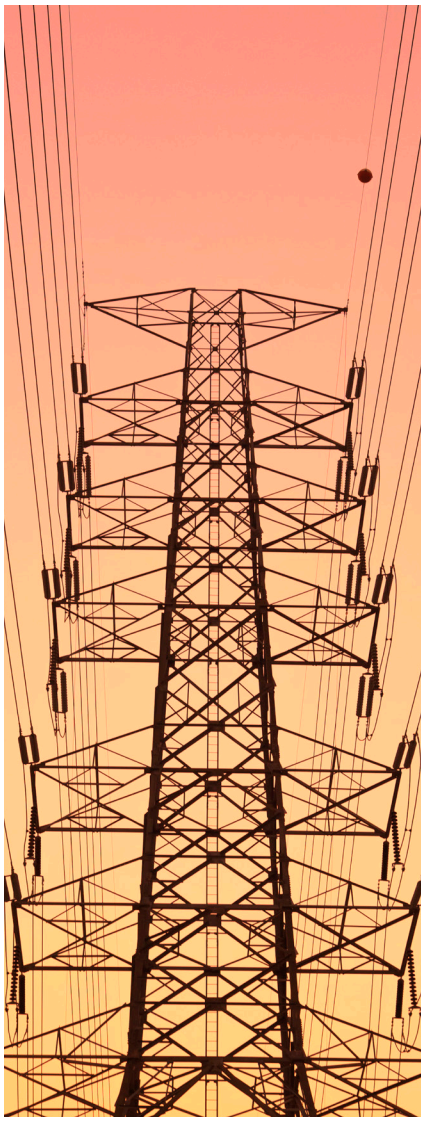
TELEPROTECTION

UBIIK mimomax

GUIDELINES FOR A ROBUST TELEPROTECTION SYSTEM



A central factor in minimizing the risk of severe blackouts is the use of a robust Teleprotection system. The communication requirements for such a system are extremely stringent due to the potential impact to the grid if such a system were to fail.

The key elements you must consider are:

Latency & Priority

- Latency is the most critical parameter for teleprotection as a matter of milliseconds can determine the difference between an isolated outage and a blackout across an entire city.
- To achieve an adequate level of protection, latency should be around or below 5 milliseconds
- In addition to speed, teleprotection traffic MUST have priority over IP traffic.

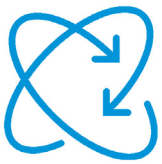
Resilience

- In order to ensure a network is protected 24/7, the use of dedicated licensed spectrum for communications is required.
- Relying on an unlicensed public channel (i.e. cellular) for delivery of critical data is obviously unwise. The options are therefore limited to licensed narrowband spectrum, fiber and microwave.

Coverage

- Again, to ensure resilience of your network, it is imperative that network availability is maintained consistently. Detailed path planning, coverage design and propagation modelling prior to deployment to minimize issues with potential path interference is crucial for mission critical deployments such as teleprotection.
- Microwave and higher bands (>1GHz) struggle to maintain coverage in non-line of sight scenarios. Antenna offset (due to weather events) is also an issue for solutions with narrower antenna beamwidth, such as microwave.

ADVANCED TECHNOLOGY RADIO

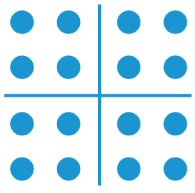


MIMO

Two transceivers in each radio to double the data throughput

FULL DUPLEX

Simultaneously transmit & receive – required for IP-based networks



QAM256

More bits per symbol = more data per transmission

THE UBIIK MIMOMAX TELEPROTECTION SOLUTION

Licensed – operates on licensed channels to ensure interference-free operation;

Ultra-low latency & jitter – typically offers latency of 5ms but can achieve rates as low as 3ms depending on channel size and modulation rate. This allows multiple MiMO links with a total latency inside of one power cycle. In a Tornado radio, jitter is minimized to less than 55ns – well below the 1ms recommendation;

Teleprotection priority – guaranteed priority is given to teleprotection traffic by inserting the serial at the lowest level in the protocol stack and with the highest priority;

Residual bandwidth – high data capacity (due to MIMO, full duplex and high order modulation) means the solution also provides the ability to use residual capacity to carry IP/SCADA traffic;

Excellent coverage – high performance for both line of sight and non-line of sight due to use of sub 1GHz spectrum;

Common platform – ability to combine teleprotection with other applications such as AMI backhaul over one radio network but with no impact on the dedicated protection circuit;

Synchronous Serial Interfaces - Ubiik Mimomax power line protection uses a synchronous serial interface including C37.94, X21, G703,RS530 (also referred to as RS422). Ubiik Mimomax supports all these interfaces at 64kbps and also supports X21 and RS530 (RS422) at 128kbps, 192kbps and 256kbps.

SEL Mirrored Bits - Support for SEL mirrored bits is provided via using RS232 with low latency and jitter.

Tornado Radio Data Rates

Channel Size	Gross Data Rate Aggregate
200 kHz at QAM256	5.12 Mbps
100 kHz at QAM256	2.56 Mbps
75 kHz at QAM256	1.92 Mbps
50 kHz at QAM256	1.28 Mbps
25 kHz at QAM256	640 kbps
12.5 kHz at QAM256	320 kbps

TORNADO OPV LATENCY TABLE

Bandwidth	Modulation	X21 64kbps	X21 128kbps	X21 192kbps	X21 256kbps	RS422 64kbps	RS422 128kbps	RS422 192kbps	RS422 256kbps	C37.94	G703
200kHz	QAM256	0.8	0.7	0.7	0.7	0.8	0.7	0.7	0.7	0.9	0.9
	QAM64	0.9	0.8	0.8	0.8	0.9	0.8	0.8	0.8	1.0	1.0
	QAM16	1.0	0.9	0.9	0.9	1.0	0.9	0.9	0.9	1.1	1.1
100kHz	QAM256	1.2	1.1	1.1	1.1	1.2	1.1	1.1	1.1	1.3	1.3
	QAM64	1.4	1.3	1.3	1.3	1.4	1.3	1.3	1.3	1.5	1.5
	QAM16	1.6	1.5	1.5	1.5	1.6	1.5	1.5	1.5	1.7	1.7
50kHz	QAM256	2.1	1.9	1.9	1.9	2.2	1.9	1.9	1.8	2.7	2.6
	QAM64	2.4	2.2	2.2	2.2	2.3	2.2	2.2	2.2	3.1	2.9
	QAM16	2.9	2.8	2.8	2.7	3.0	2.8	2.6	2.7	3.7	3.5
25kHz	QAM256	4.0	3.8	3.6	3.6	4.0	3.8	3.6	3.6	4.3	4.3
	QAM64	4.5	4.4	4.2	-	4.5	4.4	4.2	-	4.8	4.8
	QAM16	5.5	5.0	-	-	5.5	5.0	-	-	5.9	5.9
12.5kHz	QAM256	7.5	7.2	-	-	7.5	7.2	-	-	8.0	8.0
	QAM64	8.0	-	-	-	8.0	-	-	-	9.0	9.0
	QAM16	10.7	-	-	-	10.7	-	-	-	11.0	11.0

Note 1: Latencies figures are in milliseconds
Note 2: Latencies figures are for a single radio hop and are one way (not round trip)

Case Study: Orion New Zealand choose Tornado Radio for substation protection network

Owning and operating an electricity distribution network of 8000 square kilometres (3000 square miles) of diverse geography, Orion NZ Ltd required a teleprotection solution to maintain an uninterrupted, reliable power supply.

Orion's substation protection ring crosses farmland, hill and coastal terrain (including areas where stringent environmental standards need to be met) and has the following requirements:

- Ultra-low latency and phase jitter;
- The ability to be installed across difficult terrain;
- An approach which would not depend upon the installation of fibre or microwave links.

In response to these requirements, Ubiik Mimomax developed an "Optimised Protection Variant" (OPV) for Orion – a variant of its MIMO product family. The results were:

- Complete substation protection in addition to SCADA and voice traffic over one radio link;
- Interference-free operation on licensed channel with up to 256 kbps capacity (25kHz channel);
- Wide antenna beamwidth offering greater immunity to weather and path obstructions;
- Easy & low-cost integration with existing GE L90 relays.

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