



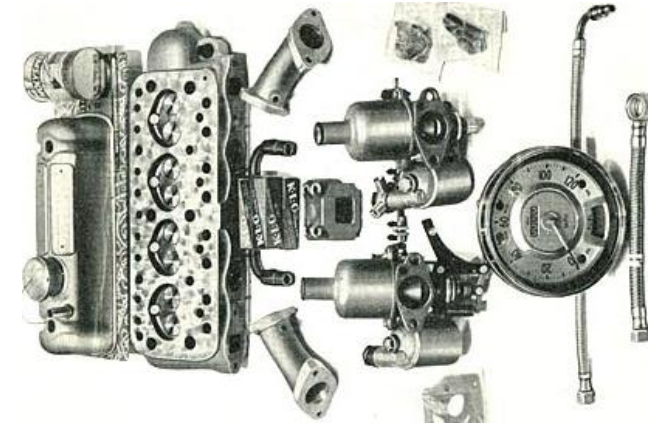
# Taking a legacy interlocking to the era of IoT

[www.siemens.nl/mobility](http://www.siemens.nl/mobility)

# The Command and Control pyramid



**has all this under the bonnet ...**

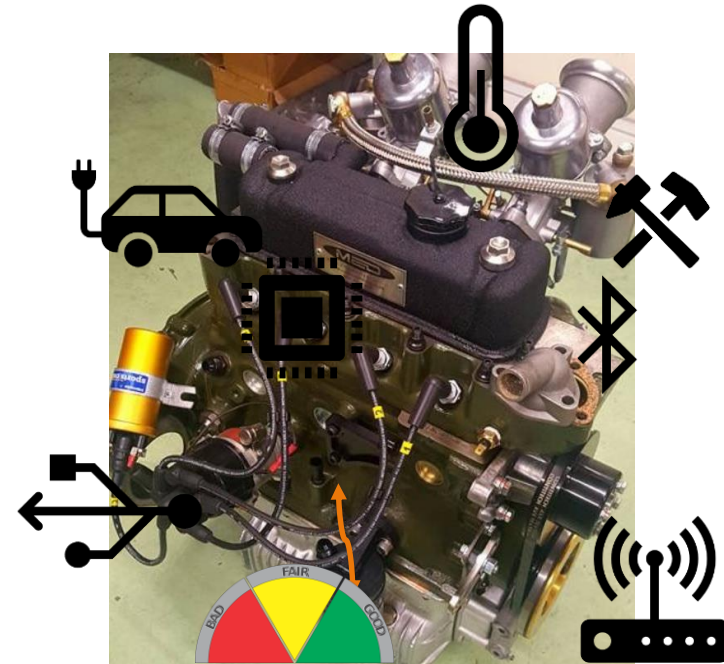


**but the driver sees very little information ...**

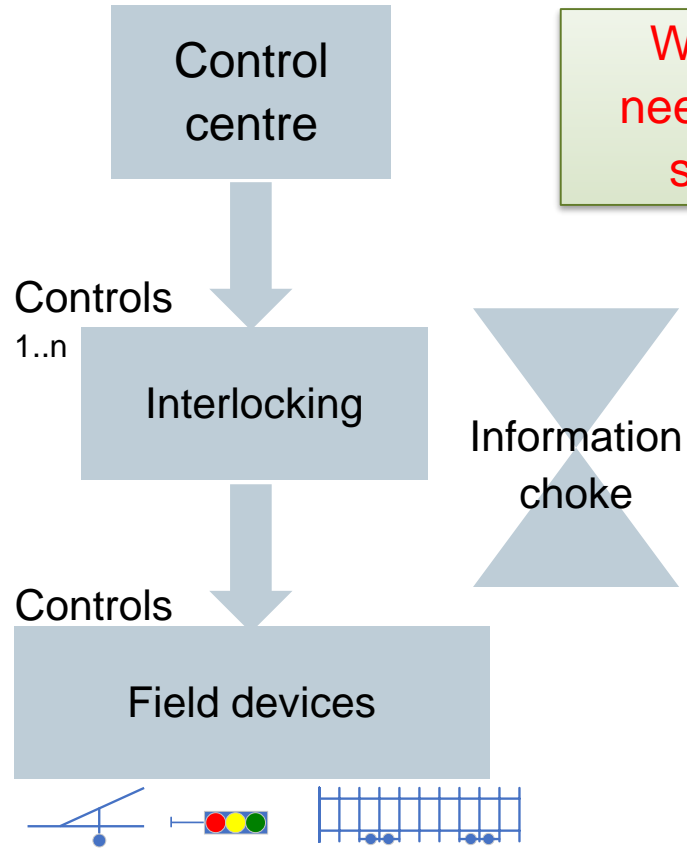


**whereas sometimes one needs to know a little more**

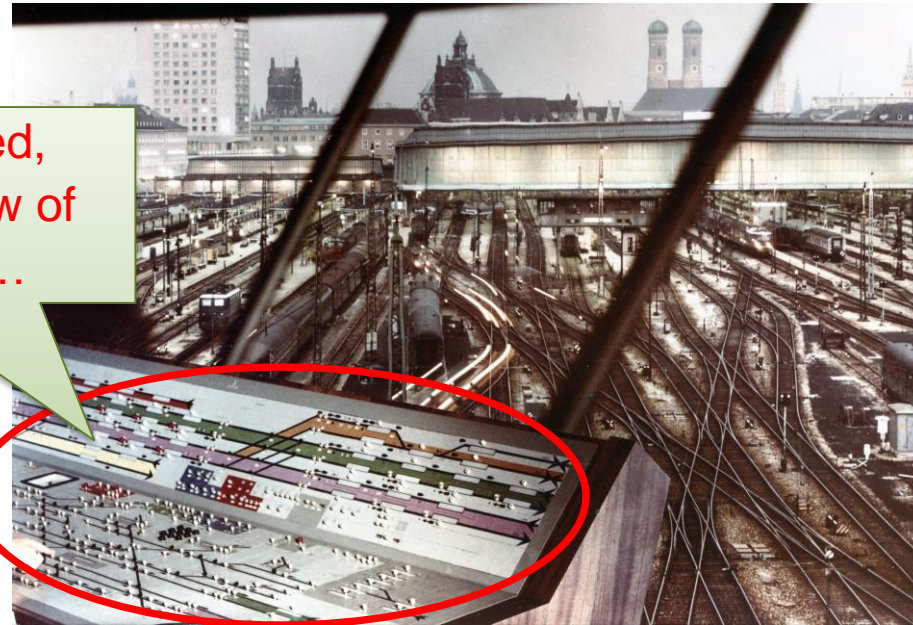
**An IoT engine is equipped with sensors**



# Similar situation in signalling



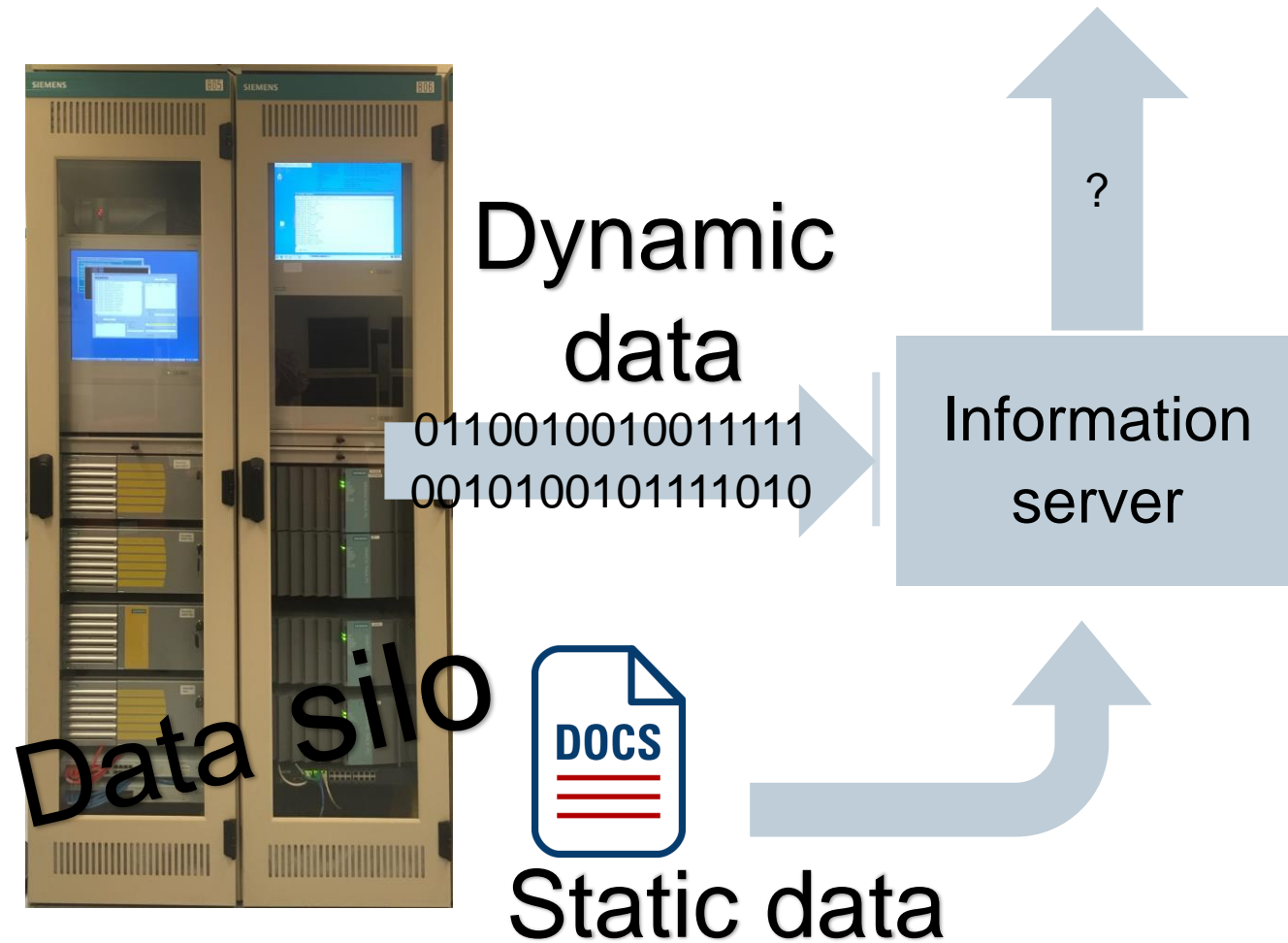
We have a limited, need-to-know view of system reality ...



but under the bonnet, it's largely a black box



# How to extract information – the upstream part



Eavesdrop on data traffic on the interlocking bus that dynamically reveals field element state

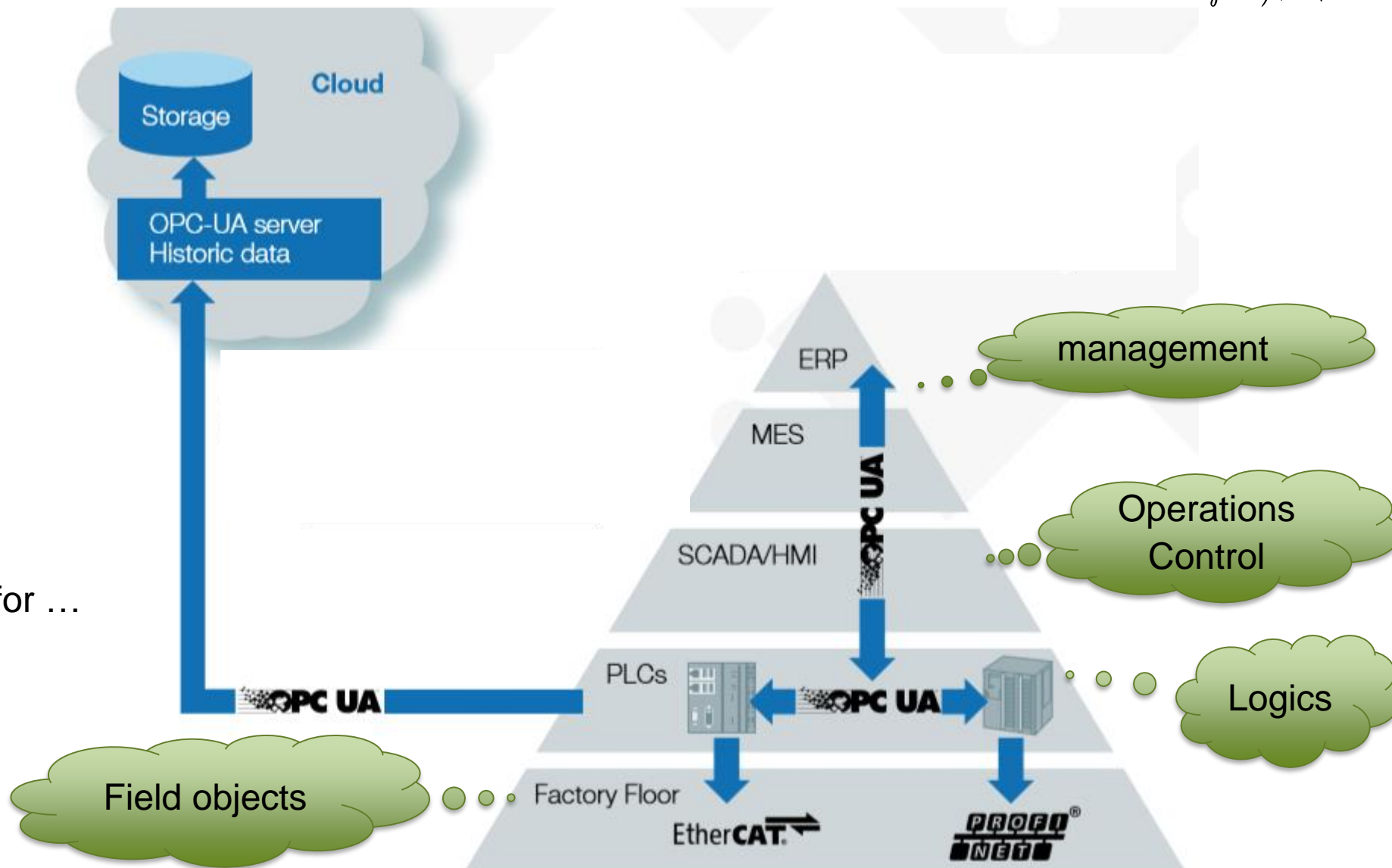
Mix in static configuration data from the configuration documents

But how to present it to the outside world ?

# Other industries have similar C&C architectures and needs

*There's  
an app  
for that*

“...data transfer standards for ...  
... secure and reliable  
interoperability in industrial  
automation”



# What can OPC-UA do for us

## Open

- Independence of the communication technology from manufacturer, sector, operating system, programming language

## Scalable

- Scalability for integrated networking including the smallest sensors embedded devices and PLC controllers, PCs, smartphones, mainframes and cloud applications. Horizontal and vertical communication across all layers.

## Security

- Secure transfer and authentication at user and application level

## Live and trend analysis

- SOA, transport via established standards such as TCP/IP for exchanging live and historic data, commands and events (event/callback)

## Structured data

- Mapping of information content with any degree of complexity for modeling of virtual objects to represent the actual products and their production steps.

## Smart networking

- Unplanned, ad hoc communication for plug-and-produce function with description of the access data and the offered function (services) for self-organized (also autonomous) participation in “smart” networked orchestration/combination of components

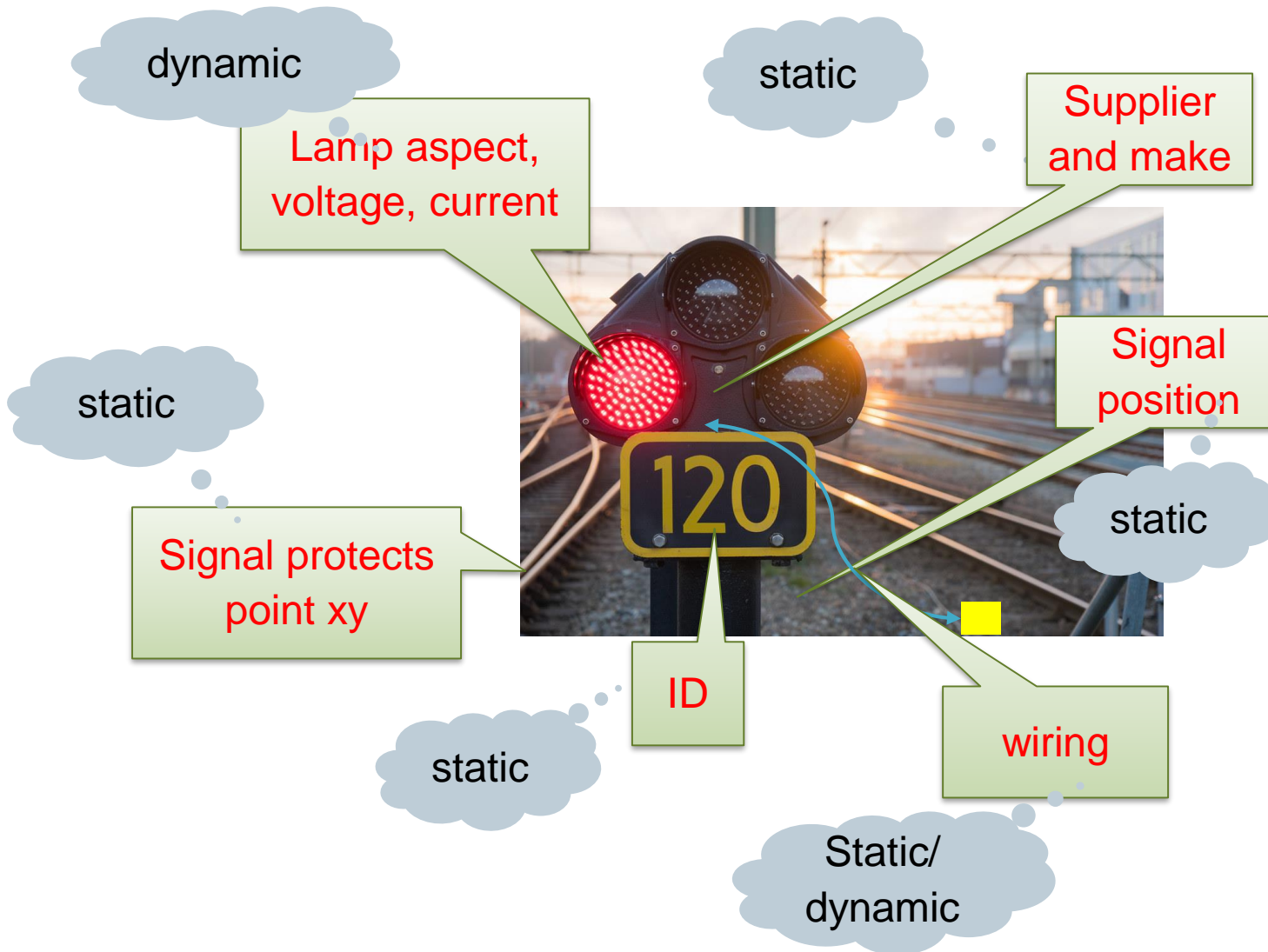
## Link to data engineering

- Integration into engineering and semantic extension

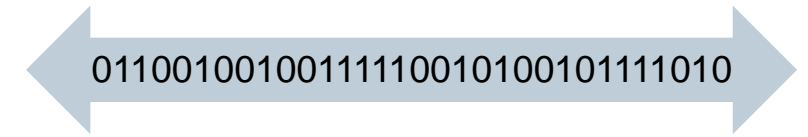
## Interoperable

- Verification of conformity with the defined standard

# What information is out there



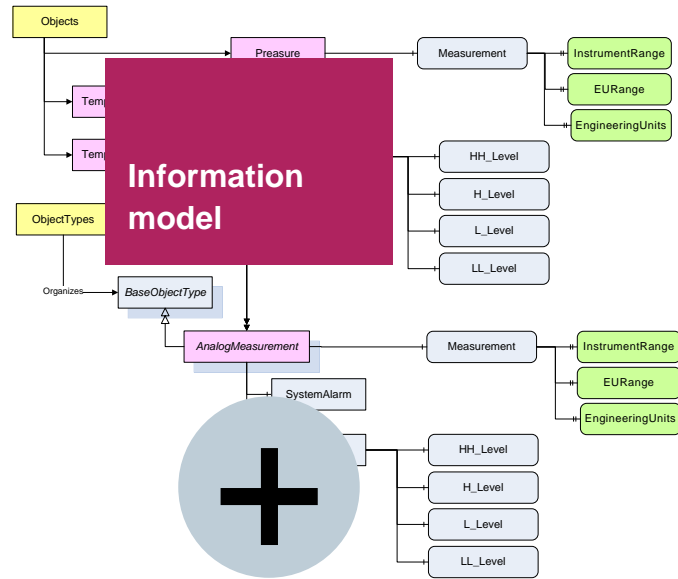
Dynamic information is present on the interlocking bus



Static information is present in plans, tables and text



# How to get an OPC-UA server running



## Compile information

- Static data
- Dynamic data
- Join meaning to data

## Create structure

- Object oriented
- Expose relations

## Authorise access

- To selected users
- To views on subsets of data
- With high security

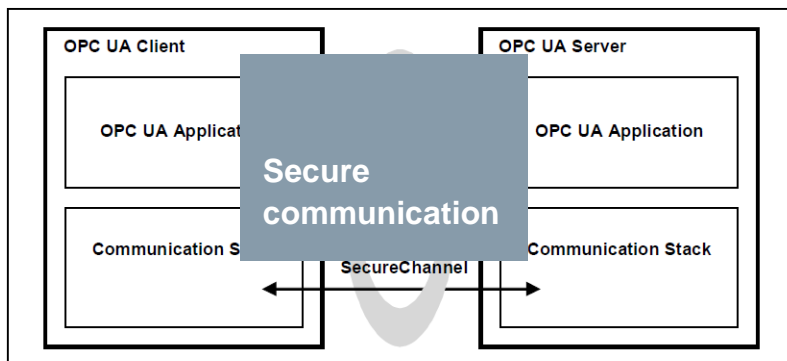


Figure 13 – SecureChannel and Session Services

# Presenting data to the end-user



00101111010

OPC-UA  
Information  
server



client

The screenshot shows the 'Unified Automation UaExpert' application. The 'Project' pane on the left displays a tree structure under 'Servers' and 'Documents'. The 'Address Space' pane shows a hierarchical view of data points, including 'Signal 55102' and its sub-elements like 'Bereich'. The 'Attributes' pane on the right shows detailed information for a selected attribute, including 'BrowseName', 'DisplayName', 'Description', 'WriteMask', 'UserWriteMask', 'AccessRestrictions', 'Value', 'DataType', and 'References'.

Attribute	Value
BrowseName	4, "Bereich"
DisplayName	"", "Bereich"
Description	"", "Nummer des Bereichsrechners"
WriteMask	0
UserWriteMask	0
AccessRestrictions	None
Value	
SourceTimestamp	30-9-2019 15:21:28.046
SourcePicoseconds	0
ServerTimestamp	30-9-2019 16:28:40.759
ServerPicoseconds	0
StatusCode	Good (0x00000000)
Value	2
DataType	BaseDataType
NamespaceIndex	0
IdentifierType	Numeric
IdentifierType	24 [BaseDataType]
ValueRank	-1 (Scalar)
ArrayDimensions	Null
AccessLevel	CurrentRead
UserAccessLevel	CurrentRead
AccessLevelEx	None

The server knows all

- Data structure
- Data semantics
- Data value
- Relations between data

information

The client is agnostic

- Retrieves information from the server

*any authorised 3<sup>rd</sup> party can browse, understand and use the information.*

# Samples of information that can be served

Location of the power supply controlling an ATP section.

Source: Siemens configuration plans

- > Schalterfunktion GFM\_5142B
- > Schalterfunktion GFM\_A5122
- ▼ Signal S5102
  - > BLISPA
    - Bereich
    - Nummer
  - > Passiergeschwindigkeit
  - > Passiergeschwindigkeit\_meldu
  - > FABREC
  - > FANZ
  - > FHCS
  - > FMZU
  - > FPOR
  - > GAN
  - > GELB
  - > GFMAUS
  - > GLADEF
  - > GRUEN
  - > GeschwindigkeitMaxAmSignal
  - > GeschwindigkeitskonstanteGes
  - > KASFS

- ▷ Element A5122/5
- ▷ Element SV10Z
- ▼ Element SV20Z
  - PUIC
  - ▼ Storing S4.1 10 01 ARELA2
    - Bitmaske
    - Portnr
    - ▼ Stellteil ATB
      - Ebene
      - Einbauplatz
        - ▼ STR S4.1 in relaishuis 20ZVO
          - ▼ Kast A02 in relaishuis 20ZVO
            - ▼ Gebouw 20ZVO
              - Lat
              - Lon

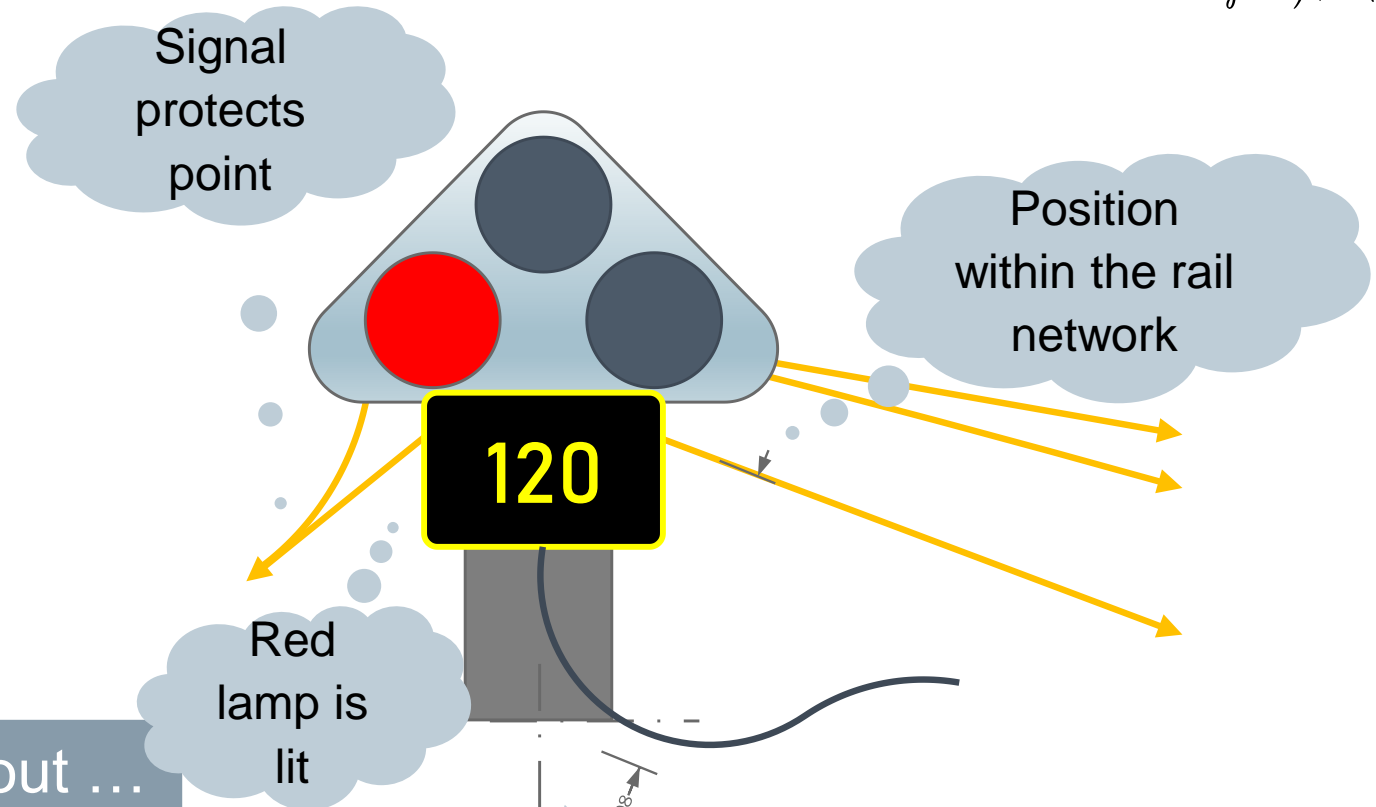
▼ Nodell	ns=4;i=19120
NamespaceIndex	4
IdentifierType	Numeric
Identifier	19120
NodeClass	Variable
BrowseName	4, "Passiergeschwindigkeit"
DisplayName	""; "Passiergeschwindigkeit"
Description	""; "Passiergeschwindigkeit"
WriteMask	0
UserWriteMask	0
AccessRestrictions	None
▼ Value	
SourceTimestamp	30-9-2019 16:57:07.318
SourcePicoseconds	0
ServerTimestamp	30-9-2019 16:57:45.161
ServerPicoseconds	0
StatusCode	Good (0x00000000)
Value	8
▼ DataType	Int32
NamespaceIndex	0
IdentifierType	Numeric
Identifier	6 [Int32]

signal state and semantics

Source: interlocking data bus

SourcePicoseconds	0
ServerTimestamp	29-5-2019 21:02:49
ServerPicoseconds	0
StatusCode	Good (0x00000000)
Value	""; "C35"
▼ DataType	String
NamespaceIndex	0
IdentifierType	Numeric
Identifier	12 [String]
ValueRank	-1
ArrayDimensions	Null
AccessLevel	CurrentRead
UserAccessLevel	CurrentRead
AccessLevelEx	None
MinimumSamplingInterval	0
Historizing	false

# Conclusion – information server is a digital mirror



Data can be enriched to inform about ...

- Where is my signal
- What is the state of the my signal
- What lies beyond my signal, e.g. a point
- Whatever information has been fed into the server

The richer the mirrored information, the more conclusions can be drawn...

# Algorithms can draw conclusions from available information

## Seeing the Big Picture allows answering clever queries

- Which routes are affected when a signal lamp fails ?
- Which parts of the network are knocked out when a power supply fails ?
- Which routes are still available when a housing burns to the ground ?
- Which component can be at the origin of an observed fault pattern ?

Needed when looking for weaknesses or root cause analyses

## The information is rich and trustworthy

- Network view replaces a tunnel view of individual objects
- Data originate from the interlocking configuration files and data bus

Keeping as-built docs in sync with reality is hard

