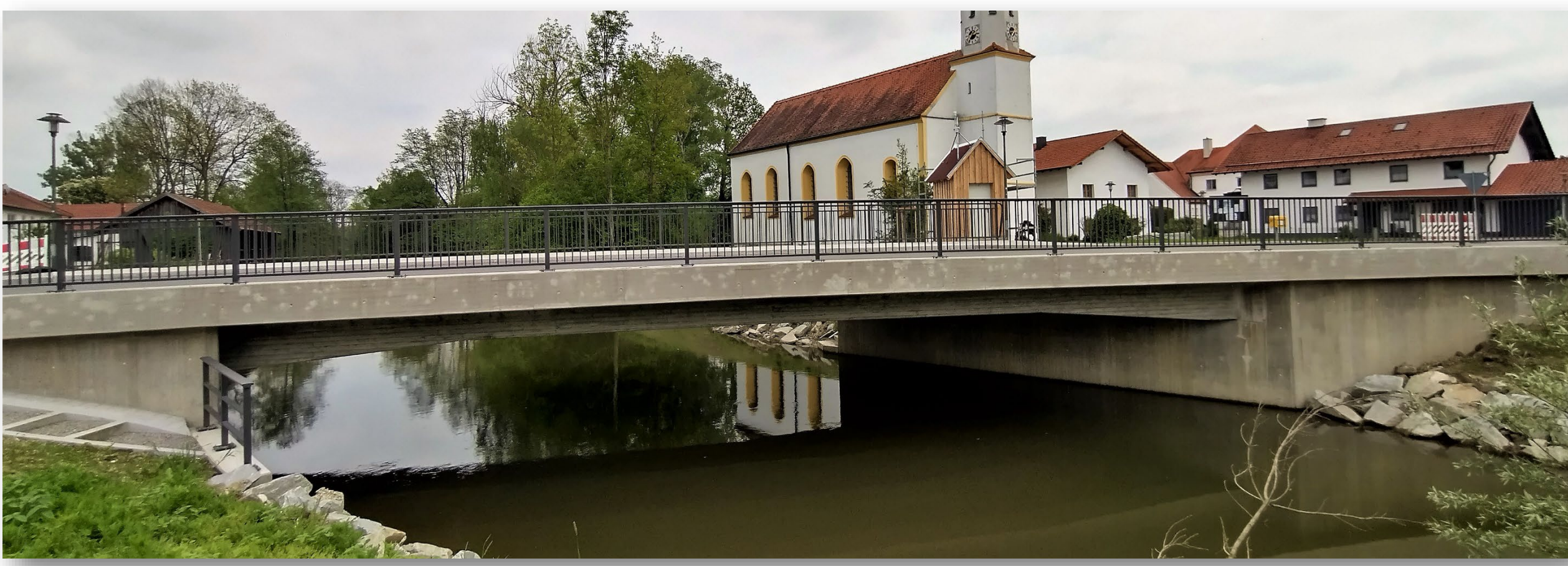


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Physical Twin: Data Acquisition

- Single-span frame bridge made of precast prestressed concrete elements
- 140 physical sensors deliver 170 individual data streams:
 - temperature, strain, inclination, acceleration, deflection, earth pressure, weather
- 4 measuring chains
- Measuring from **release for traffic**



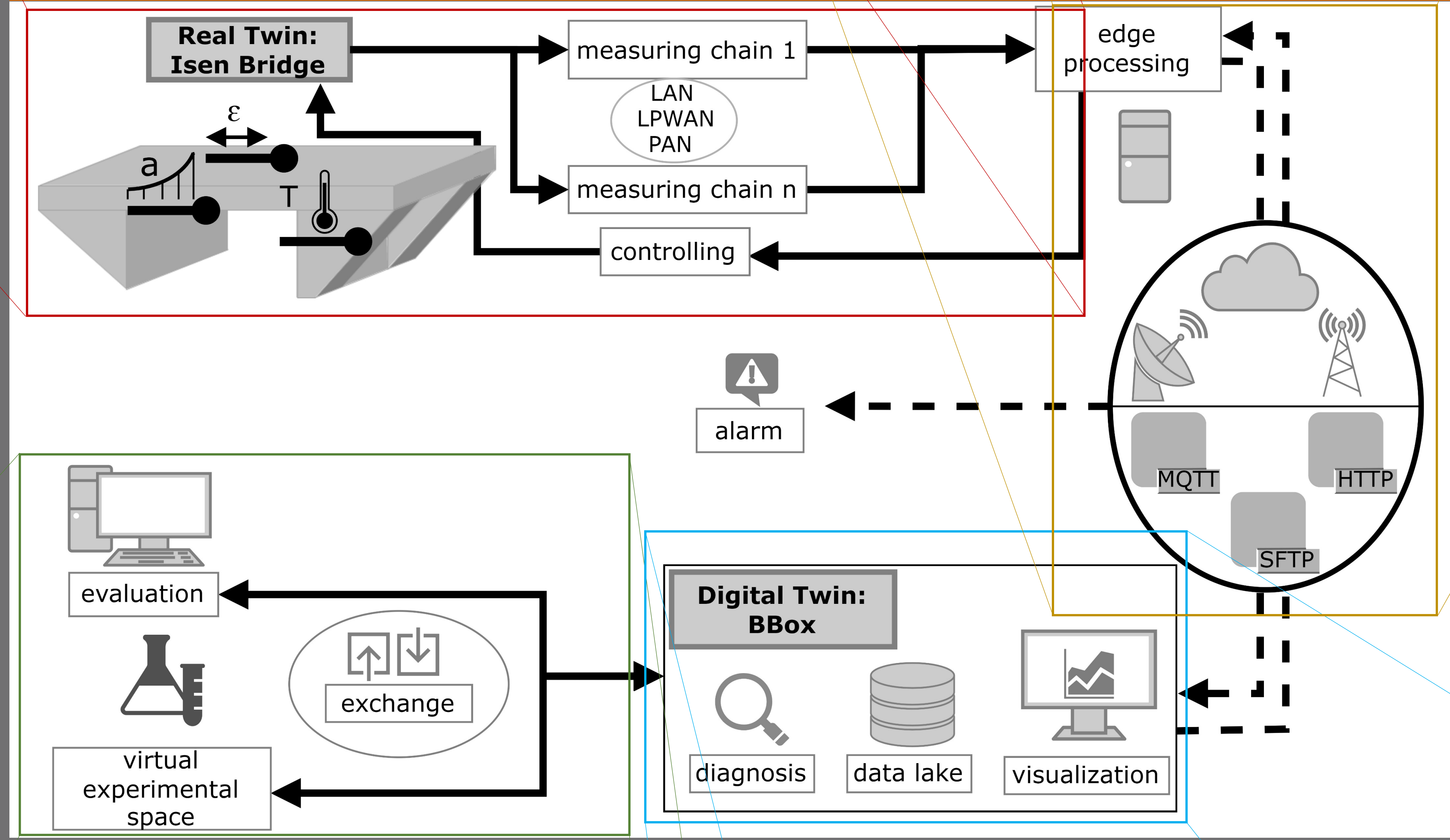
Data Transfer & Data Security

- Choice of **transfer media** and **transfer protocol**
- Depending on: **transfer speed** and **transfer volume**
- At the bridge:
 - Fiber optic, 4G
 - MQTT, SFTP
- Hardware:
 - IoT-Router
 - IoT-PC
 - Antenna

Volume	slow	fast
big	Raw science data DFOS Acceleration, strain, etc.	High frequency live data (10 ³ Hz) Live webcam Medium frequency live data (10 ¹ Hz)
small	Low frequency live data (10 ⁻² Hz) Total station Weather data	Remote Desktop compressed & processed data alarms

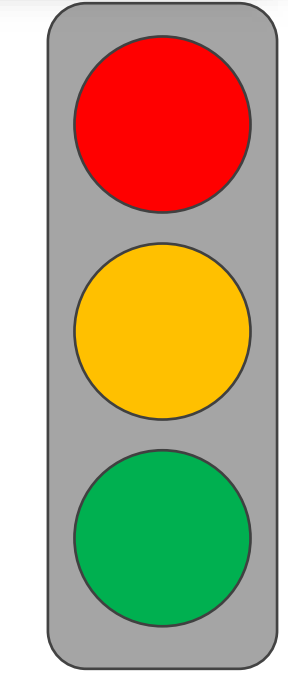
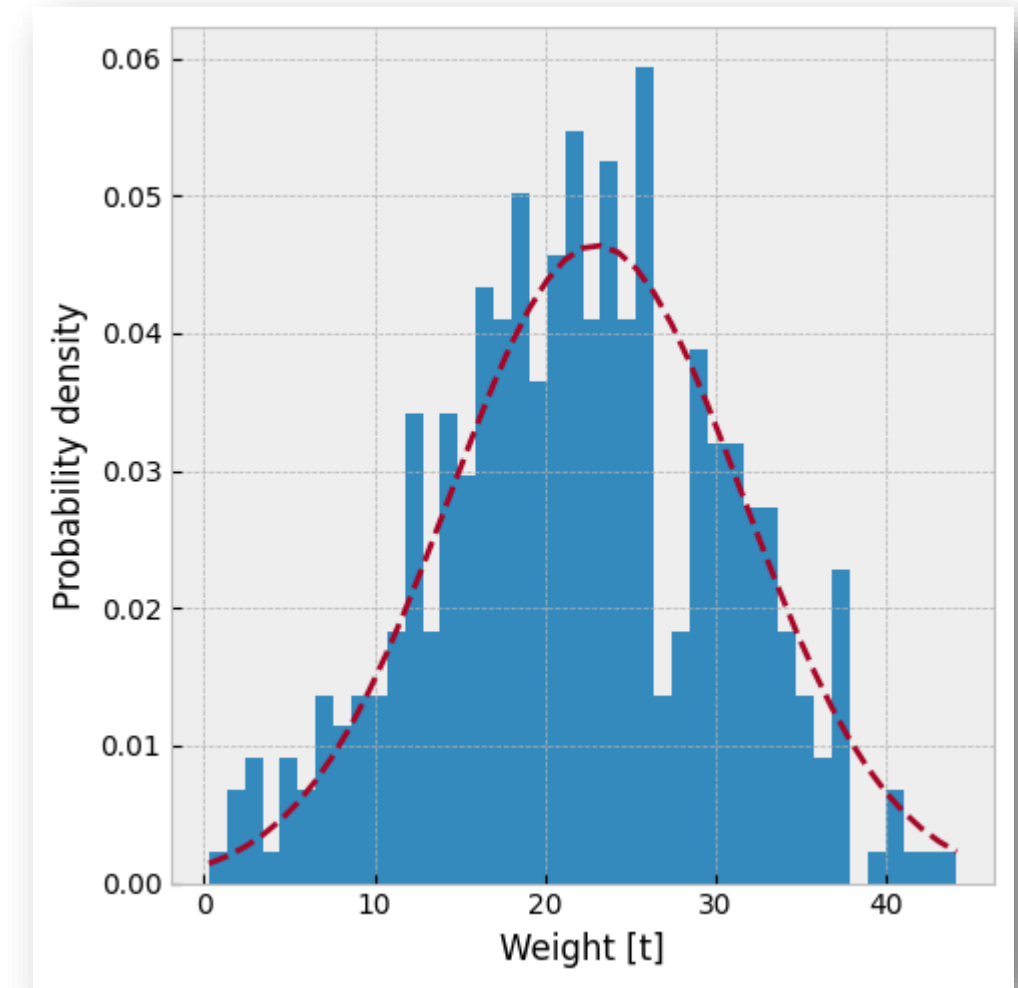
Key: LoRaWAN, FluidMesh, WLAN, SatCom, LTE 4G LTE, 5G, Ethernet, fibre

Data Model



Data Analysis

- Storage of Data in UniBw M S3 storage grid
- Providing Data for Data Scientist
- Exchange via JupyterHub
- Analysis using:
 - Live load model
 - Structural Health Information Patterns SHIPs
 - Statistic Models
- Research Goals:
 - Predictive Maintenance of bridge
 - Live Condition and Health Monitoring
 - Identification of Key Performance Indicators



Digital Twin: Data Storage & Data Visualization

- Use of **Asset Administration Shell** configurator BBox
- Visualization with **Dashboards**

The screenshot shows the 'SchwindeggDashboard' interface. It features a '3D-Modell' of the bridge structure and a 'Temperatur' chart displaying multiple data series over time. The dashboard also includes sections for 'Übersicht Sensoren', 'Link zur Verwaltungsschale', and 'Ansicht von Westen'.