NVMS SOLUTIONS

VIC Roads – Structural Health Monitoring Workshop

16th July 2018

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Who we are

- 29 years supporting industry
- Application based solutions
- Global support
- Custom solutions

NVMS SOLUTIONS

What we do

End-to- end Noise and Vibration solutions by partnering with clients and industry to build successful solutions

NVMS SOLUTIONS

Our Global Partners

"Trusted supplier of global recognised leaders in there fields, this allows NVMS to tailor solutions to meet our customers demands"

BAKER HUGHES a GE company

Channel Partner

CTC

CONNECTION TECHNOLOGY CENTER, INC.

CONNECT TO CONFIDENCE

EMS Brüel & Kjær

PARTNER

HBM

Brüel & Kjær

BEYOND MEASURE

NVMS SOLUTIONS

Structural Health Monitoring

HBM FiberSensing

Case Studies with HBM DAQ Equipment and Sensors

Bridge monitoring using the HBM measurement technology:

https://www.hbm.com/en/6826/bridge-monitoring-an-example-from-hbm/

HBM's measurements show: The carrying capacity of the Holmenbrua bridge in Norway is weakened:

https://www.hbm.com/en/4619/holmenbrua-analyzing-the-carrying-capacity/

Are our bridges safe? Monitoring solutions provide the answers. Bridge monitoring with HBM measurement technology:

https://www.hbm.com/en/3729/db-netz-ag/

Keeping an eye on the effects of heavy goods traffic: Long-term monitoring on a motorway bridge:

https://www.hbm.com/en/3524/leibniz-universitat-hannover/

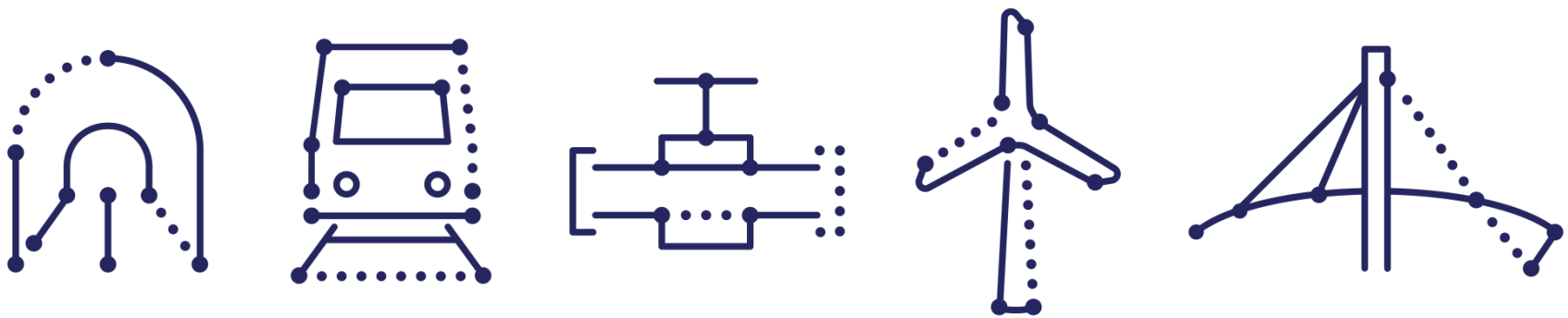
Static and dynamic load tests completed in record time: SHP opts for QuantumX from HBM for bridge monitoring:

https://www.hbm.com/en/3397/shp-opts-for-quantumx-from-hbm-for-bridge-monitoring/

Structural Health Monitoring

- What is Structural Health Monitoring?
  - Observation of an infrastructure over time by using measurements from sensors and analyzing data to determine the current state of the system's health

- What benefits from SHM?
  - All structures!! bridges, wind energy plants, water, gas and oil pipelines, tunnels, rails…

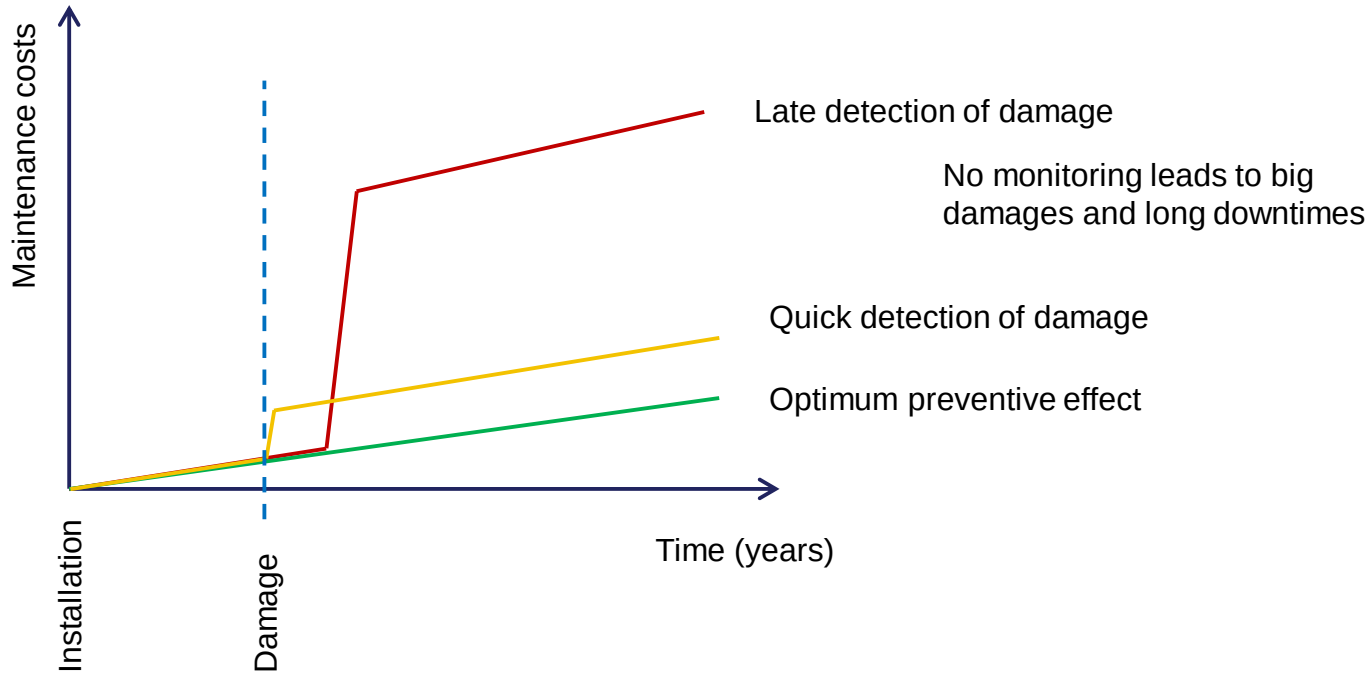


- Why do we do it?
  - Improve **SAFETY** and **STABILITY**

March 2016
Vivekananda Flyover Bridge
India

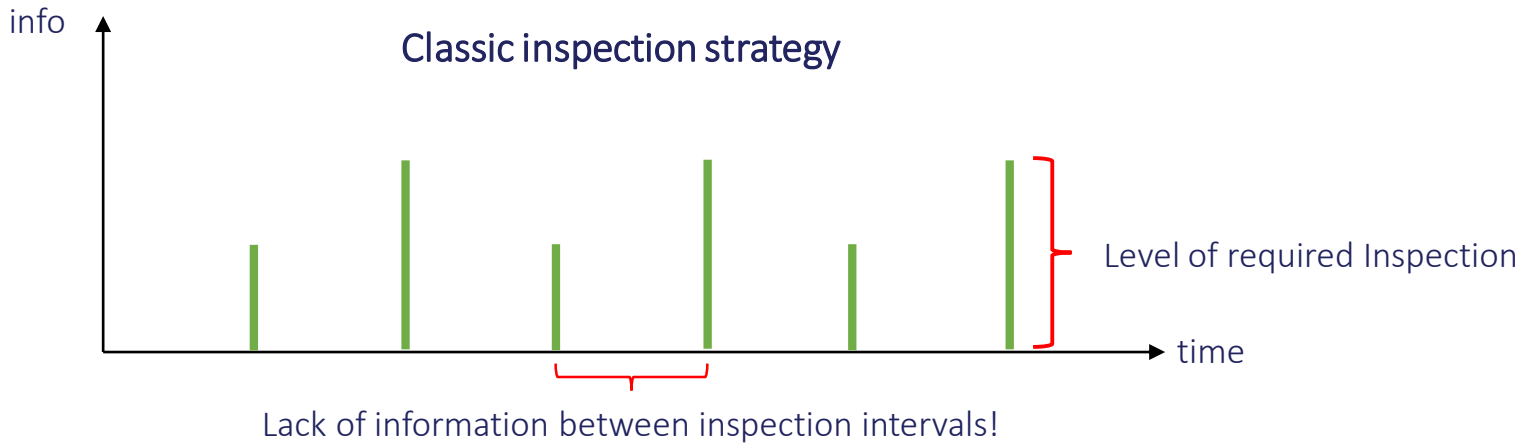
August 2007
I-35W Bridge over the Mississippi River
Minneapolis, USA

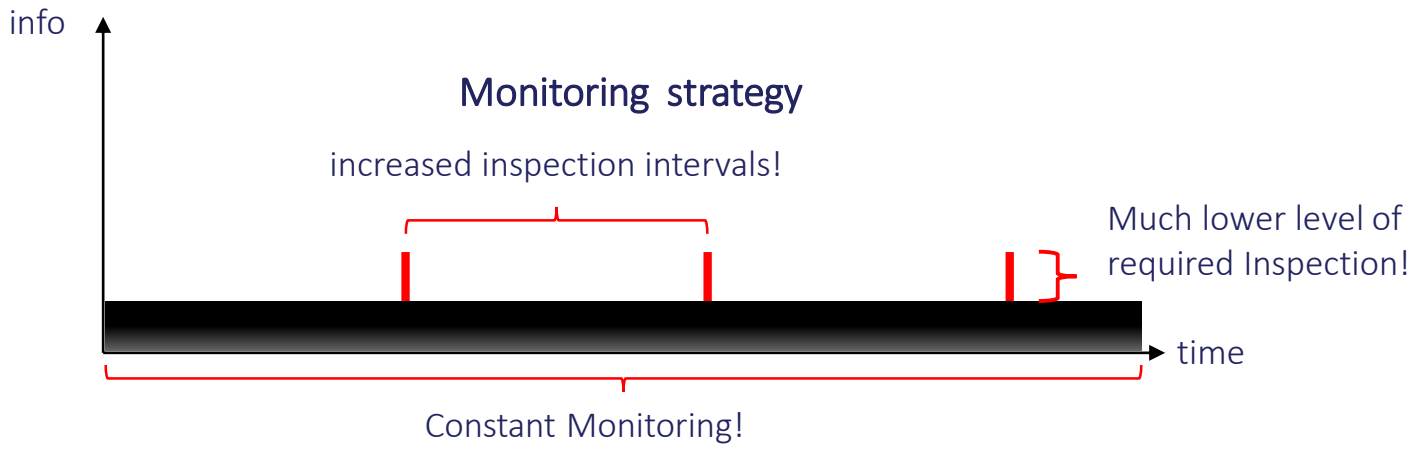
- Why do we do it?
  - Reduce **COST**
    - Time in disruption
    - Predictive maintenance



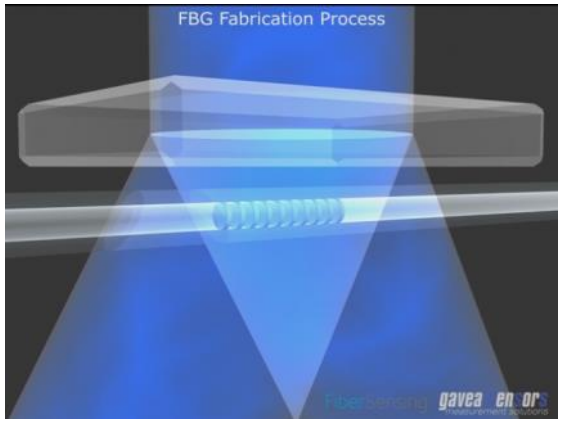
  - Increase **LIFE EXPECTANCY** and improve **PERFORMANCE**
  - **OPTIMIZE** design and support **COST EFFECTIVE** solutions

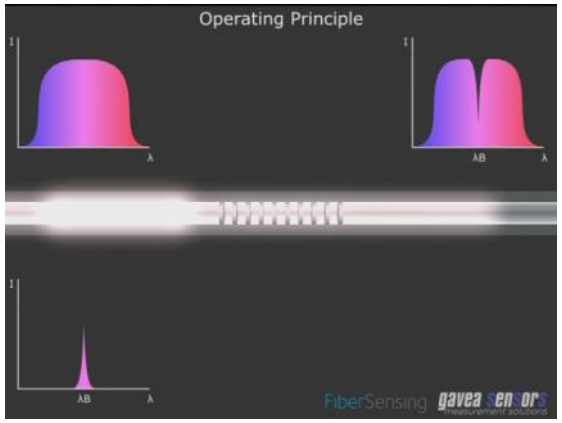
- Periodic inspection is supported by monitoring solutions!

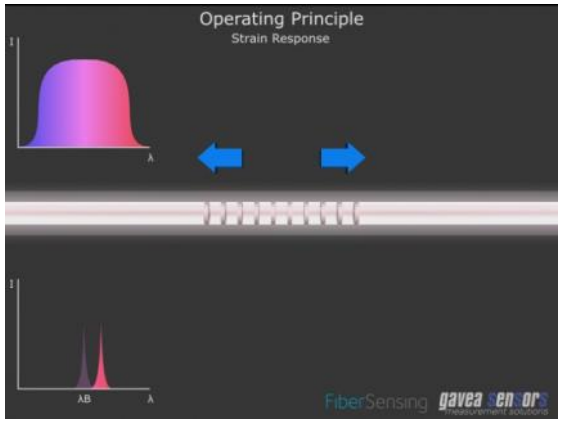


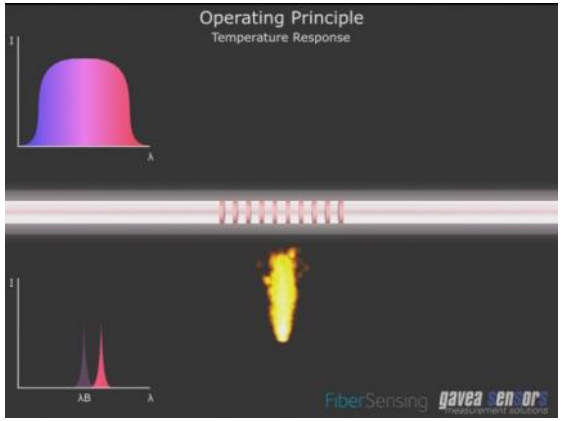


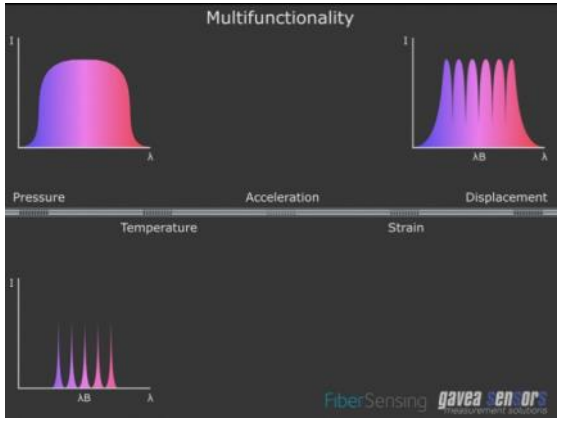
Fiber Bragg Grating (FBG) Technology

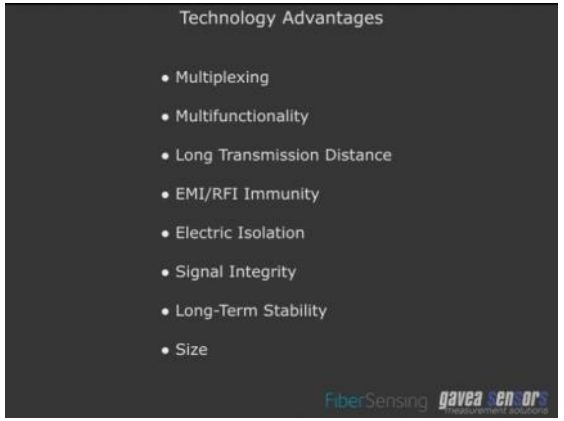








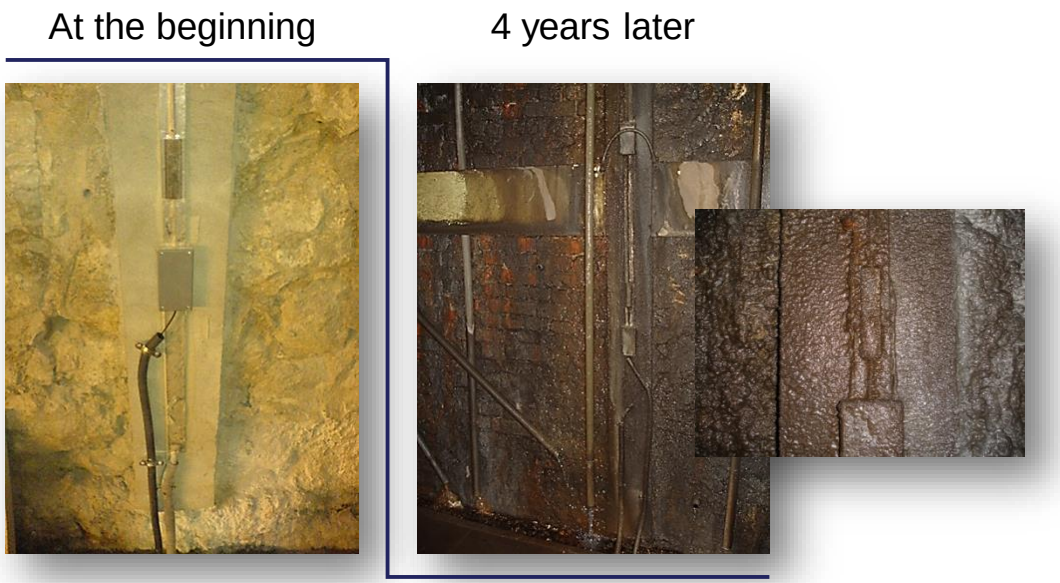




video

Challenges of SHM

- Solution durability and stability over time
  - Monitoring systems are expected to be operating for long periods and to keep their reliability even in harsh conditions
  - In most applications Structural Monitoring requires an initial reference so that damage can be identified. If the system is not stable, measurements cannot be related to each other and the reference is lost



Example of sensor application in a tunnel

FBG

- Absolute Zero Measurement with intrinsic sensor identification (spectral signature)
- Insensitive to losses (wavelength measurement)
- Built-in absolute reference on the interrogators

Challenges of SHM

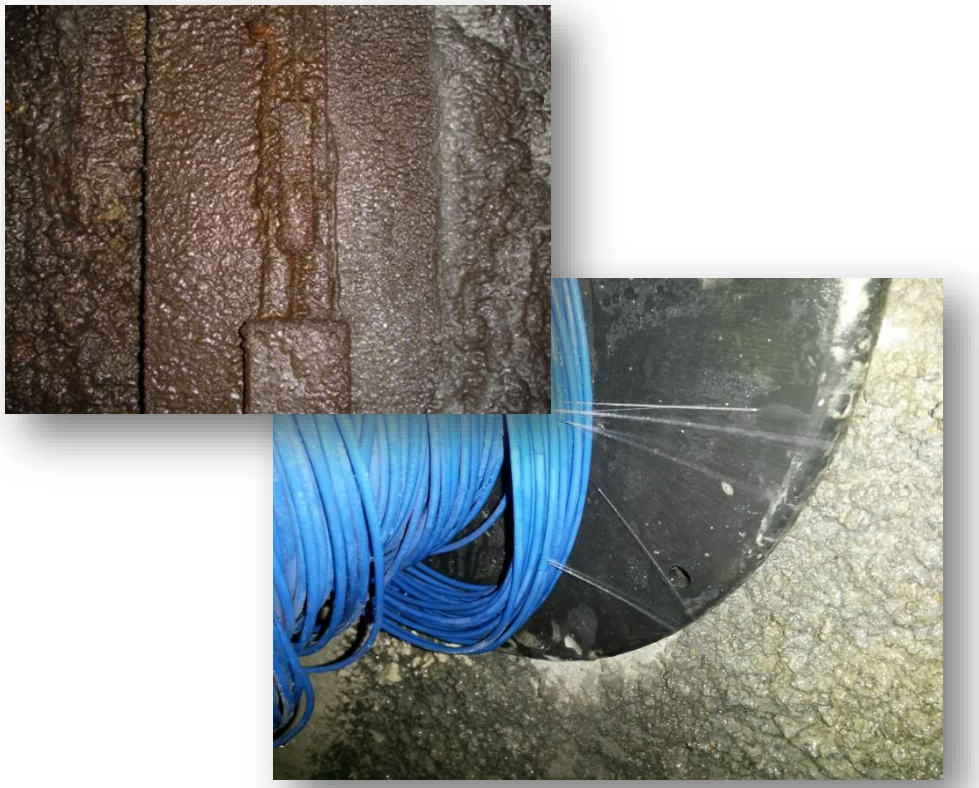
- Long structures and remote locations
  - Important structures can be large
  - Structures can be located in remote places
  - This means the installed monitoring system sometimes has to be connected through long distances
- Complex Cabling
  - When the number of sensors is large cabling and wiring can become complex

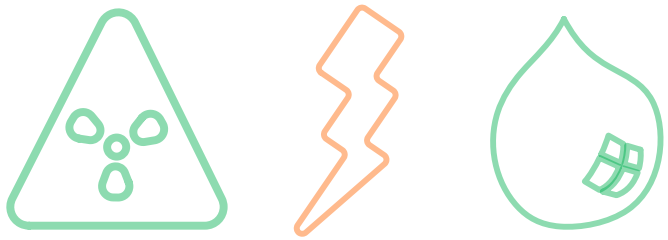
FBG

- Multiple and different sensors in one optical line (multiplexing) and long distances (km) means less cables and simpler sensing networks
- Cost effective for medium/large projects (price per sensor)
- Sensor arrays with dozens of sensors can be ready-made for installation

Challenges of SHM

- Harsh conditions and environments
  - Electromagnetic fields
  - Moisture, salt and dust
  - Radioactivity



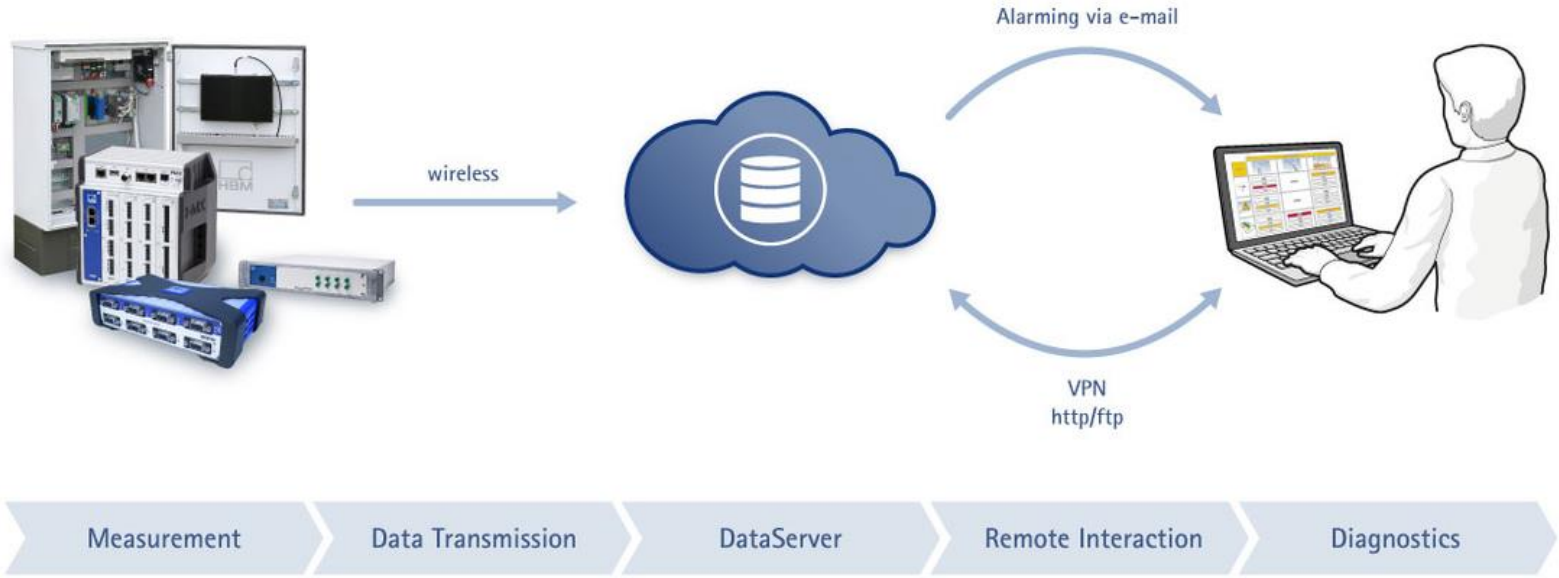


FBG

- EMI/RFI immune and passive (suitable to hazardous environments)
- Good resistance to humidity (as well as salt)
- Suitable to high pressure (tested up to 400 bar)
- Suitable to extreme temperature environments (cryogenic, high temperature)

Challenges of SHM

- Data storage, processing and analysis
  - Automatic Structural Health Monitoring systems create a large amount of data that is of no use unless it is analyzed
  - Data centers for storage
  - Automatic processing for data analysis
  - Automatic report generation
  - Alarm management



Products in Action

Product Application

- **Bridges**

System Integrators

Universities / R&D

FS22

Product Application

- **Bridges**

System Integrators

Universities / R&D

Multi Fiber Cables

Product Application

- **Bridges**

System Integrators

Universities / R&D

Protection Boxes

Splices

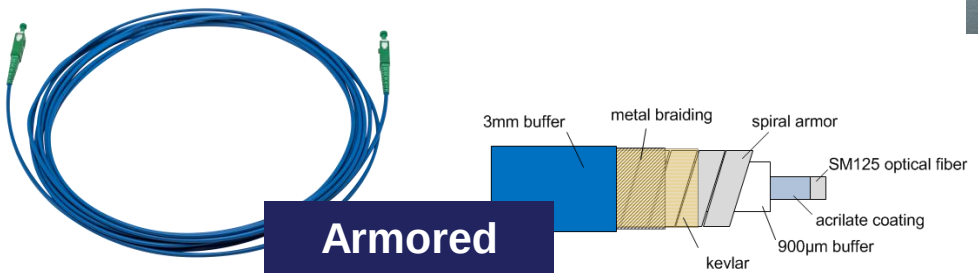
Product Application

- **Bridges**

System Integrators

Universities / R&D

Fiber Jumpers



Armored

Product Application

- **Bridges**

System Integrators

Universities / R&D

FS65 Accelerometer

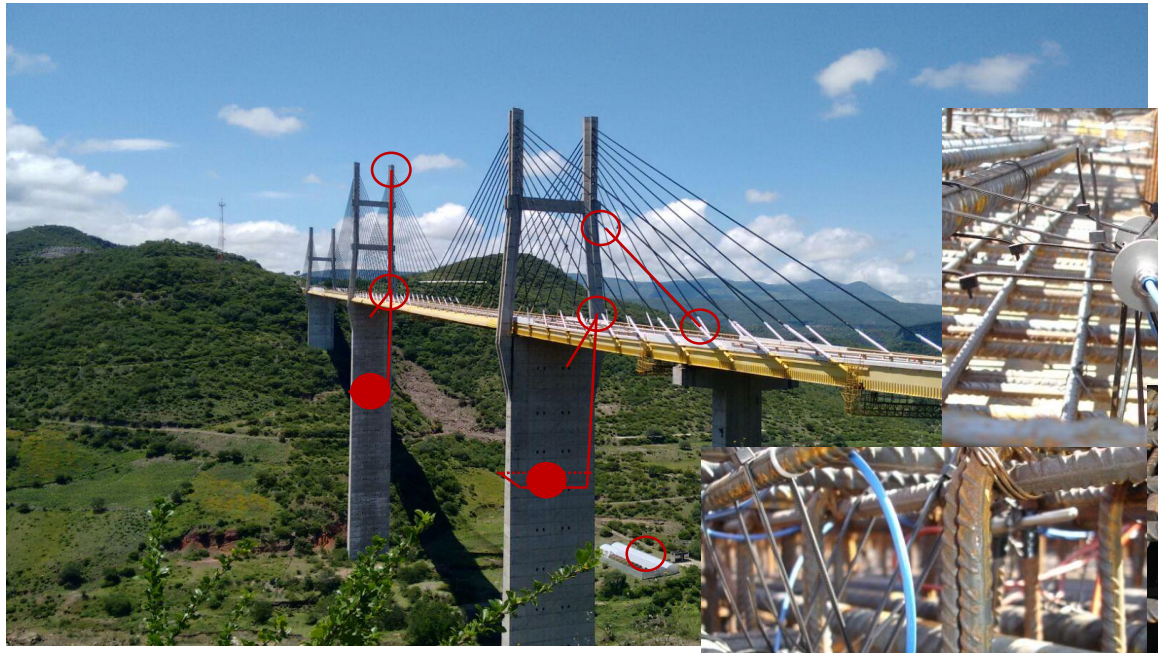
Protection

Product Application

- **Bridges**

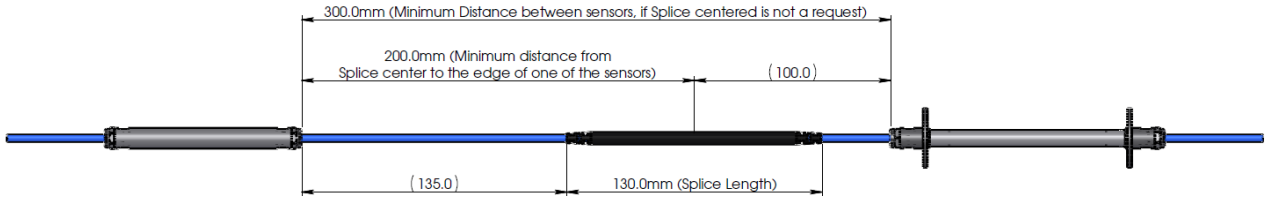
System Integrators

Universities / R&D



Protection

FS63 Temperature Sensors



Arrays

FS62 Strain Sensors

Product Application

- **Bridges**

System Integrators

Universities / R&D

FS64 Tilt Sensors

Biaxial Mounting

Increased Protection

Product Application

- **Bridges**

FS42
for installation verfication

System Integrators

Universities / R&D

Splices

Protection Boxes

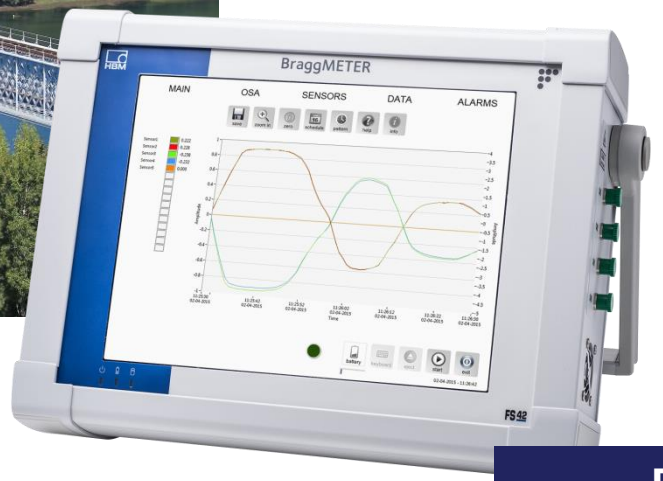
Connectors

Product Application

- **Bridges**

System Integrators

Universities / R&D



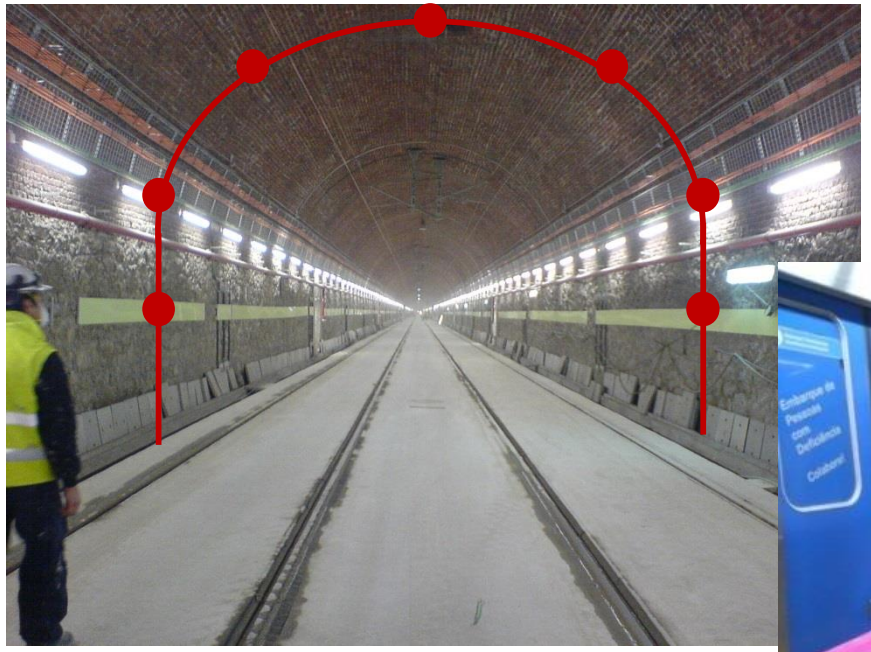
FS42 for discrete measurements

Product Application

- **Tunnels**

System Integrators

Universities / R&D

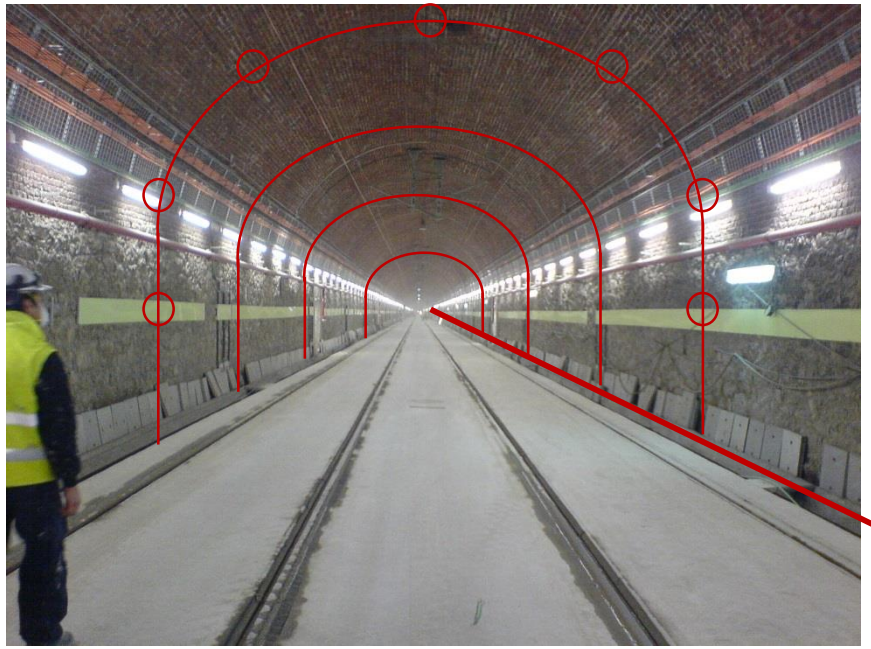


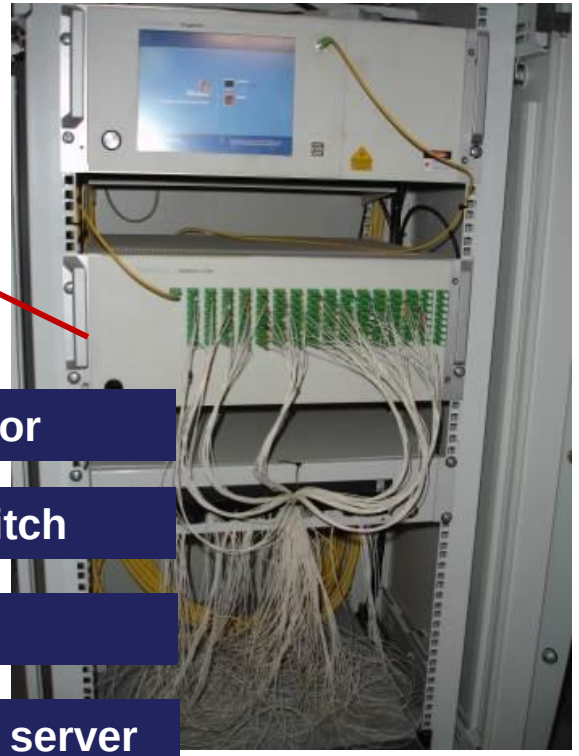
FS62/FS63 Weldable Sensors

- **Tunnels**

System Integrators

Universities / R&D





Interrogator

Optical Switch

UPS

Connection to server

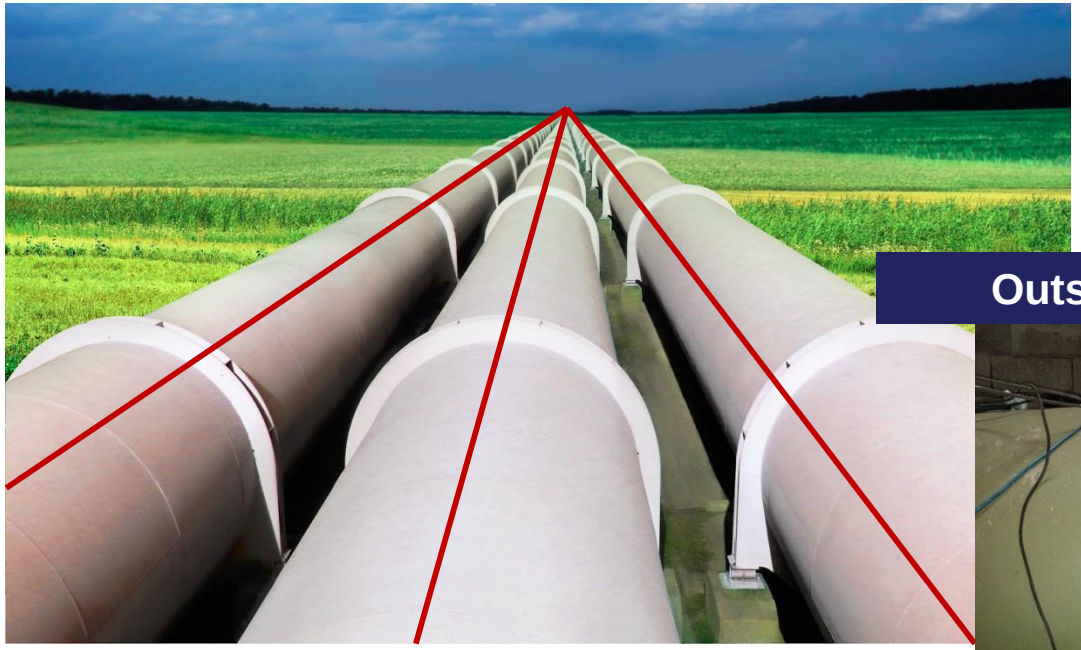
Remote Access

Product Application

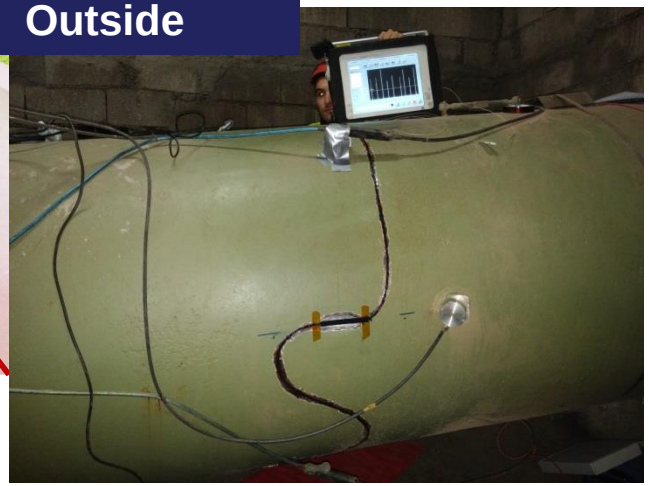
- **Pipelines**

System Integrators

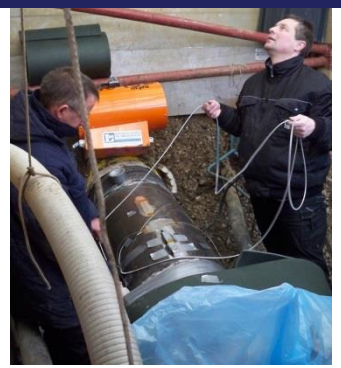
Universities / R&D

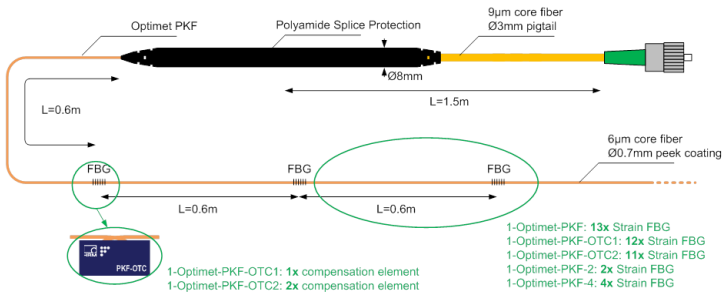


Outside



Optimet PKF



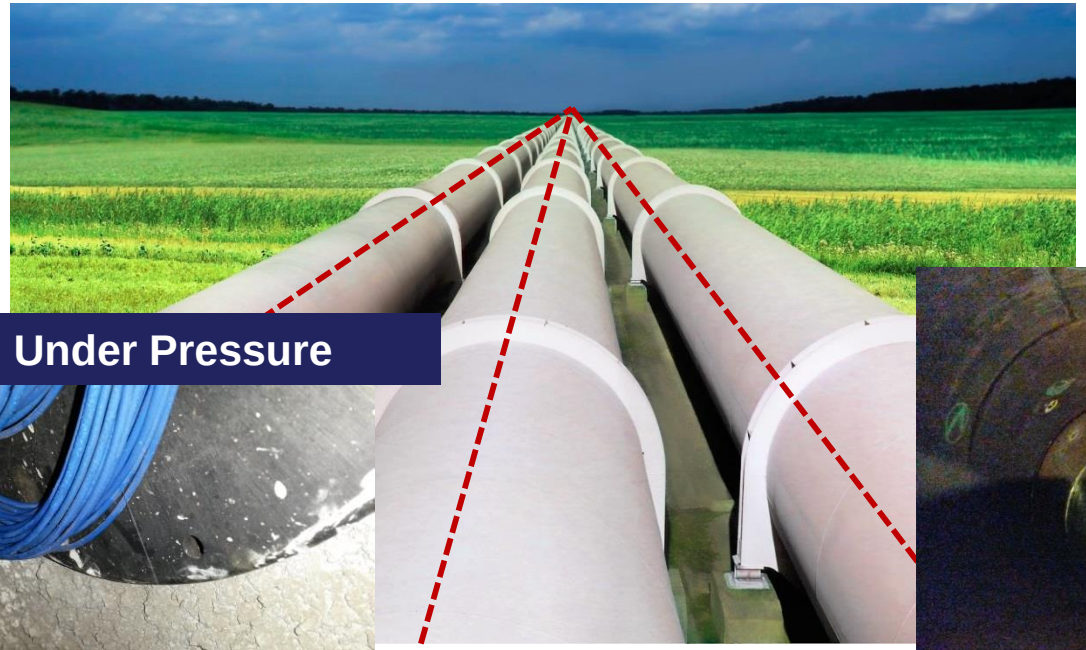


Product Application

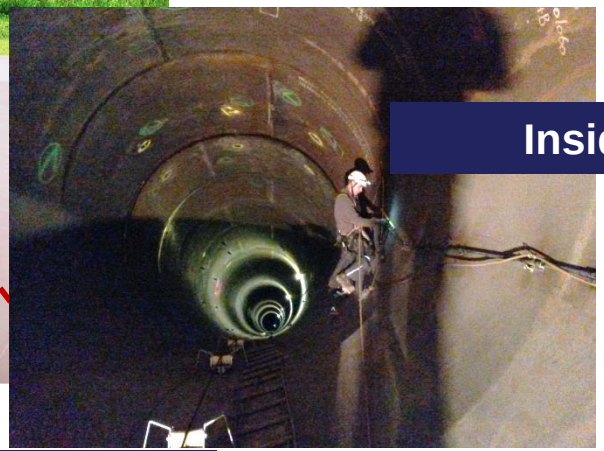
- **Pipelines**

System Integrators

Universities / R&D

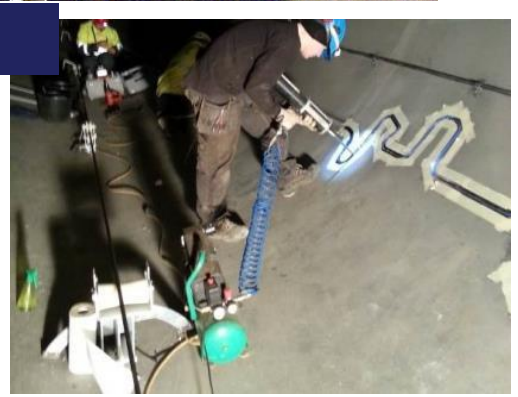


Under Pressure



Inside

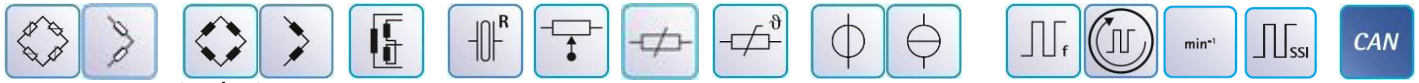
FS62 Weldable Strain



QuantumX Universal Amplifier – MX840A

Features

- 8 universal **inputs** supporting over 15 transducer technologies



on every single input

- Strain gauge full and ½ bridge
- Inductive full and ½ bridge, LVDT
- Piezo resistive, Potentiometer
- RTD (PT100, PT1000), Resistance
- Thermocouple Type K, J, T, S, E, B, N, R and C
- Voltage (+/- 100 mV, +/- 10 V, +/-60 V), Current (+/- 20 mA),

IEPE / ICP adapter
1-EICP-B-2

SG ¼ bridge adapter
1-SCM-SG120 / SG350

Thermocouple
1-THERMO-MXBOARD

300 V adapter
1-SCM-HV

Connector 5-8: pick-ups, digital encoder (/w index), counter, frequency, SSI protocol (encoder)

Connector 1: high-speed CAN **receive** signals or **transmit** up to 7 MX840A inputs

Data rates up to 19.2 kS/s per channel (bandwidth up to 3.2 kHz)

Linearization: 2-point, gain and offset, table based, polynomial

Time Synchronization: IRIG-B (all MX840A/MX440A inputs), NTP, FireWire, EtherCAT (with CX27)

THANK YOU

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