Techniques how to increase the speed for Data Communication in SCADA and Telemetry Applications using Tetra “one” Infrastructures

July 2010

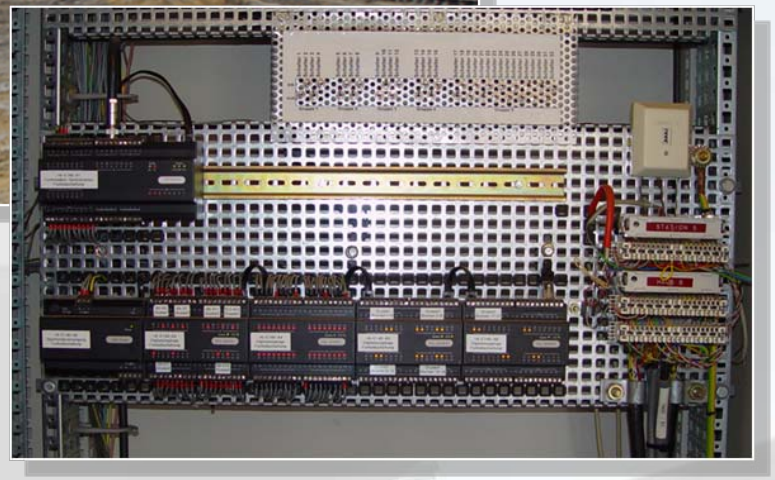
Funk-Electronic Piciorgros GmbH

1. Tetra Telemetry Applications
2. SCADA Configurations using Tetra Infrastructure
3. SDS based Radio-to-Radio Communication
4. SDS based Switch to Radio Communication
5. Packet Data Communication
6. Comparison of Data Communication with Packet Data and SDS
7. Pro and Contra SDS / Packet Data
8. Increasing the number of polled outstations to over 120 per minute

Wireless Applications

- **Water Management**
  pump controlling, ground water monitoring
  barrage, canal monitoring
- **Gas-, and Oil pipelines**
  pressure, flow management
- **Utility Companies**
  Power Distribution, Line Switches Control
- **Facility management / Real Estate**
  Airports, Public Places
- **Traffic Monitoring, management and control**
  Trans-Rapid, parking management, traffic jam monit
- **Environment protection**
  Rain measurement, water level
- **Agriculture**
  Watering systems, Ice warning systems

Surface Coal Mining (Water Level Control)



GAS Flow Control with Solar Power (Germany)

GAS Quality Control

Waste Water Monitoring Treatment Plant

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SCADA (Supervise Control and Data Acquisition)

The term “SCADA” basically includes the whole system starting from the Monitors and Computers in the Control Room, the Interfacing to the Infrastructure, the Infrastructure itself, up to the Outstations the PLC’c and Sensors or Actors.

The following Slides will demonstrate how the SCADA Control Room Part can be interfaced to Tetra Infrastructure using different options and how the data communication speed can be optimized.

SCADA transmitting Text Message to Tetra Terminal

Tetra Point-to-Point I/O to I/O connection with Embedded Micro-PLC

Transmission of 16 Inputs an 8 or 16 Outputs and optional four analog I/O

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Tetra Point-to-Point PLC to PLC connection using standard Protocols as Modbus RTU, DNP3, EN 60870-5-101, PakBus, ...

Automatic Transmission and Recording of Counter Values (Flow, Pressure, Heat – Evonic Germany)

TRM-710 mit
RS-232 oder RS-485/422

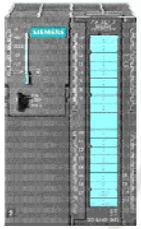
Tetra Data Network with OPC Server

Windows PC
Mit OPC Server

Funk-Zentrale
mit OPC Server

TRM-710 mit
RS-232 oder RS-485/422

RTU-710 Funkbaugruppe mit integrierten E/A und
E/A Erweiterungsmodules



SPS

TRM-710 mit
RS-232 oder RS-485/422

RTU-710 Funkbaugruppe
mit integrierten E/A

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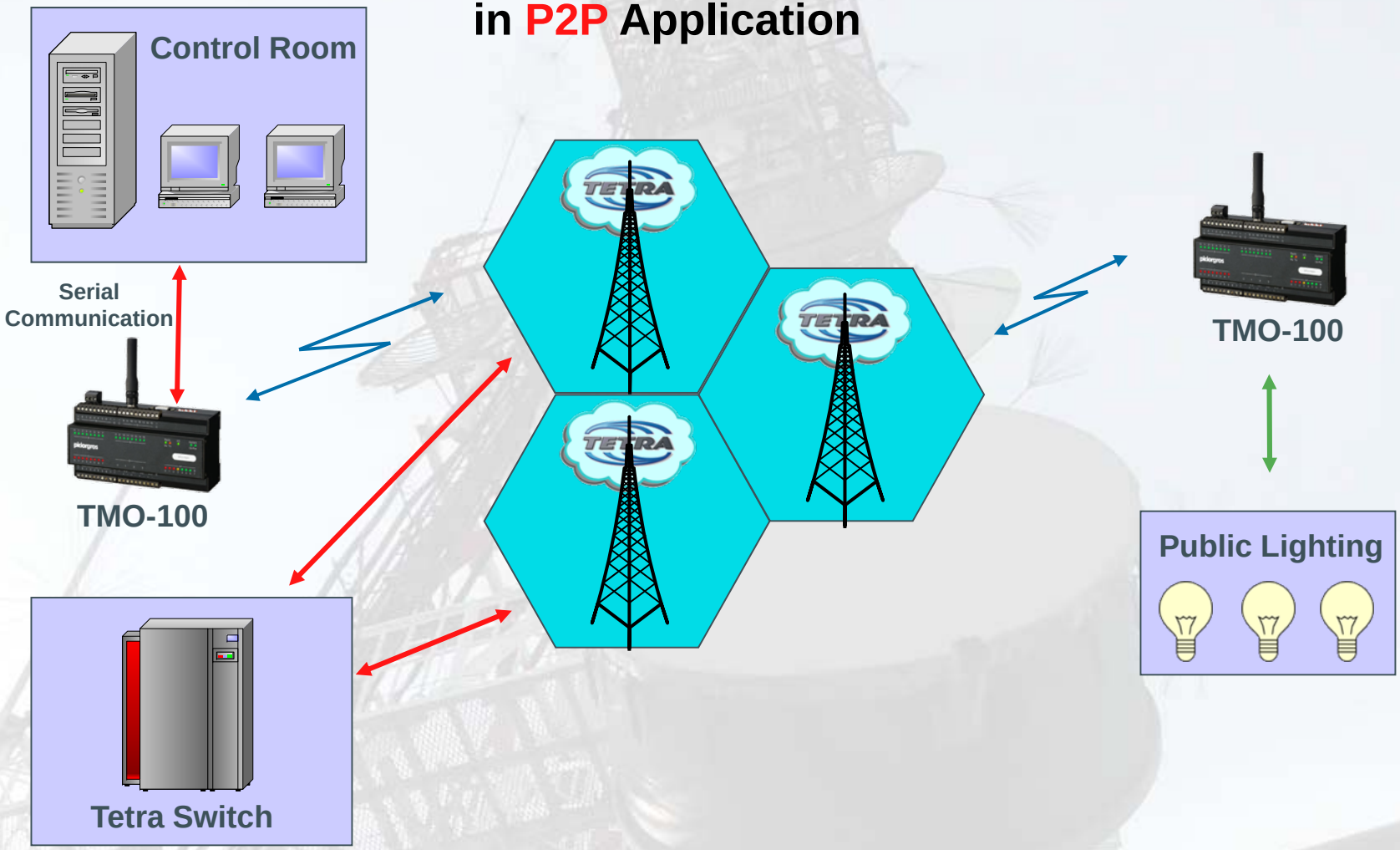
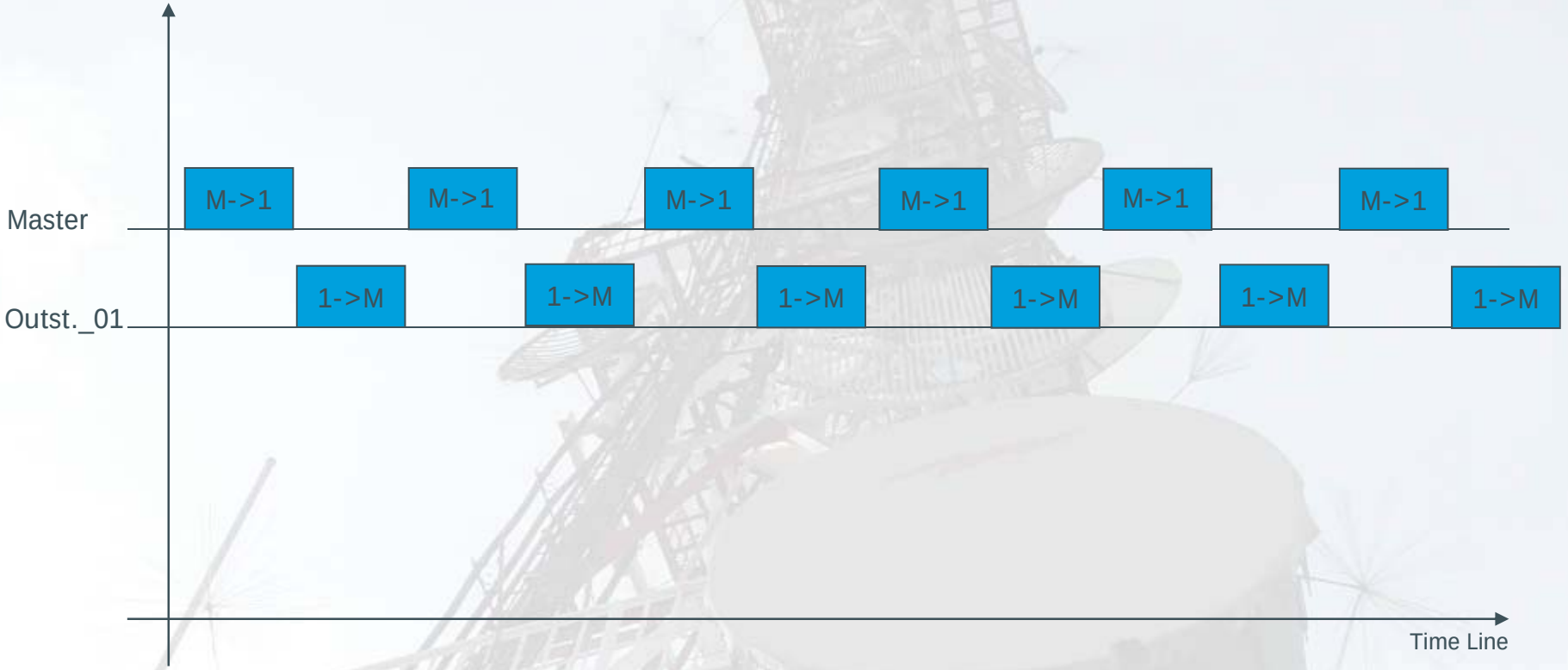
SCADA – using SDS based Radio-to-Radio Communication in P2P Application

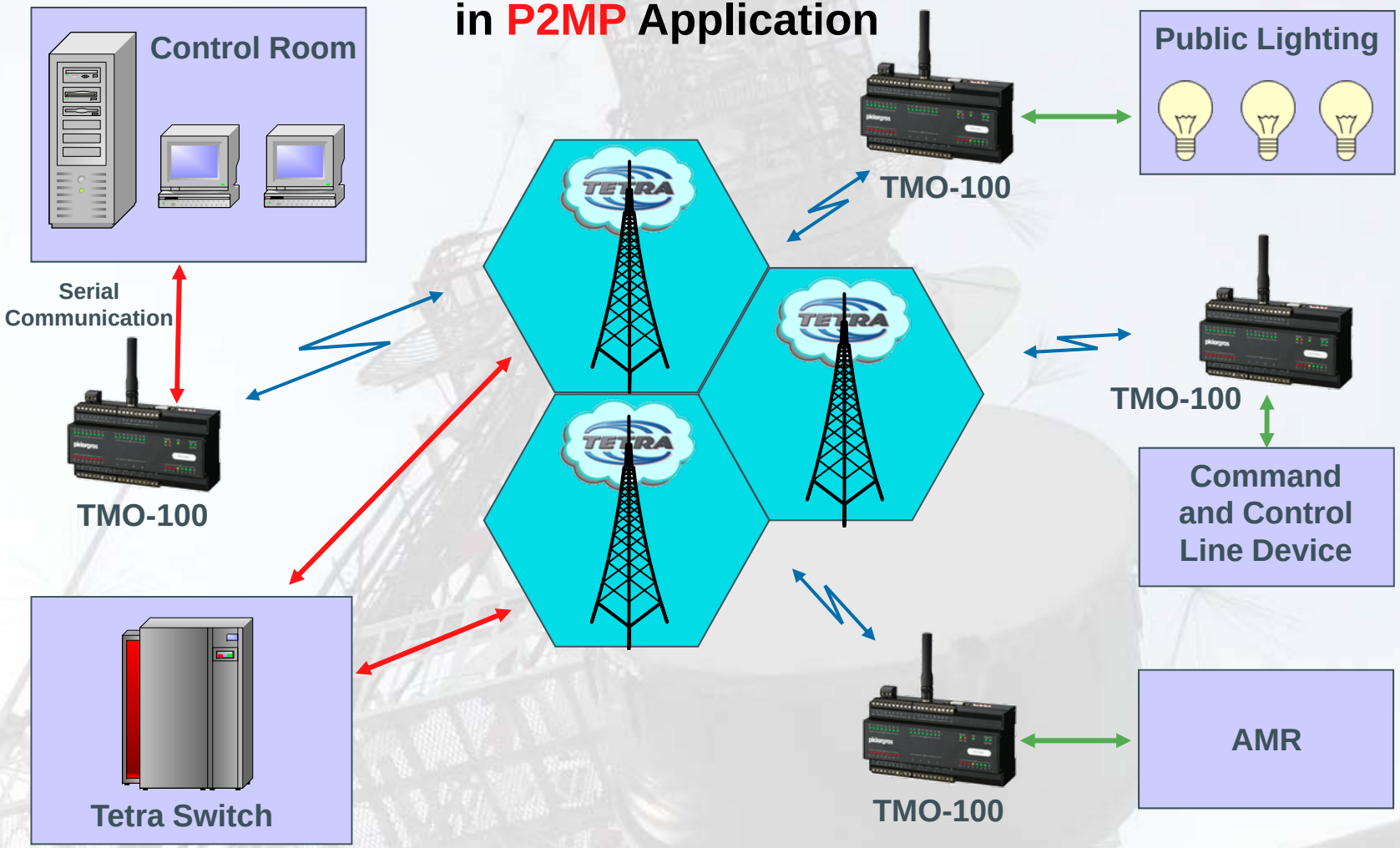


Polling-Timing in P2P Communication (Modbus RTU, DNP3, IEC60870-5-101, PakBus, ...)

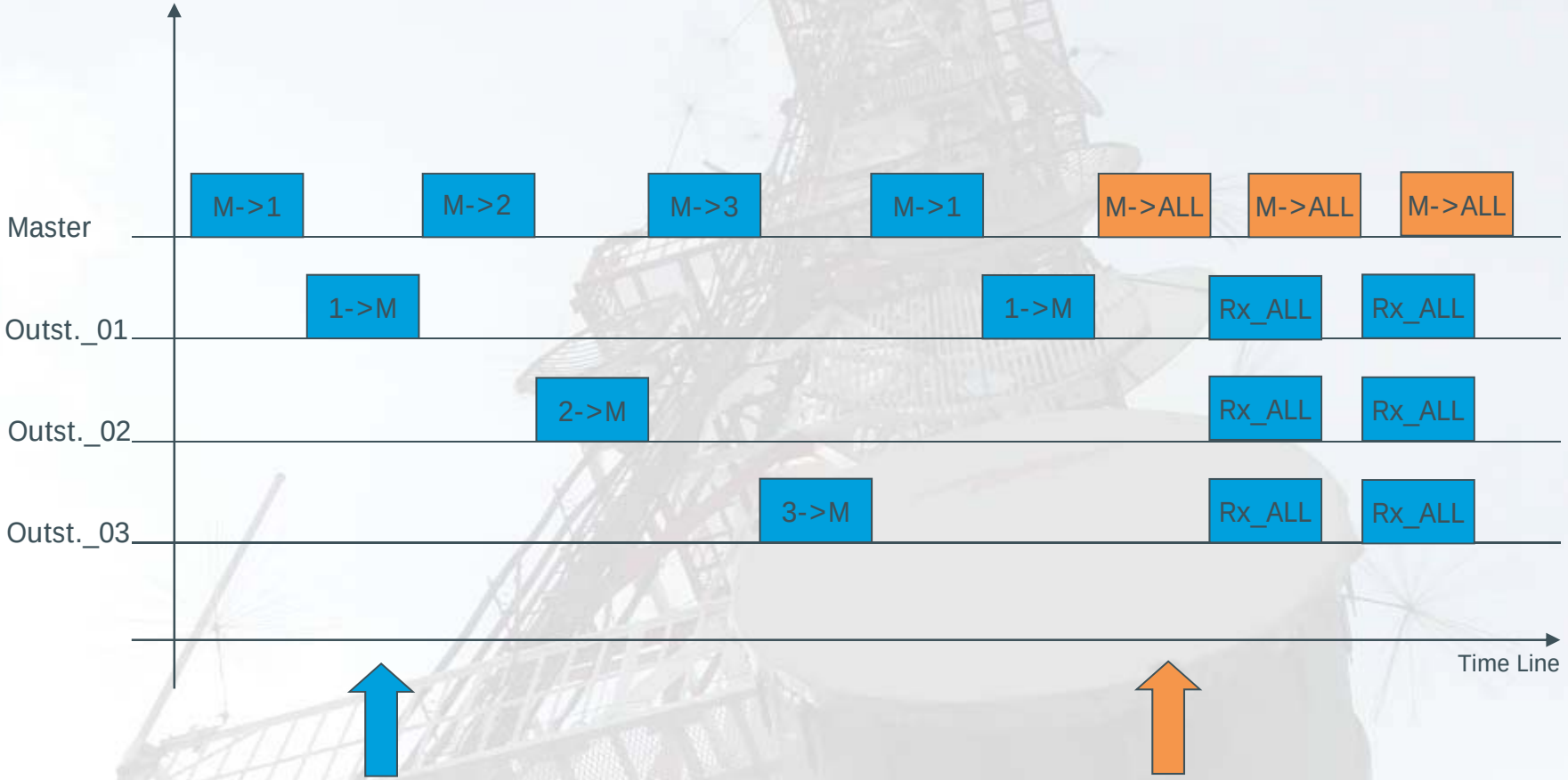


Timing does not fit to Scale

SCADA – using SDS based Radio-to-Radio Communication in P2MP Application



Polling-Timing and Broadcast in M2MP Communication

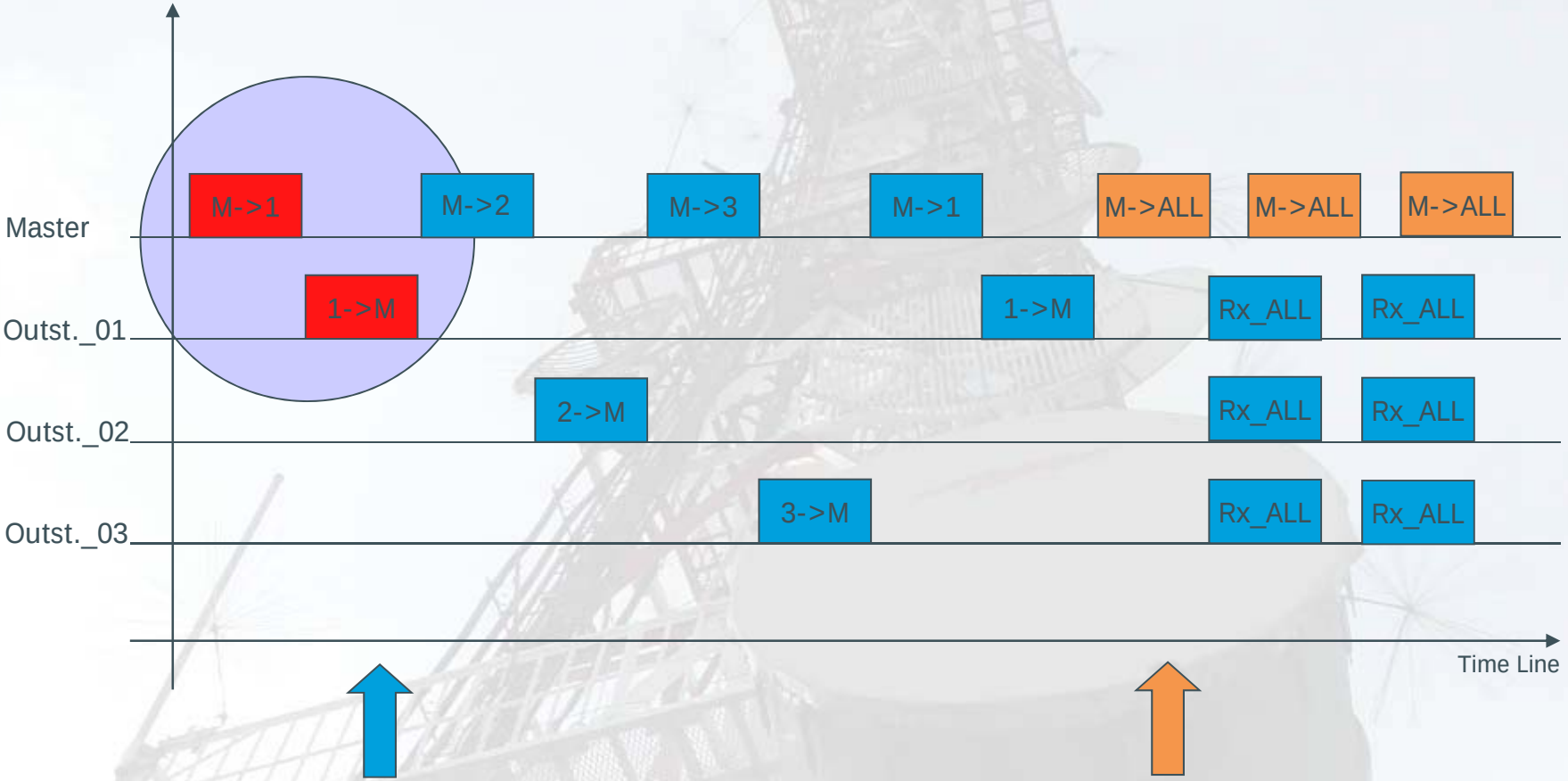


Polling Sequence. Data is sent only to one receiver at a time

Broadcast. All Units receive and act at the same time

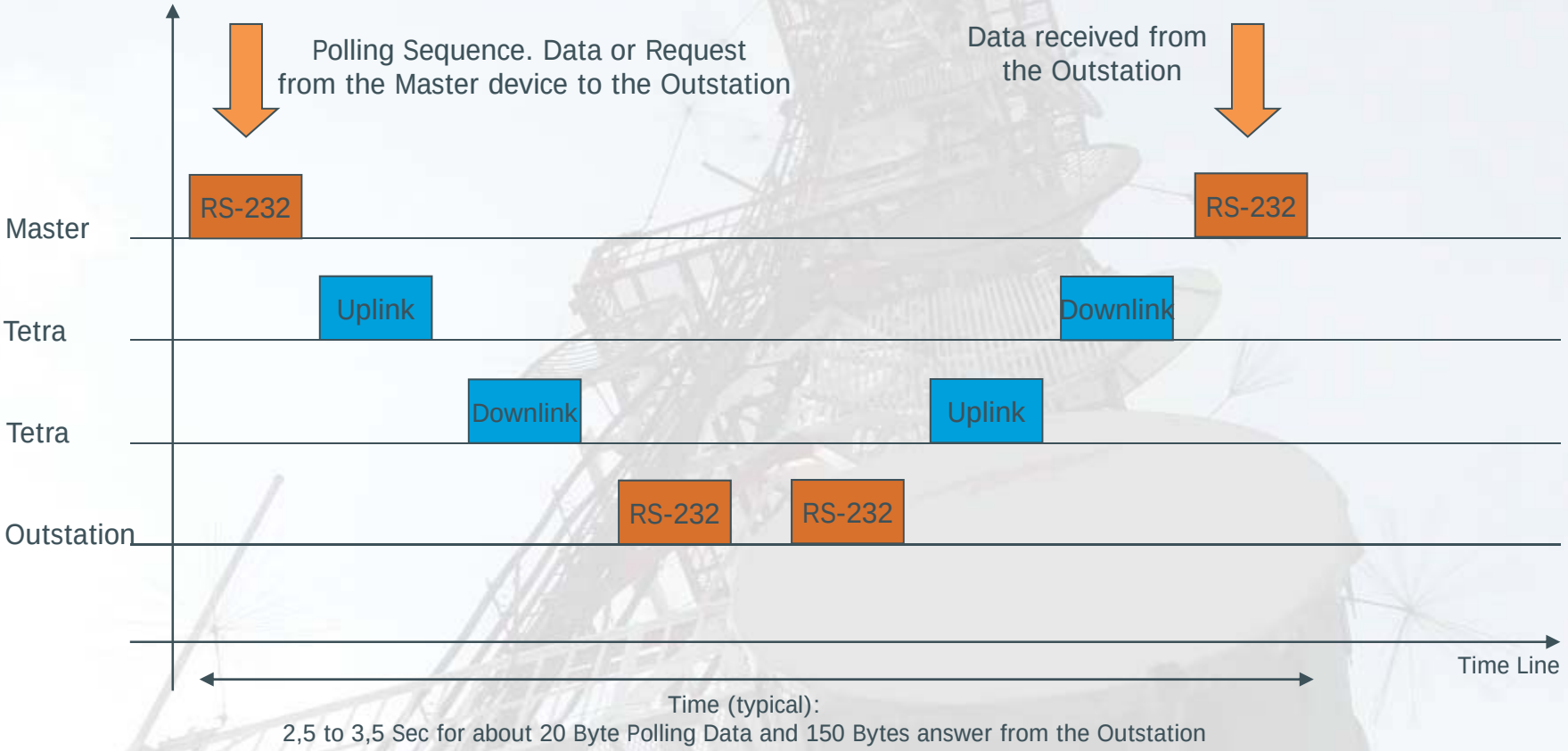
Timing does not fit to Scale

Analyze one Polling Sequence



Timing does not fit to Scale

Data Flow with Radio-to-Radio Communication



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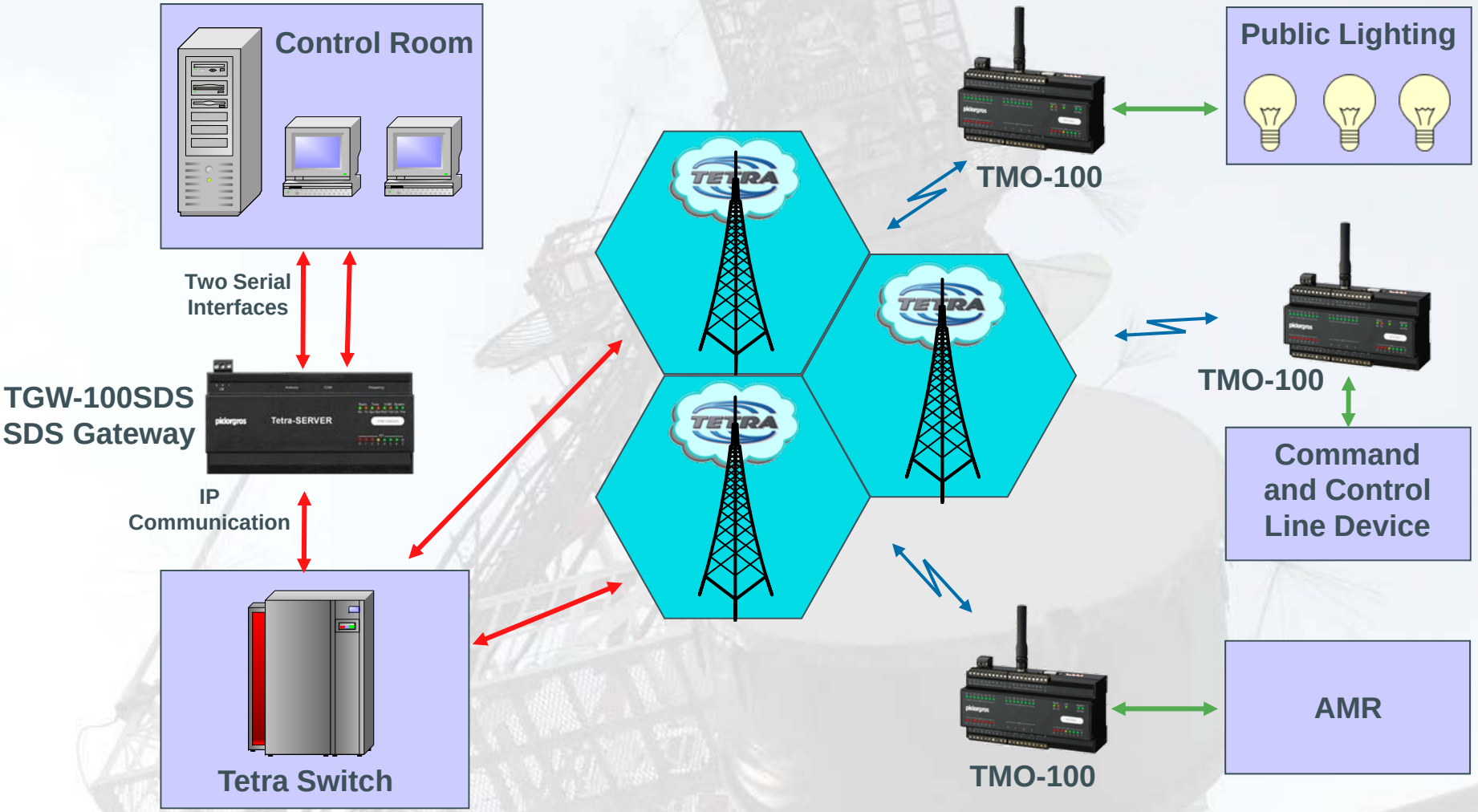
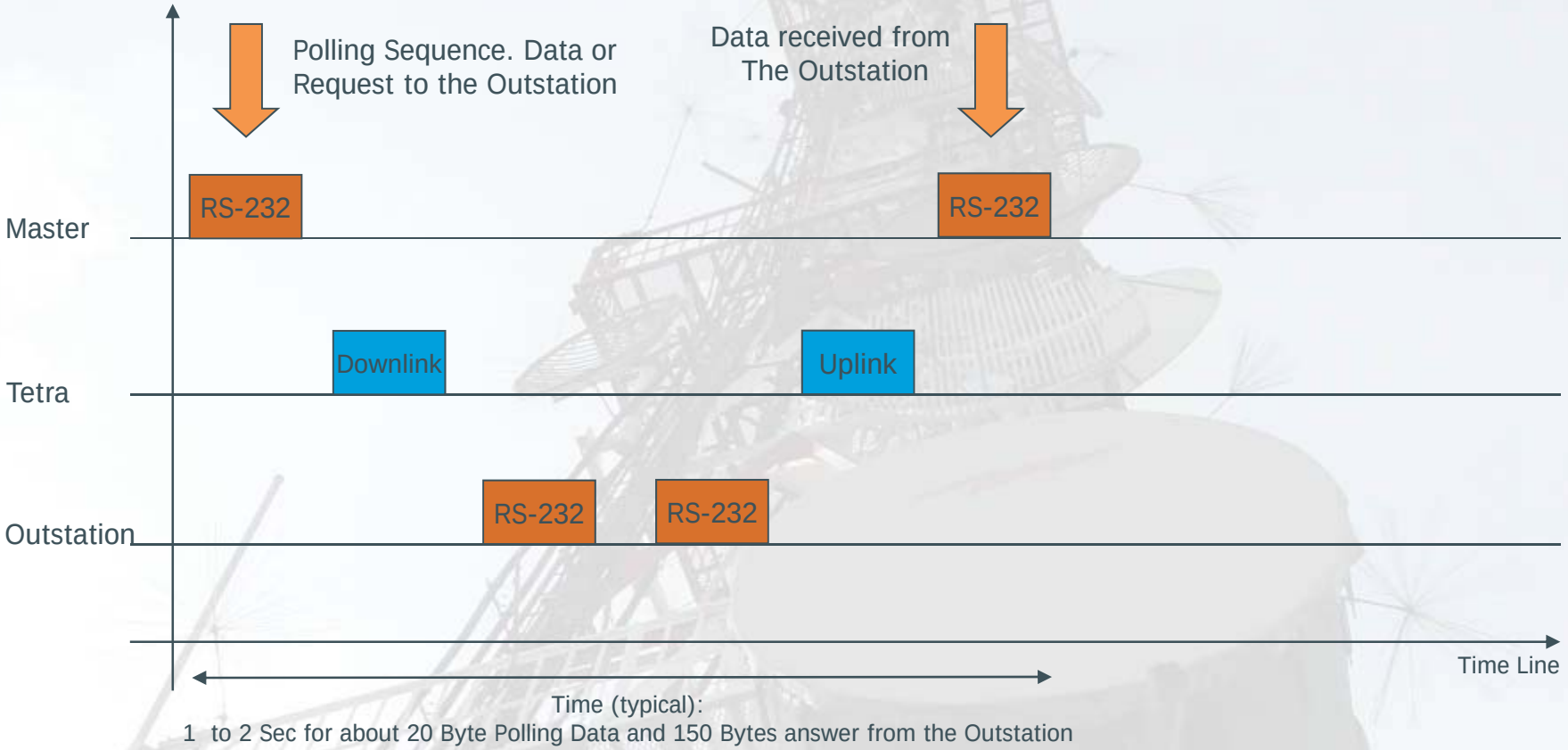
SCADA – using an SDS Gateway



Data Flow with Gateway-to-Radio Communication



Timing does not fit to Scale

Access Time for Polling Protocols using SDS Communication:

Using radio-to-radio communication and an average of about 3 seconds per polling cycle,
about 20 outstations can be accessed per minute.

Using gateway-to-radio communication and an average of about 1,5 seconds per polling cycle,
about 40 outstations can be accessed per minute.

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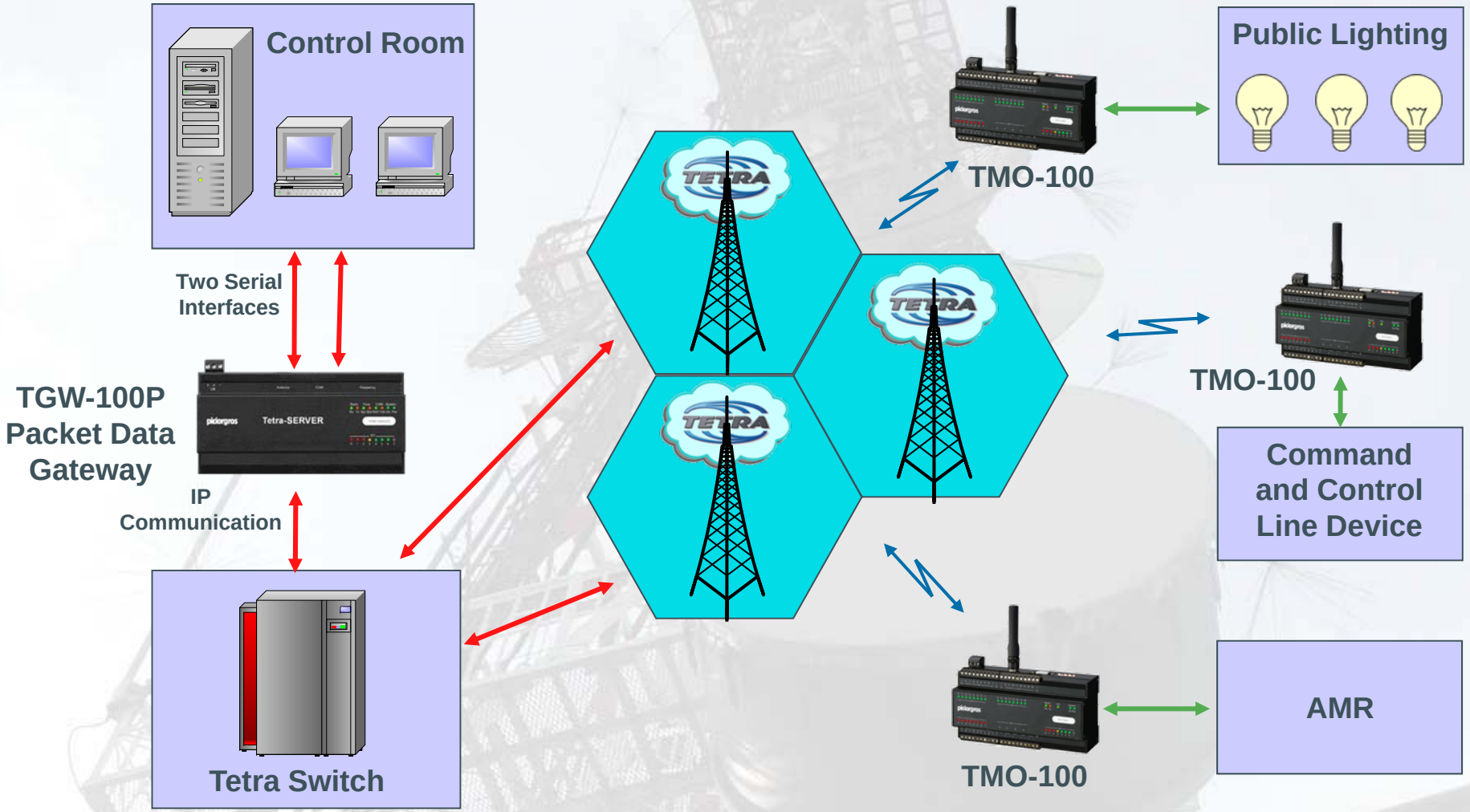
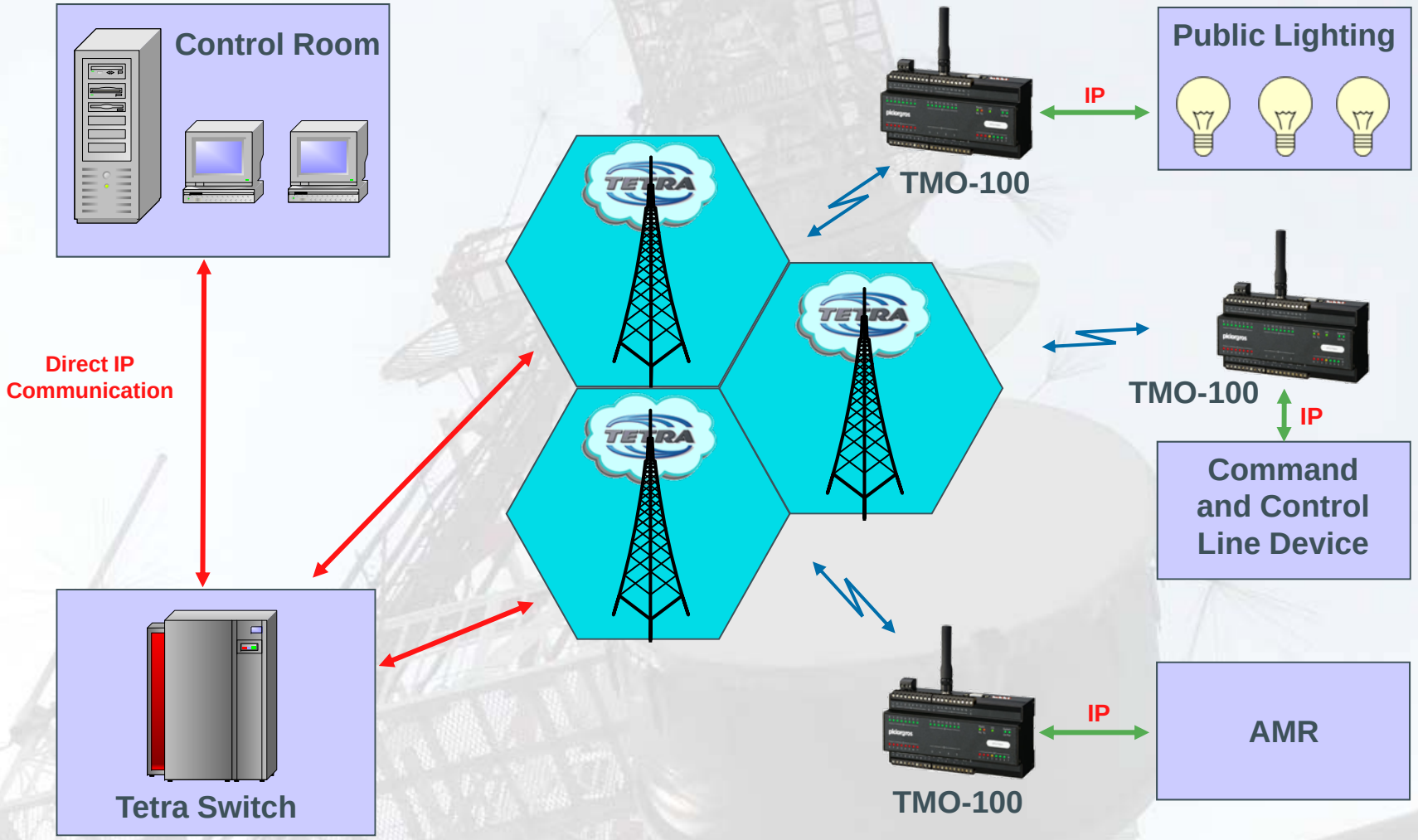
SCADA – using an Packet Data Gateway



SCADA – using direct IP Communication



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What about the difference between SDS Communication and Packet Switched Data?

Facts:

1) **SDS communication is using the Control Channel to carry the data**
2) **With Packet Data, the Control Channel is only used to "organize" the communication, while the data is fed through the Traffic Channels**
3) **Using the same amount of Data and the same protocol, in practice there is no big difference between SDS and Packet Data communication. (Packet Data is slightly faster)**

When does it make sense to use SDS Communication?

1) If the infrastructure does not support Packet data
2) On Event Driven Communication with little traffic (low network load)
3) On a low to medium number of Telemetry Devices per Base Station, and high priority for Voice Communication the SDS Data Communication has the advantage that the Traffic Channels are available all the time for voice calls.
4) If Secondary Control Channels are available

When does it make sense to use Packet Data Controlled Communication?

1) If the infrastructure does not support Secondary Control Channels and the number of outstations per Base Station is high
2) If Data Communication has priority against Voice Communication (pure data network)
3) If there are available enough Channels (Carriers) per Base Station

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Pro and Contra SDS Communication:

1) + it is easy to implement in Radio-to-Radio links as there are the same and exactly defined conditions on all infrastructures (air interface)
2) + it does not affect the Traffic Channels
3) - SDS Gateways are difficult to implement, as there is no standardized interface on the Tetra Switches
4) - with a high number of outstations or huge amount of data, the Control Channels will be overloaded
5) - the SDS size is limited on some manufacturers to 140 or 160 Bytes (a maximum of 254 bytes is specified in Tetra)

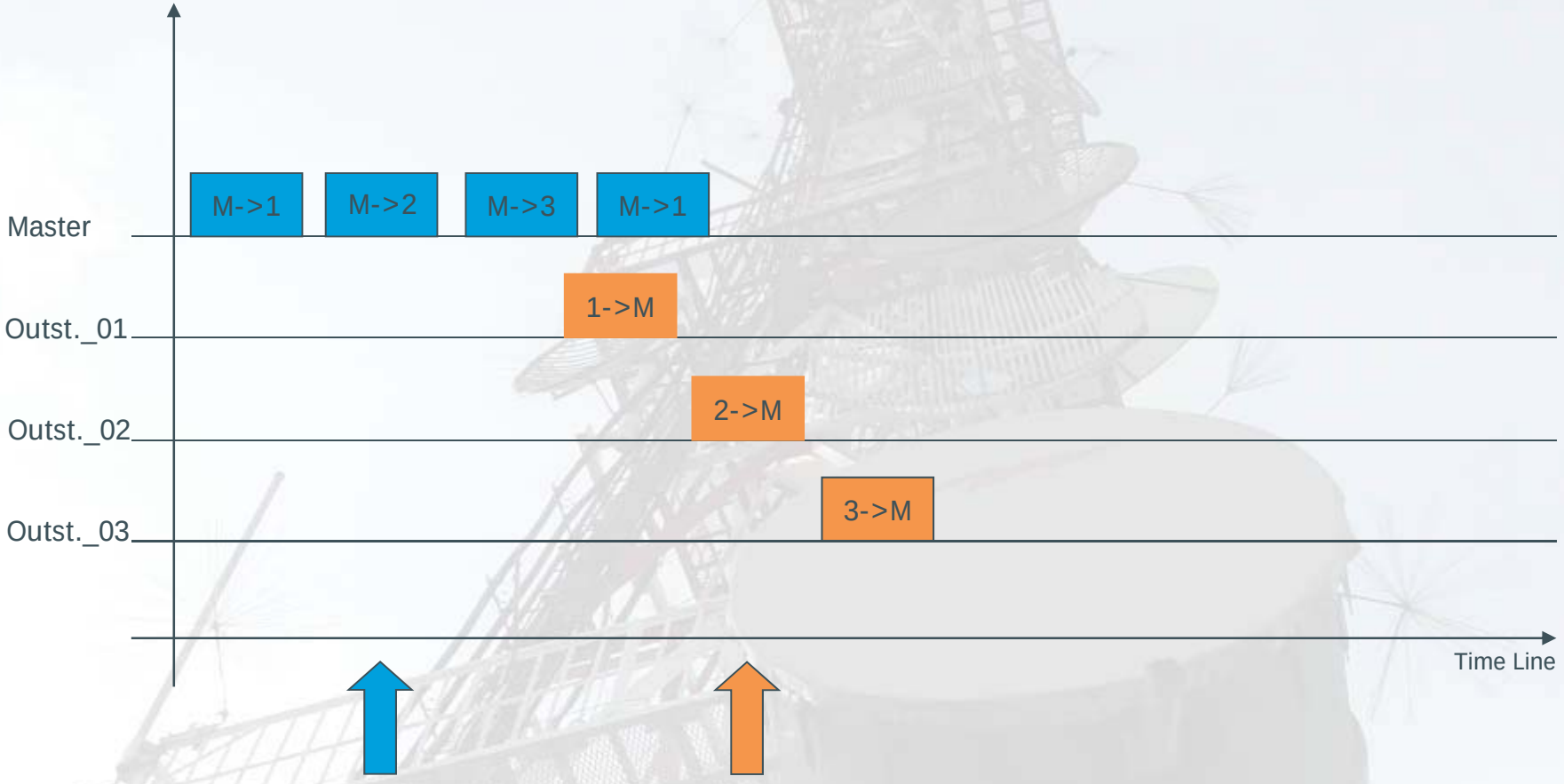
Pro and Contra Packet Data Communication:

1) + a Packet Data Gateway is easy to be connected to a Tetra infrastructure (Switch) as it only operates on IP communication
2) + IP Communication is easy to manage
3) + if there are enough traffic channels per Base Station, many outstations can be serviced and a huge amount of data can be carried without affecting the Control Channel
4) - complex Modems or Outstations are needed (Embedded Router, Port Forwarding, NAT, IP-Stack, …)
5) - if voice has priority the communication can be affected if there is high voice traffic

Increasing the number of polled outstations to over 120 per minute

1) Choose direct IP Communication or a Packet Data Gateway, directly connected to the Tetra Switch
2) Choose IP Communication or Serial (RS-232) over Packet Data Communication
3) Spread the consecutive polling's over different Base Stations
4) Poll one device after the other without waiting for each response
5) Poll every 0,5 seconds

Modified Polling-Timing to increase the number of polled Outstations per Minute



Timing does not fit to Scale

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