



4RF Application Note

Aprisa XE Teleprotection and Telemetry



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1 The Aprisa XE in teleprotection / telemetry applications

1.1 Introduction

The purpose of this document is to briefly explain teleprotection and telemetry systems and the advantages for backhaul of the information used in these systems using the Aprisa XE.

There is also a reference section included that provides more detail on some of the common systems used.

1.2 Overview

Teleprotection or Telemetry does not relate to a particular interface or data protocol, simply the collection of data and control of connected devices in a network. Interfaces needed to integrate with a teleprotection or telemetry system will depend on the equipment used for data acquisition, transmission and control. There is no industry standard and interface requirements differ greatly between equipment models.

Commonly used interfaces are RS-232, synchronous serial (RS-530, V.35 etc) and 4 Wire, which connect remote sites back to a central location. Many modern telemetry and teleprotection systems are making use of Ethernet as the interface used for data transfer. Typically capacity requirements are low with around 250 kHz channel size being commonly selected to provide suitable latency and to support future expansion for other services.

The diagram below shows some of the elements involved in these networks and where the Aprisa XE fits into a typical network.

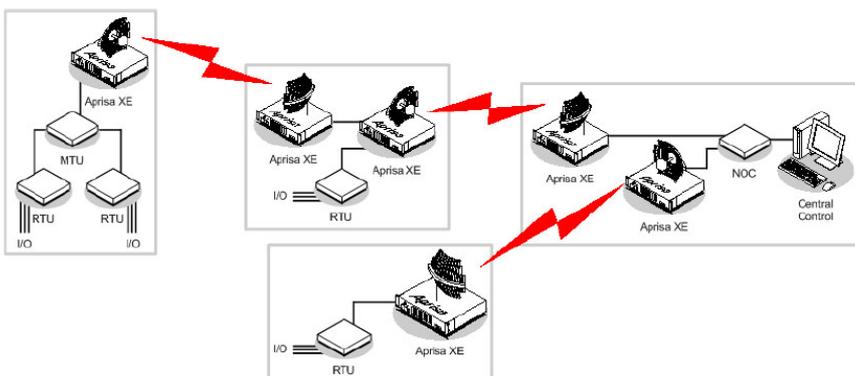


Figure 1: Telemetry network example

1.3 Teleprotection / Industrial Control System (ICS)

Teleprotection allows for remote measuring and monitoring with action control of connected systems. Teleprotection circuits often provide control of remote equipment as well as connecting automated protection relays.

Teleprotection systems often have a minimum suitable latency for operation and are normally considered mission critical.

Applications include:

- SCADA networks for utilities and oil & gas applications
- Electricity fault protection / isolation
- Load control and switching for industrial systems

1.4 Telemetry

Telemetry allows for the remote monitoring and measuring of a system. There are no active controls inherent in telemetry systems.

The RTU combines traffic from its remote input/outputs onto a transport bearer for backhaul to the central office/NOC where PLCs or software programs present the information as a measurable quantity.

Applications include:

- Monitoring of water levels at a remote dam or storage facility
- Monitoring of remote geological data for local government

2 The Aprisa Advantage

2.1 Overview

The Aprisa XE may be implemented for either teleprotection or telemetry purposes without the requirement for an external MUX or protocol converters. There is no other piece of backhaul equipment that supports this degree of flexibility when addressing telemetry and teleprotection backhaul.

Advantages include:

- Reduced equipment count / sparing requirements
- Maintenance and support technicians / engineers train on one piece of equipment
- Ability to support existing TDM / analogue interfaces
- Future-proofing: Ethernet as standard on all Aprisa platforms
- Easily integrated into existing SNMP NMS systems
- Interface flexibility: all interface types are supported on the same transport platform
- Latency: the Aprisa has the ability to link great distances with very low link latency. The Aprisa has the functionality to disable the modem interleaver to further reduce latency via software if required
- Distance of transmission: the Aprisa XE can link greater distances than competing technologies, reducing the need for intermediate infrastructure
- Reliability: the robust, field-proven nature of the Aprisa, combined with industry leading low failure rates makes the Aprisa XE perfect for remote monitoring sites where access may be an issue. The Aprisa XE has been installed in over 100 countries and operates in the most extreme environments globally

2.2 Transport Mediums

The following is a brief overview of the most commonly used backhaul systems and a comparison to the Aprisa value proposition.

Power Line Carrier

Power line carrier transmits HF carrier on HV power lines. It is used for signaling between electrical substations and important nodes on the electrical network. PLC uses AM to transport a continuously transmitted audio signal for fault detection. The Aprisa XE is often used for redundancy because if the power lines are damaged (due to act of god, terrorism, vandalism or theft) the utility does not want to lose its comms as well. The Aprisa also offers distance and capacity advantages over PLC systems.

Pilot Wire

Pilot wire is a separate wire run in parallel with the power line. It is typically only used for short distances and not widely used since advances in PLC technology. Pilot wire is simpler than the PLC application as it requires no isolation / coupling stages. The Pilot wire is not commonly used due to cost and security issues. The Aprisa XE offers greater security from damage as well as distance advantages.

Point-to-Multipoint Radio

Point-to-multipoint radio is often used to connect RTUs to a central point for traffic aggregation / monitoring. Point-to-point is often used for backhaul of point-to-multipoint systems. Point-to-multipoint systems have restrictions on distance due to antenna configuration. The Aprisa XE offers the ability to link existing systems and link remote stations without the requirement to add store and forward repeaters.

PMR / LMR

Mobile radio channels can be used with the inclusion of a 4 Wire modem on some systems. Mobile radio channels are very limited in data throughput. Key advantages are that the Aprisa XE does not require an external modem to convert traffic and provides greater throughput.

Fiber

Fiber is often run in the shielded overhead wires (OPGW) or separately in a self supporting di-electric (ADSS). Fiber provides extra capacity. Both these platforms are expensive to implement and prone to damage.

Point-to-point microwave linking

Microwave is used to link critical points in the network and carries data between points. Mission critical operations require redundancy, so microwave is often used in parallel with a fixed line carrier. The Aprisa provides the flexibility to link any combination of interfaces at a greater distance than any other microwave carrier.

3 Further Detailed Information

3.1 Supervisory Control and Data Acquisition (SCADA)

Generally refers to an industrial control system: a computer system monitoring and controlling a process. The process can be industrial, infrastructure or facility based as described below:

- Industrial processes include those of manufacturing, production, power generation, fabrication, and refining, and may run in continuous, batch, repetitive, or discrete modes
- Infrastructure processes may be public or private, and include water treatment and distribution, wastewater collection and treatment, oil and gas pipelines, electrical power transmission and distribution, and large communication systems
- Facility processes occur both in public facilities and private ones, including buildings, airports, ships, and space stations. They monitor and control HVAC, access, and energy consumption

A SCADA System usually consists of the following subsystems:

- A Human-Machine Interface (HMI): the apparatus which presents process data to a human operator, and through this, the human operator monitors and controls the process
- A supervisory (computer) system: gathering of data on the process and sending commands to the process
- Remote Terminal Units (RTU): connecting to sensors in the process, converting sensor signals to digital data and sending digital data to the supervisory system
- Programmable Logic Controller (PLC): used as field devices because they are more economical, versatile, flexible, and more configurable than special-purpose RTUs
- Communication infrastructure connecting the supervisory system to the RTUs

3.2 Power system protection

The objective of a protection scheme is to keep the power system stable by isolating only the components that are under fault, whilst leaving as much of the network as possible still in operation. Thus protection schemes must apply a very pragmatic and pessimistic approach to clearing system faults. For this reason the technology and philosophies utilised in protection schemes can often be old and well-established because they must be very reliable.

Protection systems usually comprise five components:

- Current and voltage transformers to step down the high voltages and currents of the electrical power system to convenient levels for the relays to deal with
- Relays to sense the fault and initiate a trip, or disconnection, order
- Circuit breakers to open/close the system based on relay and auto-recloser commands
- Batteries to provide power in case of power disconnection in the system
- Communication channels to allow analysis of current and voltage at remote terminals of a line and to allow remote tripping of equipment

For parts of a distribution system, fuses are capable of both sensing and disconnecting faults.

Failures may occur in each part, such as insulation failure, fallen or broken transmission lines, incorrect operation of circuit breakers, short circuits and open circuits.

Telecommunications services are expected to operate within a standard performance objective as outlined in the section below.

3.3 Service Performance Objectives (SPO) or Quality of Service

Protection devices are installed with the aim of protecting assets and ensuring continued supply of energy.

The three classes of protective devices are:

- Class A: service must be available before, during and after the fault event
- Class B: service must function before and after, but not necessarily during the fault event
- Class C: interruptible, non-critical service

SCADA and most teleprotection services operate under Class B.

4 Glossary of terms

Abbreviation	Term
ADSS	All-Dielectric Self-Supporting
HMI	Human-Machine Interface
HVAC	High-Voltage Alternating Current
I/O	Input / Output logic
LMR	Land Mobile Radio
MTU	Master Terminal Unit
NOC	Network Operations Center
OPGW	Overhead Power Ground Wire
PLC	Programmable Logic Controller
PMR	Professional Mobile Radio
PtMP	Point-to-Multi-Point
QoS	Quality of Service
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SPO	Service Performance Objectives
TDM	Time-Division Multiplexing

About 4RF



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