OPC DAY FINLAND 2018

NOVEMBER 13TH 2018 #OPCUA #INDUSTRY40 #IIOT #OPCDAY #OPCDAYFINLAND #AUTOMAATIO

OPC UA in the Real World

Jukka Peltola

Plant4You Oy

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Introduction

Jukka Peltola, Process Engineer (BSc)

Background:

35 years experience in automation and integration projects, first OPC UA implementations in 2010

Last projects:

- Planning and coordination of several multi vendor integration projects using OPC UA as basic technology
- Automation project head of the case factory. Plant wide integration of process and machine control systems to central SCADA, recipe management and MES systems

Actual project:

- Solution architect and integration coordinator for a big part manufacturing and assembly line. Integration of machine automation, line control and MES systems

Plant4You Oy services:

- Supervision of the customer's advantage in complex, multi vendor automation projects
- Design of automation systems, integration architecture, SCADA and recipe mgmt. systems
- Coordination of integration projects
- Automation project management

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Objectives and Agenda

The purpose of this presentation is to share some experiences of OPC UA integration projects

The case factory - How OPC UA was used in a green field factory project

But there are many possible pitfalls, like:

1. Data integrity is not automatically guaranteed
2. OPC UA Client can easily overload the server
3. Same data types are not the same

…

And how can you avoid them:

4. Recommendations for Testing
5. Comprehensive documentation
6. Visualizing of interfaces

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Let's build up an smart factory!

ISA95

LEVEL 4 — **SCM ERP**

- PRODUCTION PLANNING
- MATERIAL MANAGEMENT
- INVENTORY MANAGEMENT
- RESSOURCE MANAGEMENT

Supply chain

DISTRIB. → CUSTOMER

LEVEL 3 — **MES**

- FINE SCHEDULING
- QUALITY MANAGEMENT
- TRACEABILITY
- REPORTING
- KEY PERFORMANCE INDICATORS

LEVEL 2 — **SCADA**

Central control room

- PROCESS CONTROL
- RECIPE MANAGEMENT
- ALARM MANAGEMENT
- PERFORMANCE MANAGEMENT
- HISTORIAN, STATISTICAL ANALYSIS
- WORK EXECUTION

Maintenance control room

LEVEL 1 — **HMI OP PLC DCS**

LINE AND MACHINE CONTROL ↔ PROCESS CONTROL ↔ PROCESS CONTROL ↔ PROCESS CONTROL ↔ WMS & CONVEYOR CONTROL ↔ LINE AND MACHINE CONTROL ↔ WMS & MACHINE CONTROL

BUILDING & UTILITIES

- ENERGY, WATER TREATMENT, STEAM, PRESSURICED AIR, COOLING, BUILDING AUTOMATION, …

LEVEL 0

MATERIAL SUPPLIERS → TRUCK → INFEED → PROCESS 1 → PROCESS 2 → PROCESS 3 → BUFFER STOCK → PACKING LINES → WAREHOUSE & TERMINAL → TRUCK → CUSTOMER

VALUE STREAM

OPC UA AC:

- **PRODUCTION EVENT MESSAGES:**
  - **JOB START / END**
  - **BATCH START / END**
  - **MATERIAL MOVEMENTS**
  - **PROUCED / CONSUMED**
- **MACHINE DATA**

OPC UA DA:

- **JOBS and CONTROL RECIPES**
- **PRODUCTION EVENT MESSAGES**
- **MACHINE DATA**
- **ALARMS**
- **PROCESS MEASUREMENTS**
- **BATCH DATA**
- **(INTERLOCKINGS)**

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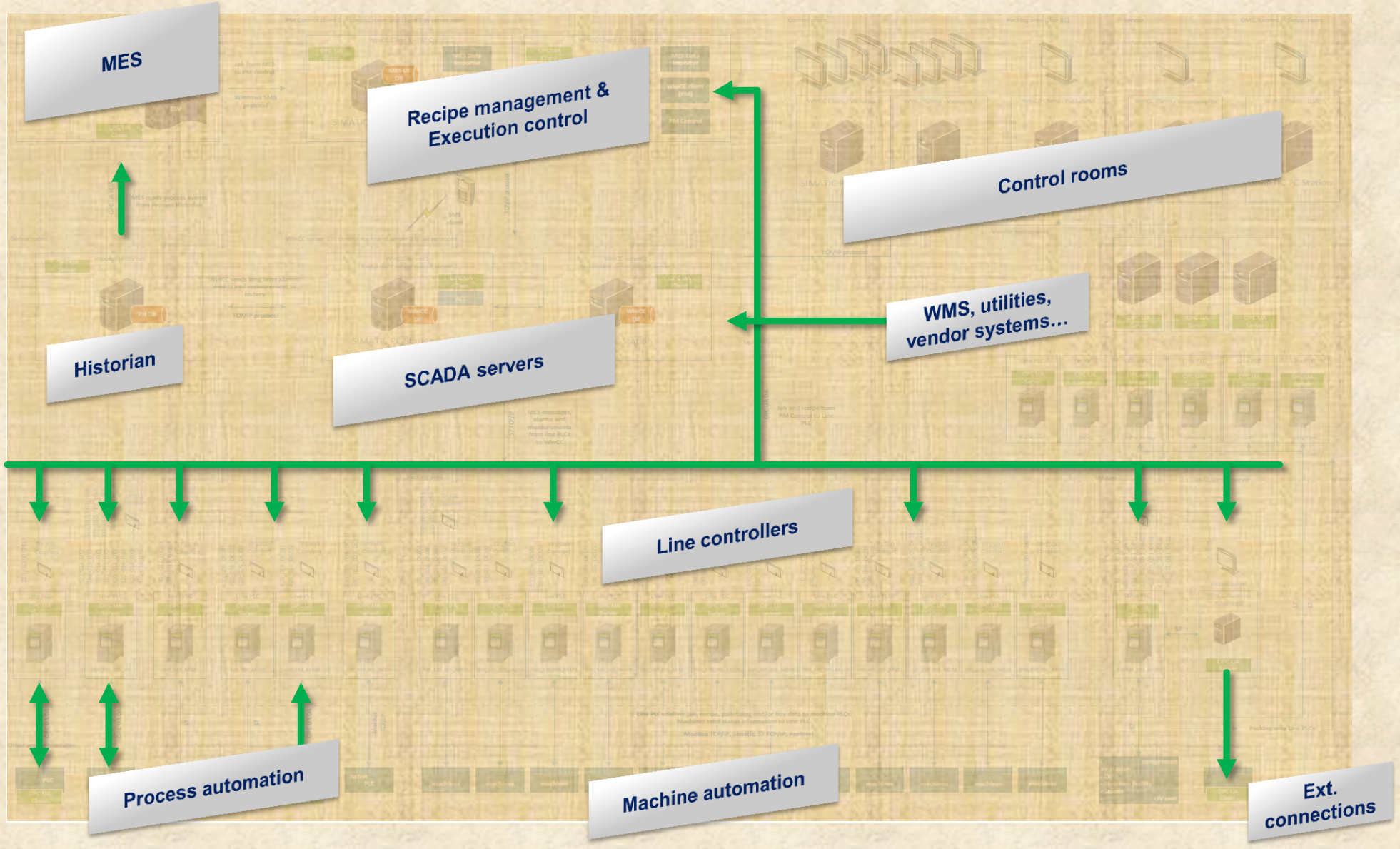
The case factory

- ~20 Production lines
- ~50 machine vendors
- ~25 networks
- 1000+ Ethernet nodes
- ~100 PLC's

OPC UA:

- 9 OPC UA Clients
- ~40 OPC UA DA servers
- One OPC UA HA Server
- One OPC UA AC Server
  - 3-4000 MES events / d



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Agenda

But there are many possible pitfalls, like:

1. **Data integrity is not automatically guaranteed**
2. **OPC UA Client can easily overload the server**
3. **Same data types are not the same**

…

And how can you avoid them:

4. **Testing, testing and testing**
5. **Comprehensive documentation**
6. **Visualizing of interfaces**

1. Data integrity is not automatically guaranteed!

Writing a message to a PLC data block with OPC UA DA

- Writing to tags – each tag is updated in random order!

  Video 1

- Writing to structured tags – the whole data block is updated in one shot!

  Video 2

How to avoid this pitfall?

1. Use structured tags if possible!
2. If not, agree tight handshake protocol between vendors

   Ensure that all tags have been overwritten!

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2. OPC UA Client can easily overload the server!

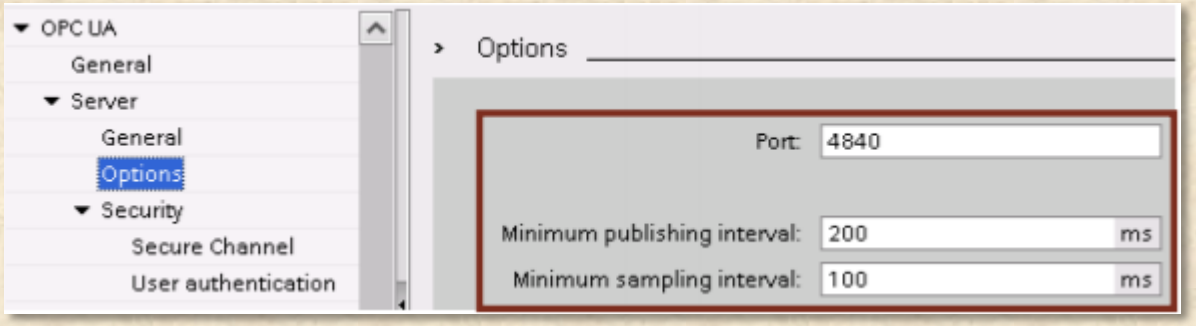
Every OPC UA Client can easily crash the OPC UA server!

If the OPC UA DA Client is requesting data faster than the server minimum publishing interval is, it will overload the server's communication processor from time to time. At that moment all communication to CPU will be stuck!

Sampling & publishing intervals in OPC UA DA server

"Minimum publishing interval": This value determines at what minimal intervals the OPC UA server is allowed to send data to a client via OPC UA subscriptions.

"Minimum sampling interval": This value determines at what minimal intervals the OPC UA server is allowed to request data changes of the CPU data management. / Source Siemens.



How to avoid this pitfall?

Sampling interval < Publishing interval < Subscription interval

<----------UA Server----------> <-----UA Client----->

3. Same data types are not the same!

Unfortunately OPC UA standard variable types are not same for different automation vendors!

" There is discovered a driver issue sending from UA client to Line controller (UA server). The write command fails when writing other than numbers, we use strings in both ends so it has been a big bump on the road as no information could be exchanged from the client to the server. Beckhoff has found the problem and the cause so there is work in progress to make an updated OPC driver, this is expected to be ready end September."

"The decision is made to change the variables to number type (double integer) and from UA Client side write them one by one to Line Controller, this decision make it possible to continue the work instead of waiting for the driver several months."

The root cause was "Other vendor use Little Endian and other use Big endian".

How to avoid this pitfall?

1. **Do real time tests when using different vendors!**
2. **Do it before starting the programming!**

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Agenda

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And how can you avoid them:

4. Recommendations for Testing
5. Comprehensive documentation
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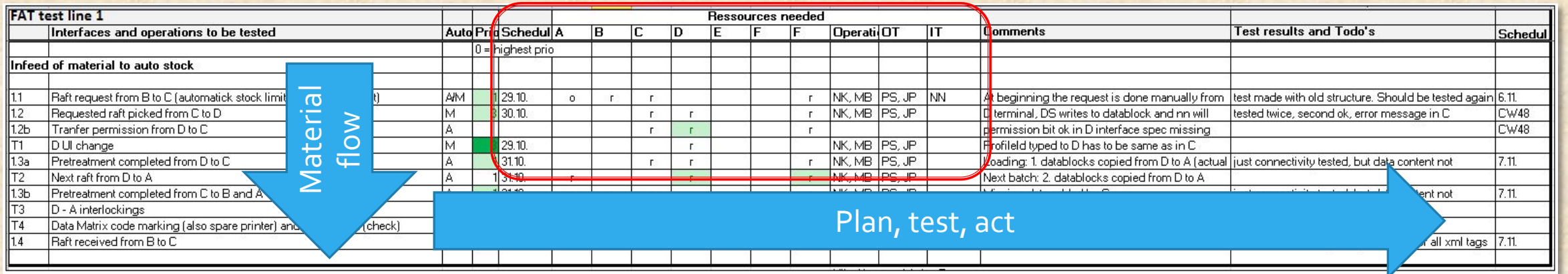
4. Recommendations for Testing

1. Testing of vendor interoperability:
   - Data types
   - Data integrity

2. FAT testing:
   - Simulate material flow
   - Data content and integrity
   - Hand shake protocols
   - Abnormal situations
   - Test all interfaces!

3. Commission testing:
   - With real material flow
   - Security settings activated
   - Data content right
   - Test all interfaces!



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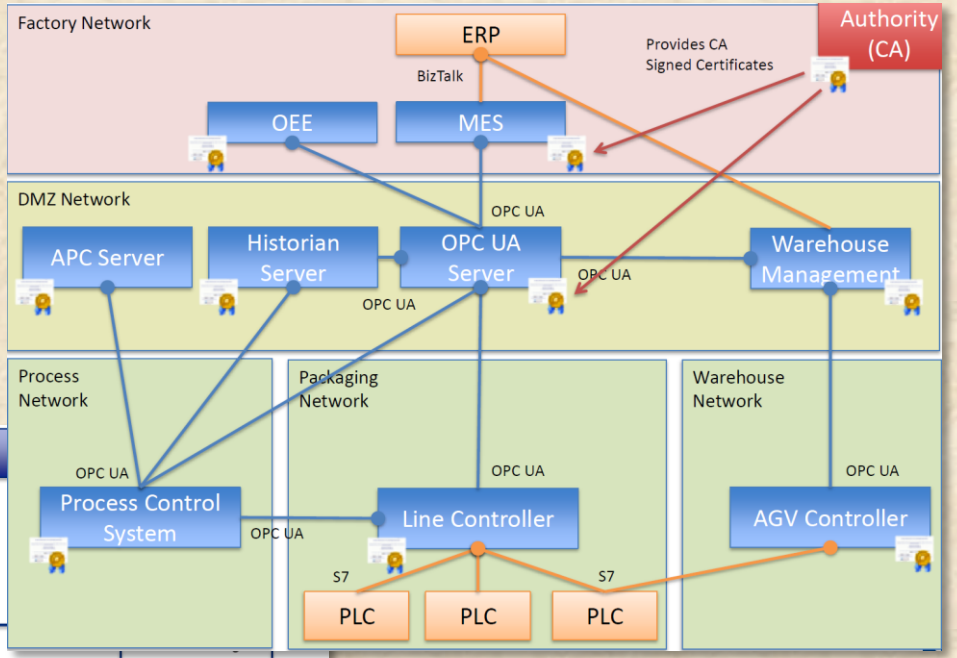
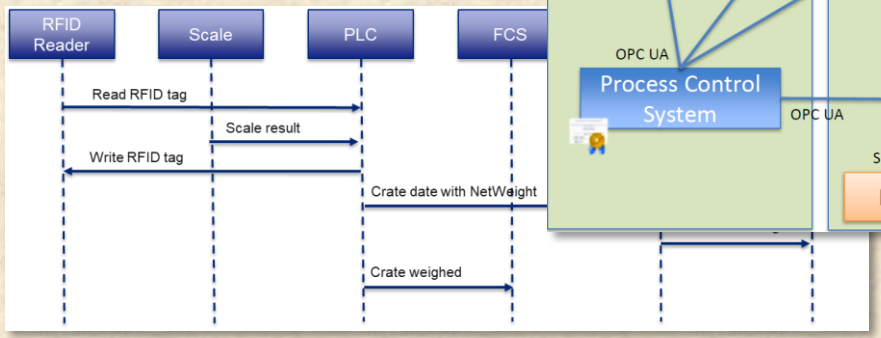
5. Comprehensive documentation

- Define an interface requirement specification
  - what technology should be used between machines and upper level systems
  - basic data for all machines and lines (states, alarms, counters,measurements), data types
  - Hand shake method, life beats, abnormal situation handling, …
- Draw an overall component diagram where all systems and interfaces can be seen:
  - Protocol used
  - Direction (read/write, Client/Server)
  - Security settings, ports
  - Vendor, contact information
- Request a interface specification from all vendors
- Draw data flow diagrams





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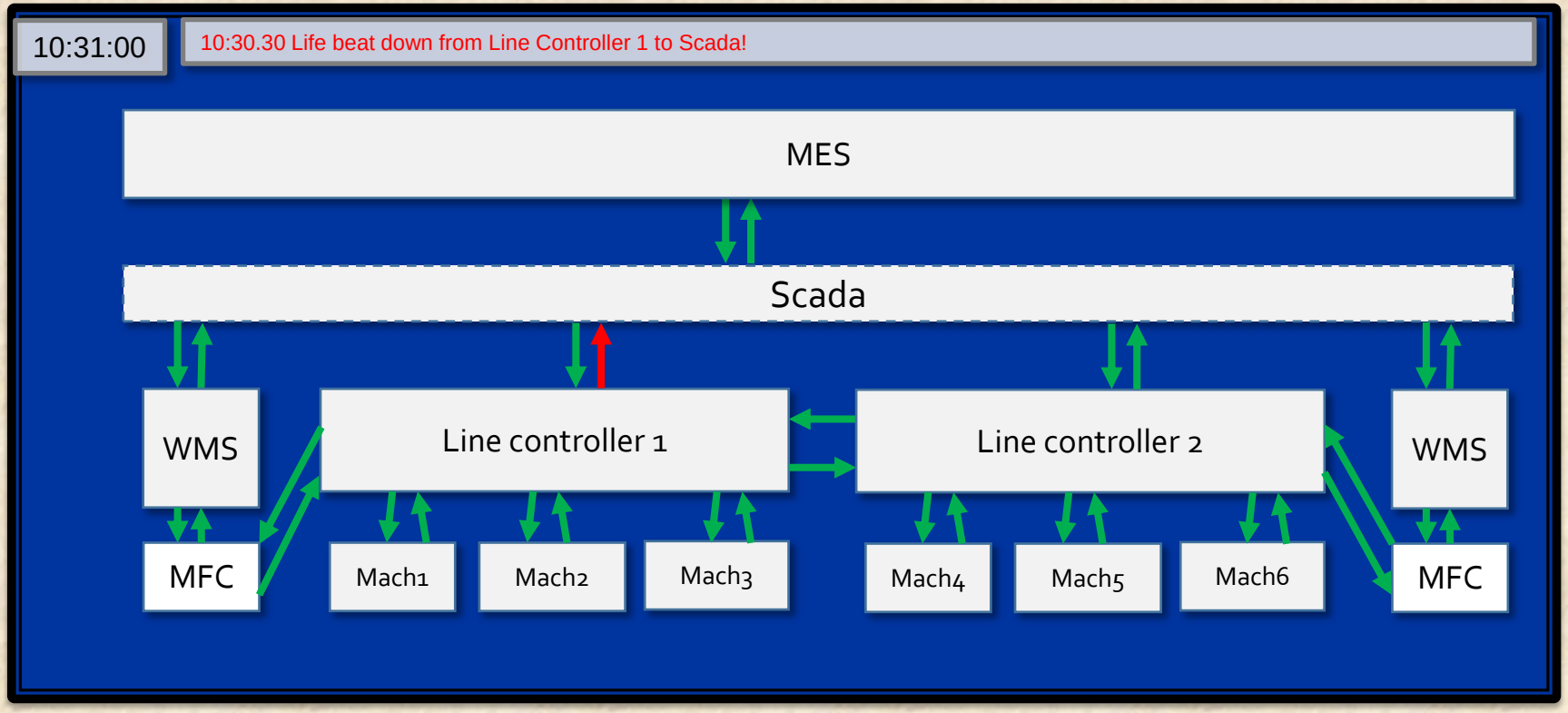
6. Visualizing of interfaces

- System overview display (component diagram)
- Life beat monitoring (requirement for each vendor)
- Error log files (requirement for each vendor)
- Alarm messages (sms, e-mail)
- Alarm archive



Thank you!

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Thank you!

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