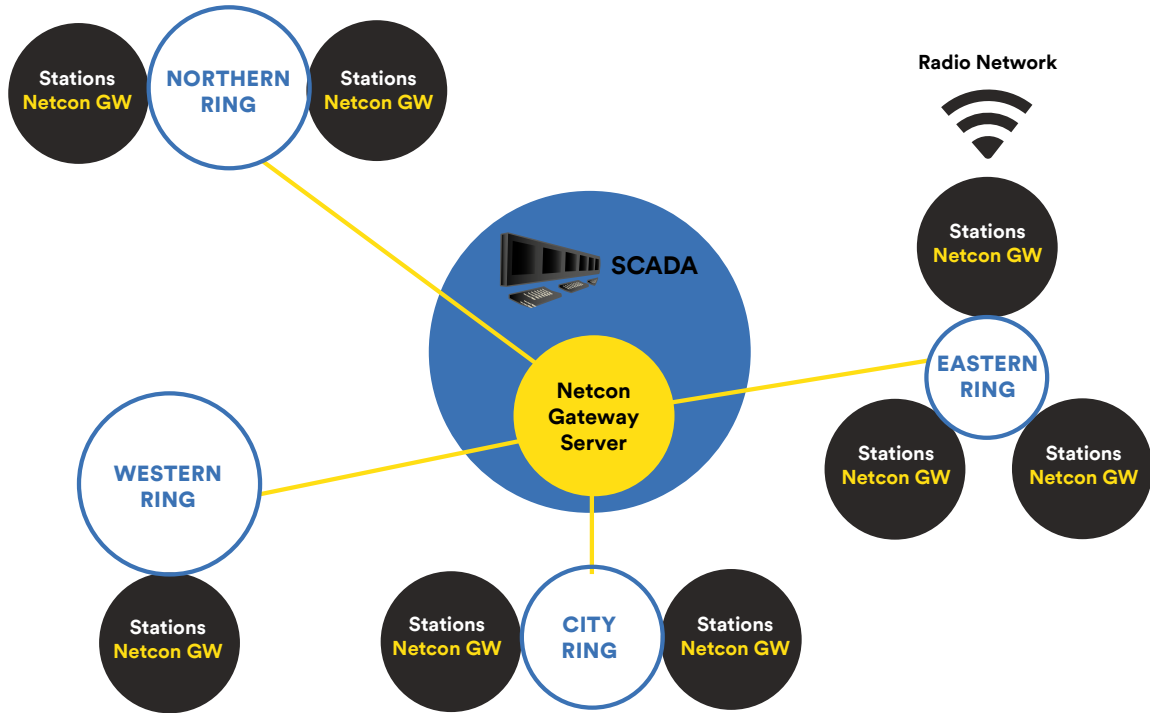
was divided into milestones of east ring, city ring, north ring, west ring and last but not least Netcon All-IP manager. The project consist of project management, planning, workshops, procurement of microwave links, fibre connections, leased IP connections, routers, switches, gateways and finally installation/commissioning of the All-IP network and services per each milestone.

3. Full rollout spanning over several years

The All-IP project spans over seven years as the network is built when not disturbing the distribution network operation and mostly during summer as in the winter it is not possible or it is very demanding. The All-IP project lives on and grows with new connections and services in the years to come – the bandwidth can be increased where needed by updating devices, connections added or replaced by fibre or microwave links, equipment reused in the network expansions/reconfigurations etc. The common All-IP technology makes it possible. Legacy serial devices and applications can be migrated into the All-IP network and utilises until the end of their life-cycle.

Wide Area Rings

- Centrally controlled and managed from the master stations
- Wide area network rings cover the Loiste operation area
- Ring structure brings redundancy
- Each ring has a diameter in excess of 100km

- Network rings consist of a mixture of broadband networking technologies:
  - Fibre
  - Microwave links
  - Leased connections from telecom operators
  - Broadband copper connections

Central Site

- Central site (master station) has SCADA and other utility IT systems
- Netcon Gateway Server connect the master station (SCADA) into wide area ring offering cyber security and protocol conversion capabilities

Stations

- Station are substations or dedicated communication stations
- Stations have Netcon Gateways to connect the applications and RTU's to the Master Station over the ring networks
- Netcon Gateways also operate as a communications concentrator for the local radio networks

ICT SERVICES – NETCON ALL-IP

The utility ICT services are consolidated in the
Netcon All-IP network covering:

- SCADA communication with RTU/IEDs
- Serial over IP for SCADA and other services
- Data communication for condition monitoring
- Secondary station monitoring and control
- RoIP – private radio over IP
- VoIP – voice over IP telephony
- Service and maintenance connections
- AMR Concentrator data transport
- Power quality data
- Fault recorder data
- Office connections
- CCTV – video surveillance data transfer
- Security/access control system data
- Intrusion alarm data
- Fire extinguisher/detector data
- NTP time synchronization service
- NMS (network management system) data

TRAFFIC PRIORITIZATION – NETCON ALL-IP

Prioritization of traffic will ensure the transport of
important messages while less important ones are
slow or blocked. The network capacity may change
due to weather conditions or rerouting. Microwave
links with adaptive modulation are able to keep
the connection up but with reduced capacity
where synchronous fixed speed links will drop the
connection in bad weather conditions.

Multiple ICT services – shared common network
- Availability
- Latency
- Bandwidth

Quality of Services classes
- High – network operation services
- Medium – maintenance, access control, VoIP,
  private radio
- Low – CCTV, office

BENEFITS OF ALL-IP

- Consolidation of data communication – all
  communication using one technology, sharing
  resources and costs

- Standard network technology – widespread
  know-how, public tools, vendor interoperability,
  equipment and service availability, versatile
  security features
- Variety of transport media – optimal choice of
  media, speed, distances, services
- Free localization of services – flexible
  arrangement of network access points,
  maintenance, back-up, updates, security
- Future Proof – the Internet standard, widely
  used and adapted, stable, developing
- Wide Coverage – any place, any time, any
  binary data, wide choice of services
- Legacy serial devices and applications
  mirgration into the All-IP network

NETCON GATEWAY SERIES
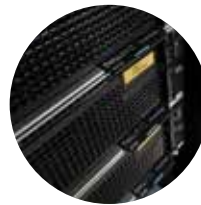
Netcon GW Server
Master station connectivity

Netcon GW502
CPU of Netcon 500 Substation RTU

Netcon GW502-iM
Substation Gateway & Protocol
Converter

Netcon GW102
CPU of Netcon 100 Secondary
Substation RTU

Netcon GW325
Wireless 2G GPRS Gateway for
switching stations