

Professional TETRA Data Modem TMO-100 and TETRA Test Set



 **FUNK-ELECTRONIC**
piciorgros
GMBH

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1 TETRA System Structure for Data Applications

Data applications for utilities, water/ wastewater, gas and oil and similar applications can be operated in different ways. Polling protocols, polling protocols (also) using unsolicited messaging, protocols based on serial communication and protocols based on IP communication.

The TETRA infrastructure can also be used in different ways to communicate the data messages from one or more SCADA server(s) to the data outstations: SDS communication, Packet Switched Data and Multi Slot Packet Data.

1.1 Serial Protocols on TETRA

Serial protocols can be sent as SDS or with PD.

When sending as SDS messages care should be taken, as the lengths of SDS messages differ from infrastructure to infrastructure, so it may take more time to transmit with SDS when the SDS length is not using the full TETRA specification of 254 bytes per SDS message.

When sending data messages with PD (that will be the user's choice if the TETRA infrastructure does not support SSCH and he wants to avoid too much SDS traffic on the MCCH), the serial data will be framed into an UDP/IP data frame and sent on traffic channels.

1.2 IP protocols on TETRA

1.2.1 TETRA Packet Data Feature

When using IP communication over the TETRA network from end to end (SCADA server to data outstation), the TETRA PD feature is the best choice. In this case one or more TETRA time slots can be used simultaneously for the data transport (three time slots on the first carrier, four on each of the additional RF carriers on the same BS). It is important to know that on each PD traffic channel more than one MS (outstation) can operate in "semi" parallel when **Packet Data Channel Sharing** is enabled on the infrastructure. Even if simultaneous operation on a single time slot is not essentially needed it is important to enable the packet data channel sharing, because once the data communication between the SCADA server and the outstation is completed, the MS will stay on the PDCH until the Ready Timer (MS and Infra) has been elapsed – which usually takes 3-5 seconds. And without packet data channel sharing this timeslot will be blocked and the SwMi will report on a new data transmission request from the SCADA Server with "No Resources".

End-to-End IP communication is easy to install on TETRA infrastructures, because no special data gateway needs to be installed on the SCADA server side and a simple IP connection from SCADA Server to the SwMi (please contact your Infrastructure manufacturer for more details) without any special API can be used.

1.2.2 TCP and UDP Protocols

With Packet Switched Data or Multi Slot Packet Data, IP communication can be used on TETRA infrastructures. But when using standard PC applications like SCADA servers and TCP/IP (Protocols like: DNP3/IP, Modbus/IP, IEC60870-5-104), the timeouts of the TCP/IP link are often too short to guarantee a smooth and effective data

communication over the TETRA network. Therefore the TCP/IP timing has to be adjusted on the SCADA server (mostly changes in the Windows registry are needed) to ensure a proper operation over TETRA.

In comparison to the TCP-Protocols, UDP is more efficient for TETRA because it does not use any additional “logical handshaking” and it can be seen similar as serial data protocols, where the SCADA Server and its data timeouts control the communication link.

1.3 TETRA Data Gateway for Serial Protocols

To avoid a “data bottle neck” on the TETRA network air interface on the SCADA servers side (here all data to and from all outstations has to pass from the SCADA server to the TETRA infrastructure) a TETRA Data Gateway should be used between SCADA server and TETRA SwMi.

The TETRA Data Gateway will receive all serial data frames from the SCADA Server and will send it using a special API (in TETRA this interface is not specified, so each TETRA infrastructure manufacture will have its own interface) to the data outstations.

1.3.1 Gateway Routing Table

Serial protocols will always contain (there may be some exceptions on proprietary user protocols) a destination address. Care has to be taken to NOT USE TETRA group communication but send the serial data to an individual ISSI for each single data outstation. Therefore the TETRA Data Server needs to convert the serial data protocol received from the SCADA server into a TETRA message to be sent to an individual MS.

1.3.2 Gateway Data Compression

In many cases protocols for utilities, water, wastewater, gas and oil, (more) are not very efficient and can contain a lot of “00” or “FF” or similar data. In this case data compression is useful to minimize the load and to use the TETRA network in the most efficient way.

1.4 Optimizing the Data Throughput on TETRA networks

1.4.1 Data Throughput with SDS Communication

When polling data (requesting data from the outstation) - using e.g. the Modbus RTU protocol with an SDS message of about 10-15 bytes for the poll request and 100 bytes of responding data - a complete polling cycle in a live network will need about 1,5 seconds (not including the field device (PLC) latency!). During that time period the TETRA network (time slots) will not be used efficient and most of the time being in idle state not carrying any data.

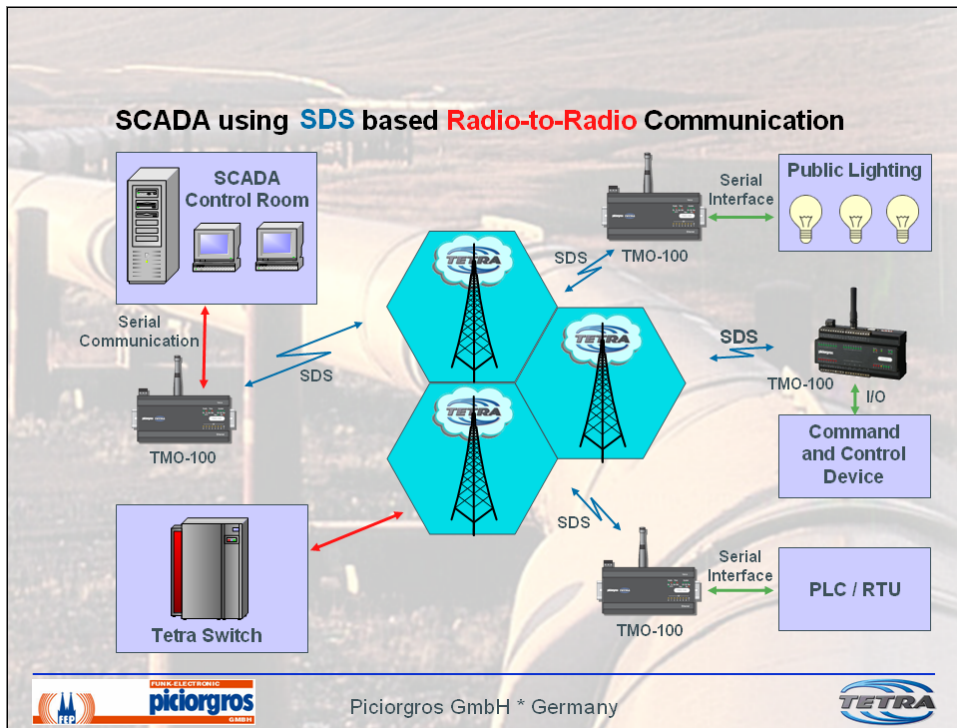
When splitting the SCADA Server into several polling nodes and polling simultaneously on the same timeslot(s) the data throughput can be increased substantially. De facto up to four (depending on the infrastructure) polling nodes on a single time slot will (also) increase the data throughput by four times. Care has to be taken in this scenario, because the single response time for a single polling request can be increased, and a suggested value for the SCADA Server polling timeout is about 3 seconds

1.4.2 Data Throughput with PD communication

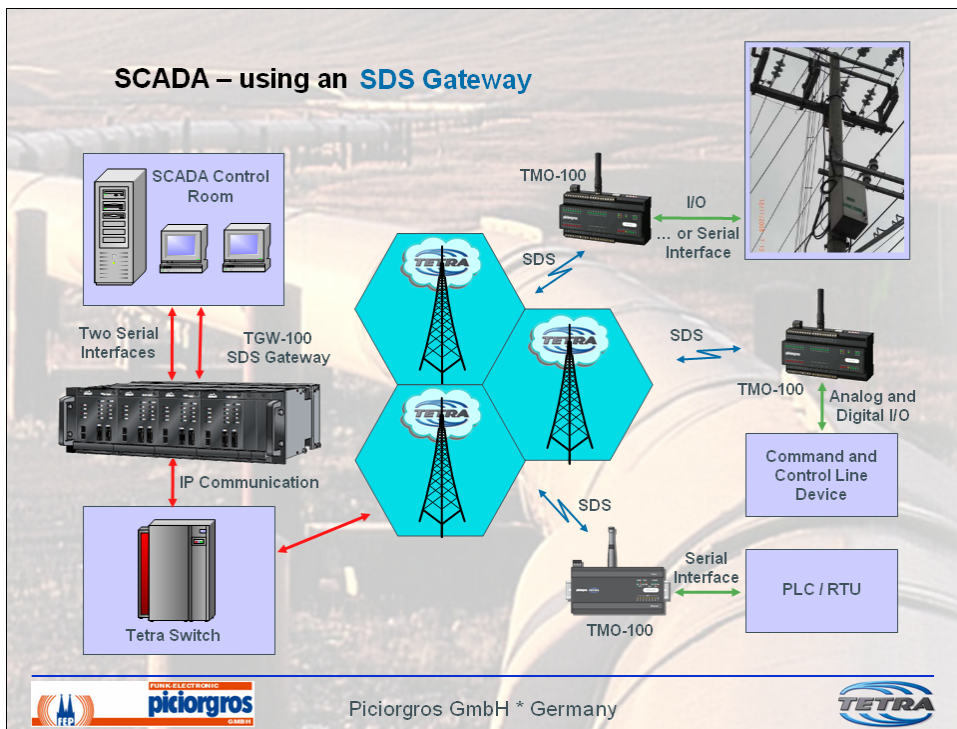
As already mentioned above, it is essential that on Packet Data communication, the TETRA channel sharing for all of the used packet data channels has to be enabled, otherwise each single data communication to a single outstation device will block the used timeslot (logic channel) for the pre-programmed SwMi and MS "Ready Timer". And as the data packets can be in different sizes and the outstation can respond with different latency, the Ready Timer should be chosen not too short (suggested: 5 seconds).

1.5 TETRA Network architectures

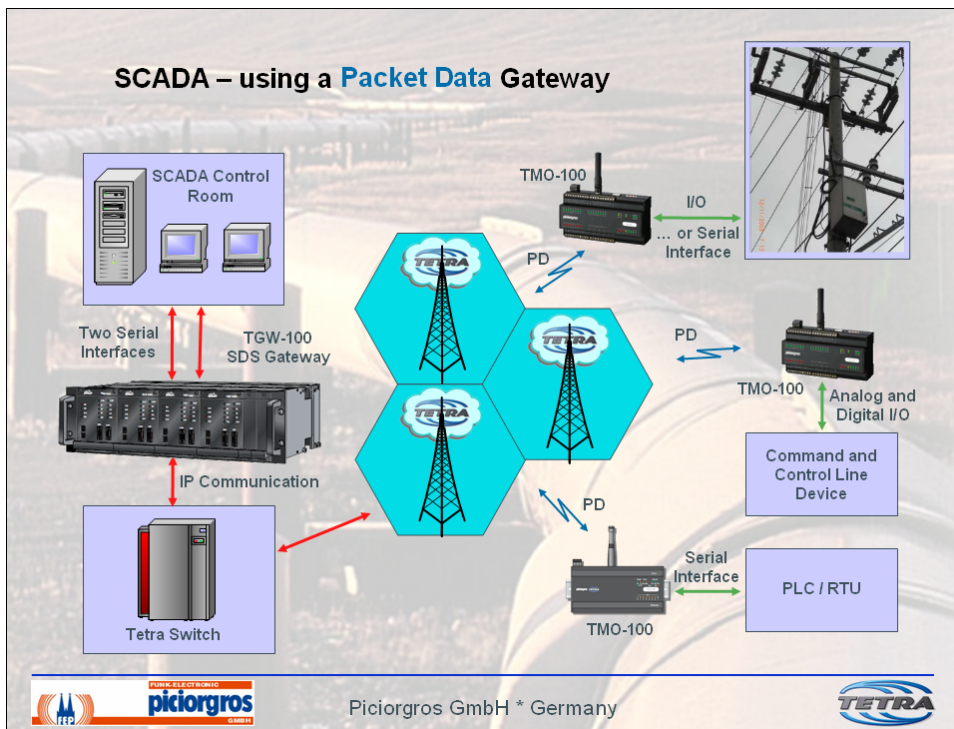
1.5.1 SCADA Control Room linked to TETRA via Master Radio and TETRA Air Interface



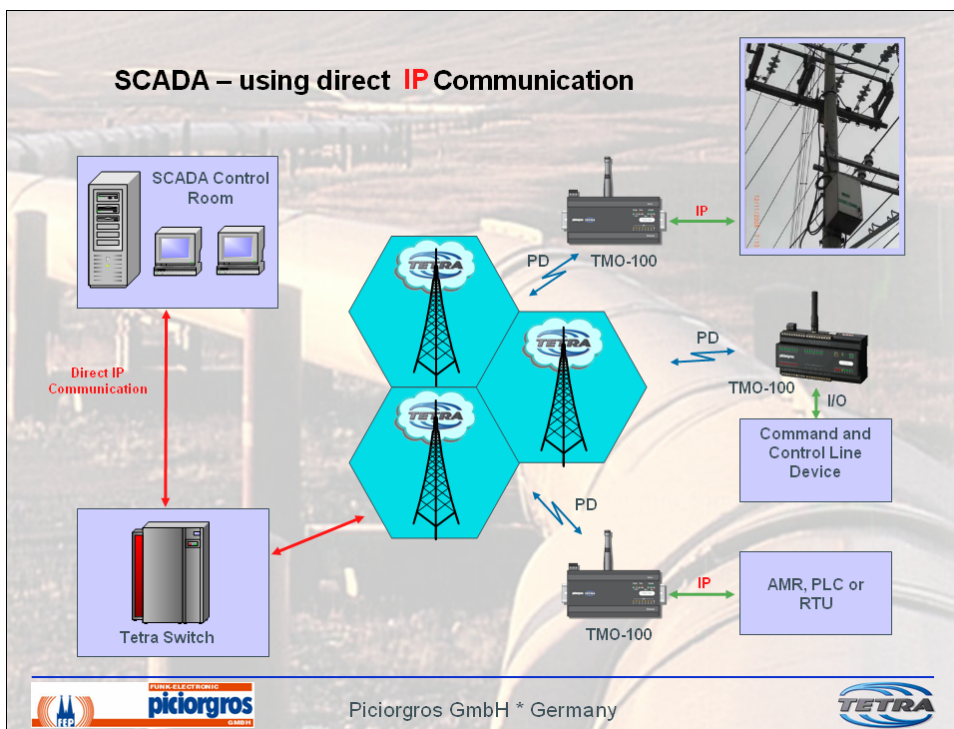
1.5.2 SCADA Application using a SDS Gateway (no Air Interface on Control Room site)



1.5.3 SCADA Application using a Packet Data Gateway (no Air Interface on Control Room site)



1.5.4 SCADA Application using IP to IP Communication over PD or MSPD (no Air Interface on Control Room site)



1.6 TMO-100 Data Modem Features

1.6.1 TMO-100 Data Modem

The TMO-100 TETRA Data Modem fulfils all Requirements for Data Communication over TETRA infrastructure.

The unit is a full functional and transparent IP Data Modem that does not need any additional commands or actions from the connected data concentrator or PLC for establishing the PPP context and the IP link.

1.6.2 TMO-100 General and Protocol Features

- TETRA IP Data Modem with RJ-45 10/100 T-Base connector
- Automatic PPP context set up after power on
- UDP and TCP/IP
- Embedded router function with NAT and Port Forwarding,
- Port Forwarding pre sets for DBP3/IP, Modbus/IP, IEC60870-5-104
- Embedded Web-Server for Set up and Configuration
- Copy Configuration to/from PC using TFTP protocol

1.6.3 TMO-100 TETRA Features

- TETRA RF output power class 3 (3 Watt)
- Automatic PPP context set up
- SNMP/Trap on TETRA exceptions (Power up, Network lost, Low RSSI)
- TETRA Black List, White List, Forbidden Cell feature
- Remote Configuration over the TETRA Network (Register access)

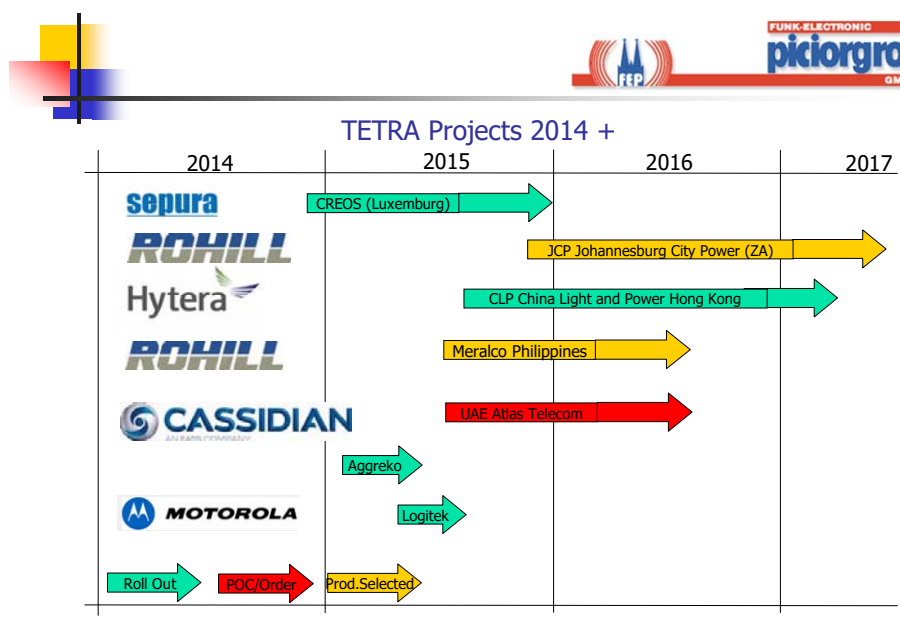
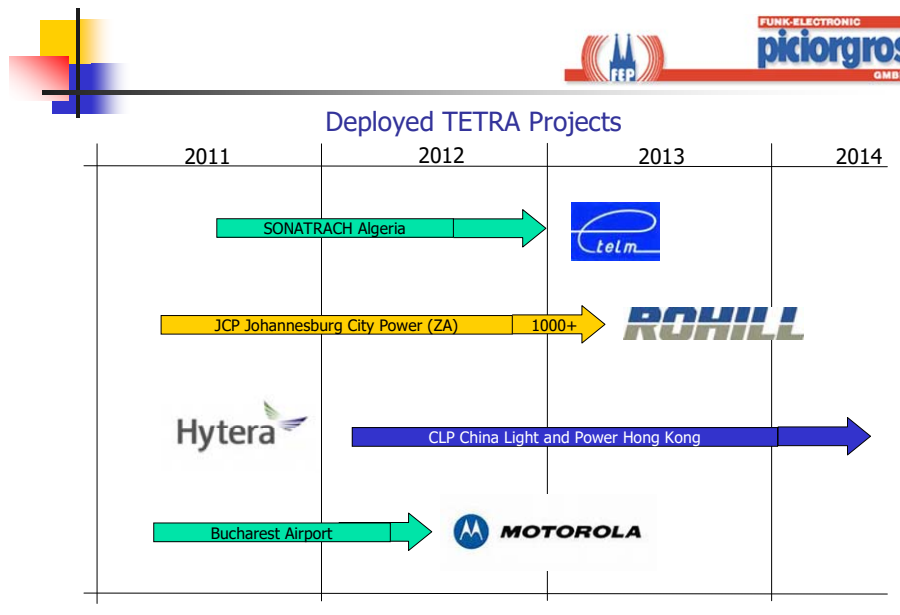
1.6.4 TMO-100 Certificates and Approvals

- CE Certified (BABT, see attached)
- IOP Certificates (Several Infrastructures, see www.TetraModem.com Download)
- Industry Canada Certifies
- FCC approved

2 Piciorgros Reference and Experience

2.1 Piciorgros Experience:

Piciorgros (The company was founded in 1995) is a TETRA core manufacturer with its own TETRA product since 2008 and experience in TETRA software and hardware technology. Our main focus is TETRA for SCADA, Telemetry and Telecontrol applications in Water Wastewater, Gas and Oil, Utilities, Electricity Companies and many other applications.



2.2 Some Piciorgros SCADA Projects:

Street Lighting

JCP – Johannesburg City Power – Johannesburg, South Africa

Infrastructure: Rohill

Number of Units Sold: 1000

- SCADA Application
- Street Lighting Control (with Philips)
- Mini Substations

Smart Meter

CLP – China Light and Power – Hong Kong

Infrastructure: Cassidian, Hytera (Former R&S)

Final number of Modems: 700-1000

- Smart Meter reading
- SCADA
- Other applications

Gas and Oil

Aramco – Kingdom of Saudi Arabia (Pilot)

Infrastructure: Cassidian

- Cathodic Protection

Sonatrach Algeria

Infrastructure: Etelm

Number of Units Sold: 150

- Other applications



Germany

- GVG Rhein Erft, 150 Stations CP-Application
- Gas Supply City of Hürth

Tunisia

- STEG-Gas, pipeline control of the international Algeria-Italy pipeline

Estonia

- Gas Supply and Control with Siemens PLC Type S7-315

Water- and Wastewater Monitoring

Algeria

- Control of water pumps and lift stations

Afghanistan and Korea

- SCADA control of freshwater pumps and wells

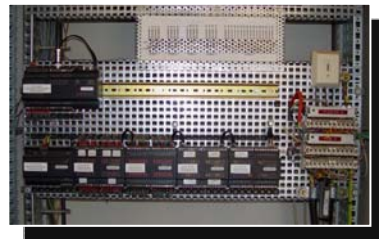
Some Projects for Water- and Wastewater in **Germany**:

- Water monitoring in chemical production Bayer-Dormagen,
- Others: Wasserversorgung Altusried, Stadt Osnabrück, Kläranlage Krefeld, Stadt Duisburg, Stadt Brilon, Stadt Bielefeld, Stadt Düren, Stadt Papenburg, Stadt Waldsassen, Stadt Böblingen-Schwippe

Mining

Germany

- Open Pit Mining (Water Level Control) Tagebau Hambach, Germany



Turkey

- Mining Application – DMO Mode



Utilities

Germany

- Surface Mining Hambach,
Control of 80 Pump Stations

Chile

- SAESA, sociedad austral de electricidad
Power Measurement and Control

Korea

- Samsung Electronics Onyang Factory
Radio Controlled Power Management

Asia

- Utility (Energy Companies) Pole Mounted Switches

President Palace



Traffic Management Systems and Car Parking Routing

Germany

- ICE Warning-System on Interstate A9, A1, A2 (Bremicker)
- Car Park Routing in the following cities:
Lippstadt, Ulm, Timmendorfer Strand, Düsseldorf, Ingolstadt, Limburg, Arena
Hamburg, Soest, Rinteln, Gelsenkirchen,

Austria

- Car Park Routing Salzburg (Siemens)
- Car Park Routing Bregenz (Dambach)

Luxemburg

- Car Park Routing Luxemburg (Siemens)

Switzerland

- Car Park Routing Bern (Siemens)

Egypt



- Car Park Routing Cairo (Scheid und Bachmann)

Industrial Application

India

- Cement Industry: Maihar Cements, Aditya Cements, Vikram Cements, Rajashree Cements, Ultratech – Awarpur, Binani Cements, Ambuja Cements, JK Cements, ACC – Chaibasa, Ambuja Eastern,
- Steel Companies: Durgapur Steel Plant, Bhilai Steel Plant, Bokaro Stelle Plant Grasim – Rawan, Tata Steel

Korea

- Samsung Soowon Factory:
Energy Control of Steam Energy

Middle-East Africa Region:

- Cement Industry: Citi Cement Riyath, Saudi Cement Damman, Obajan Cement Nigeria

