



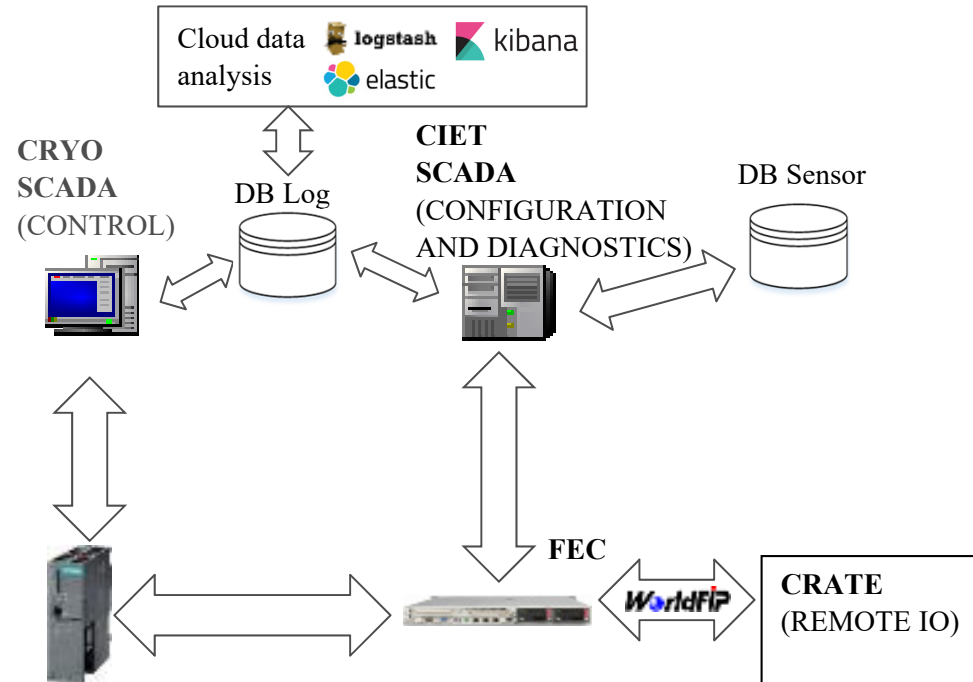
PROFINET COMMUNICATION CARD FOR THE CERN CRYOGENICS CRATE ELECTRONICS INSTRUMENTATION

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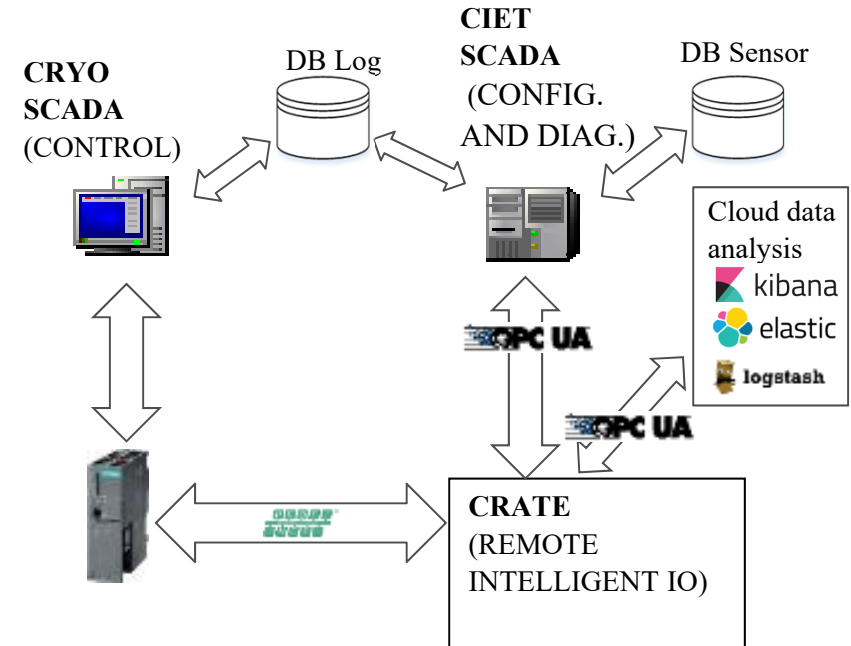
Agenda

- General introduction and motivation for the project
- System architecture
- Development (IT, automation, electronics)
- Conclusion

Motivation – architecture design change



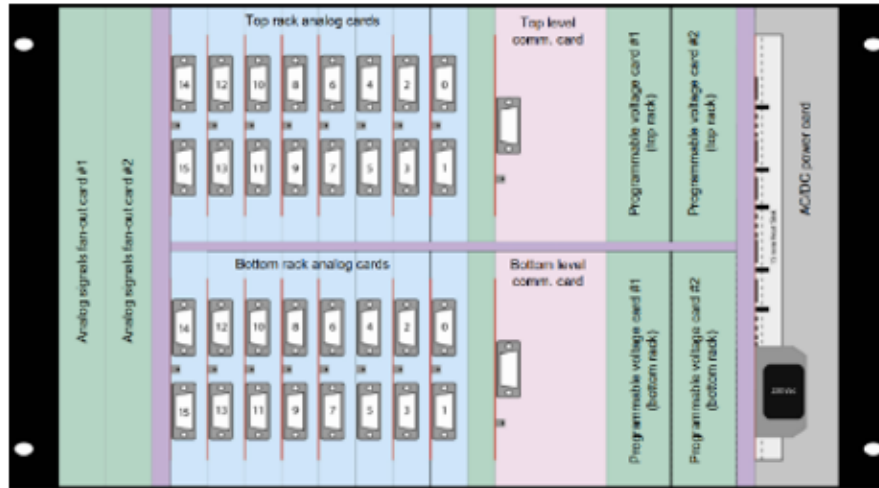
Current architecture overview



New architecture overview

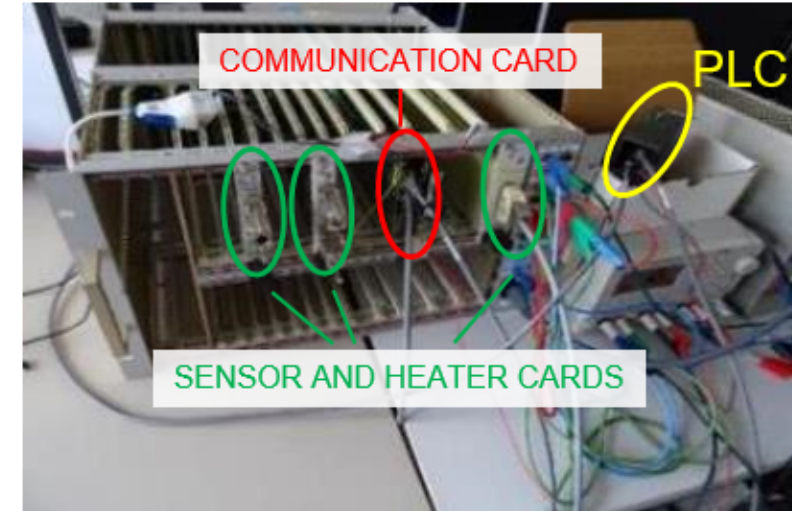
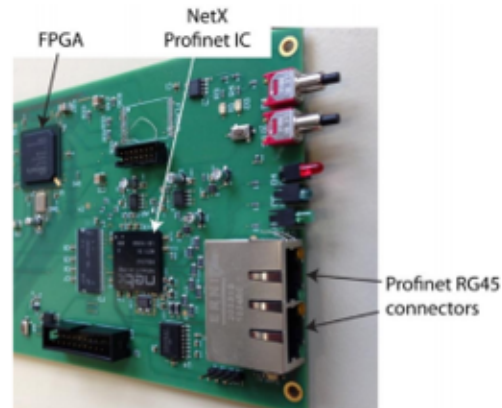
CIET - Cryogenics Instrumentation Expert Tool
FEC - Front End Computer

CRATE (REMOTE IO)



Crate overview

BERN Technical
University
communication
card prototype

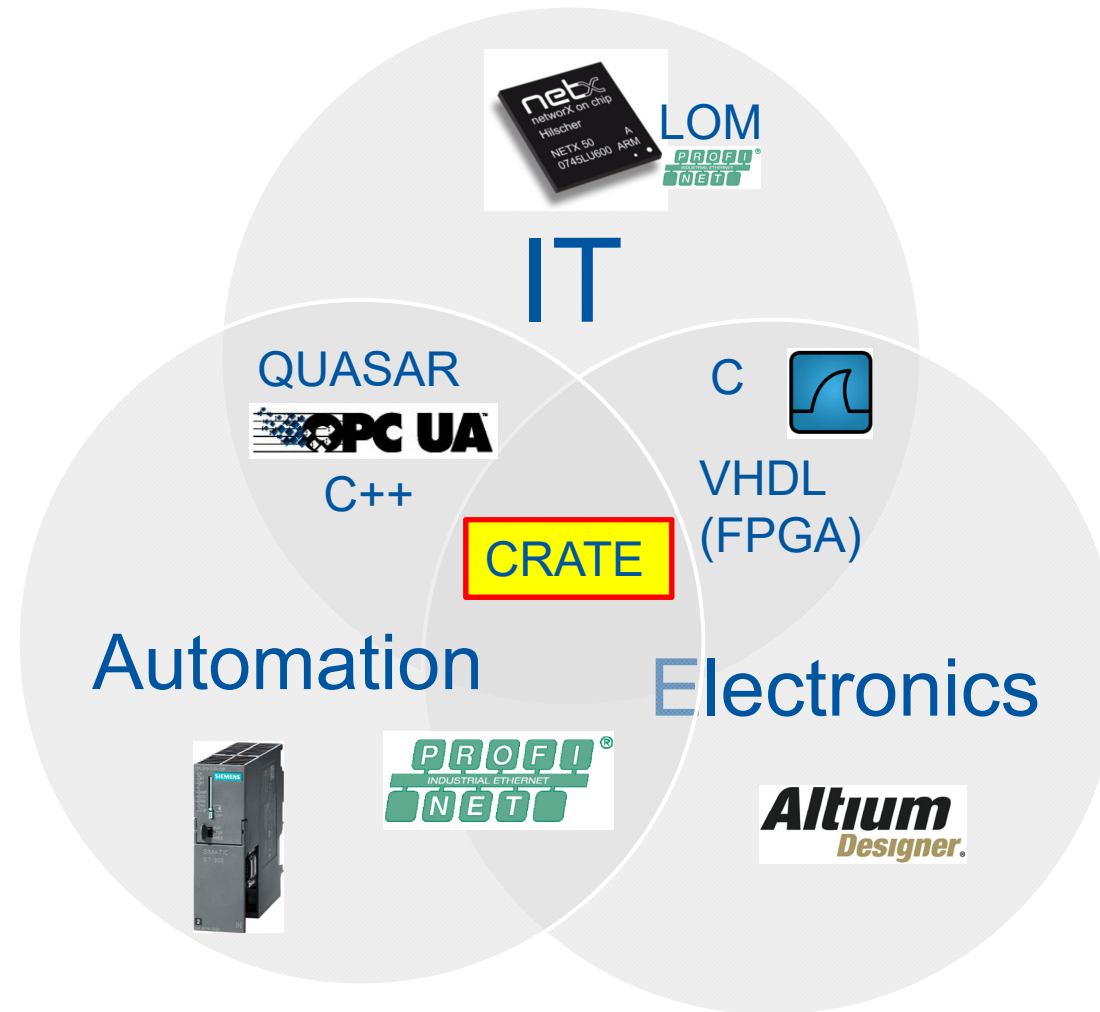


Crate prototype

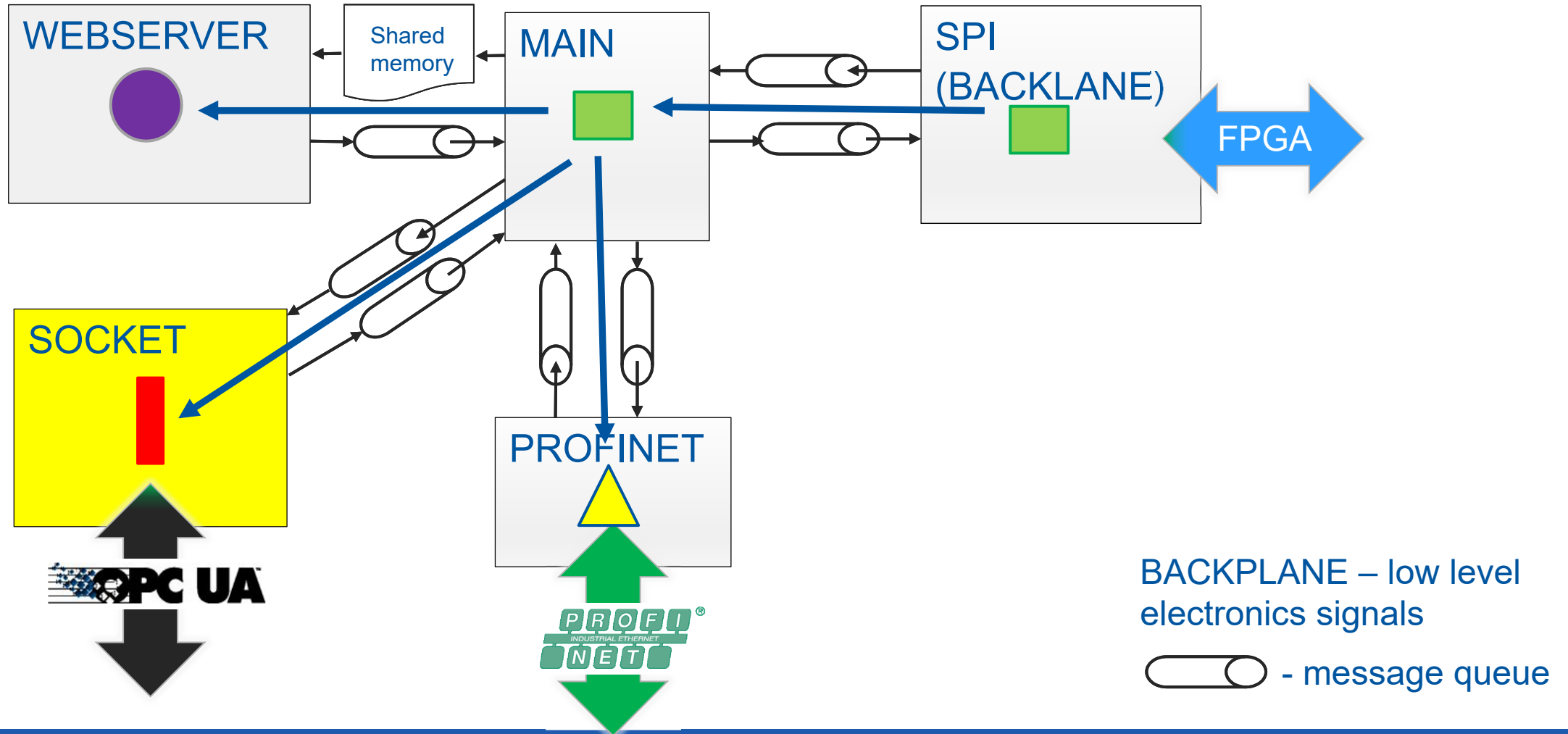
Requirements (non-radiation tolerant):

- calculations on the card
- simplification of the architecture

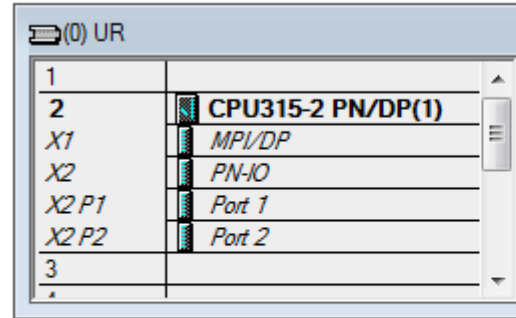
Development



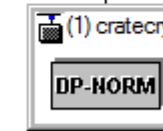
IT - Multithreading application



Automation - PLC

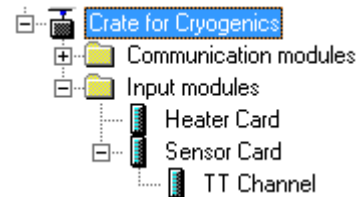


Ethernet(1): PROFINET-IO-System (100)



```
<SubmoduleList>
<SubmoduleItem ID="12" SubmoduleIdentNumber="0x00000001">
  <IOData IOPS_Length="1" IOCS_Length="1">
    <Input>
      <DataItem DataType="Float32" TextId="ProcessValue"></DataItem>
      <DataItem DataType="Unsigned8" TextId="Diagnostics"></DataItem>
    </Input>
  </IOData>
  <RecordDataList>
    <ParameterRecordDataItem Index="2" Length="4" TransferSequence="1">
      <Name TextId="Channel Parameters"></Name>
      <Ref DataType="Unsigned8" ByteOffset="0" BitOffset="0">
        <Default Value="120" Changeable="true" Visible="true" TextId="FilterSize"></Ref>
        <Ref ValueItemTarget="FilterMethods" AllowedValues="0 1 2" DataType="Unsigned8"
          ByteOffset="2" BitOffset="0" Default Value="2"
          Changeable="true" Visible="true" TextId="FilterMethod"></Ref>
      </ParameterRecordDataItem>
    </RecordDataList>
    <ModuleInfo>
      <Name TextId="TT SubModule"></Name>
      <InfoText TextId="TT InfoSubModule"></InfoText>
    </ModuleInfo>
  </SubmoduleItem>
</SubmoduleList>
```

GSDML - General Station Description
Markup Language

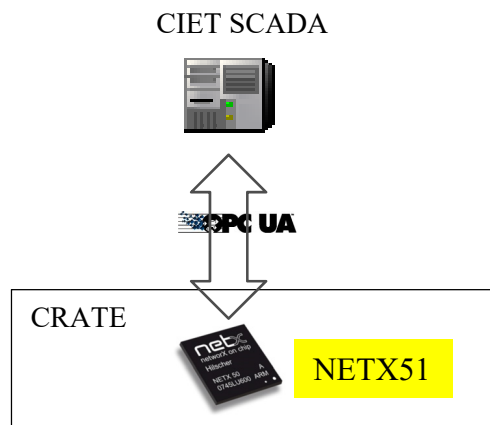


Real hardware configuration
to integrate the device

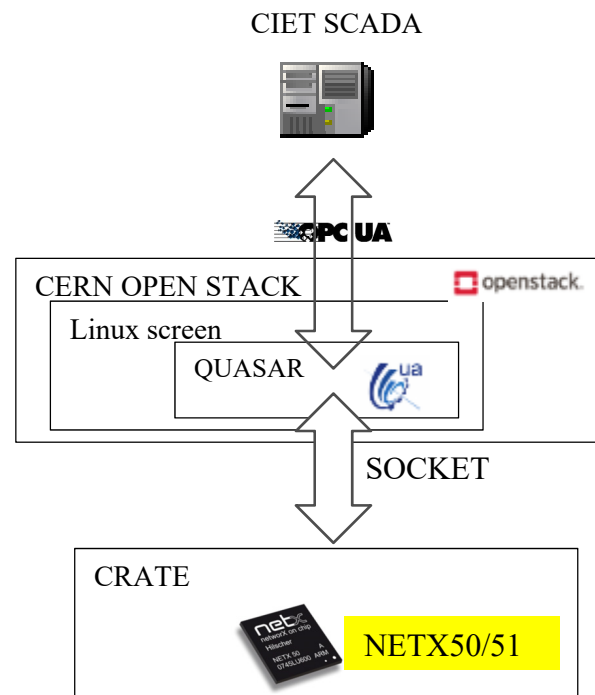
Slot	Module	Order number	I address	Q address	Diagnostic address	Comment
0	erotec cryogenics-1	TBD			2038*	
	Interface1				2039*	
	Interface1Port1				2036*	
	Interface1Port2				2035*	
1	CMODE 1 Communication		729	272...275		
2	Sensor Card				730*	
Channel Top	TT Channel		730...753			
Channel Bottom	TT Channel		754...777			
3	Sensor Card				778*	
Channel Top	TT Channel		778...801			
Channel Bottom	TT Channel		802...825			
4	Sensor Card				826*	
Channel Top	TT Channel		826...849			
Channel Bottom	TT Channel		850...873			
5	Sensor Card				874*	
Channel Top	TT Channel		874...897			
Channel Bottom	TT Channel		898...921			
6	Sensor Card				922*	
Channel Top	TT Channel		922...945			
Channel Bottom	TT Channel		946...969			
7	Sensor Card				970*	
Channel Top	TT Channel		970...993			
Channel Bottom	TT Channel		994...1017			
8	Sensor Card				1018*	
Channel Top	TT Channel		1018...1041			
Channel Bottom	TT Channel		1042...1065			
9	Sensor Card				1066*	
Channel Top	TT Channel		1066...1089			
Channel Bottom	TT Channel		1090...1113			
10	Heater Card		1114...1157	276...281		
11	Heater Card		1158...1201	282...287		

IT – socket, QUASAR ()

Ideal system architecture
(OPC UA not available yet as LOM in NETX)

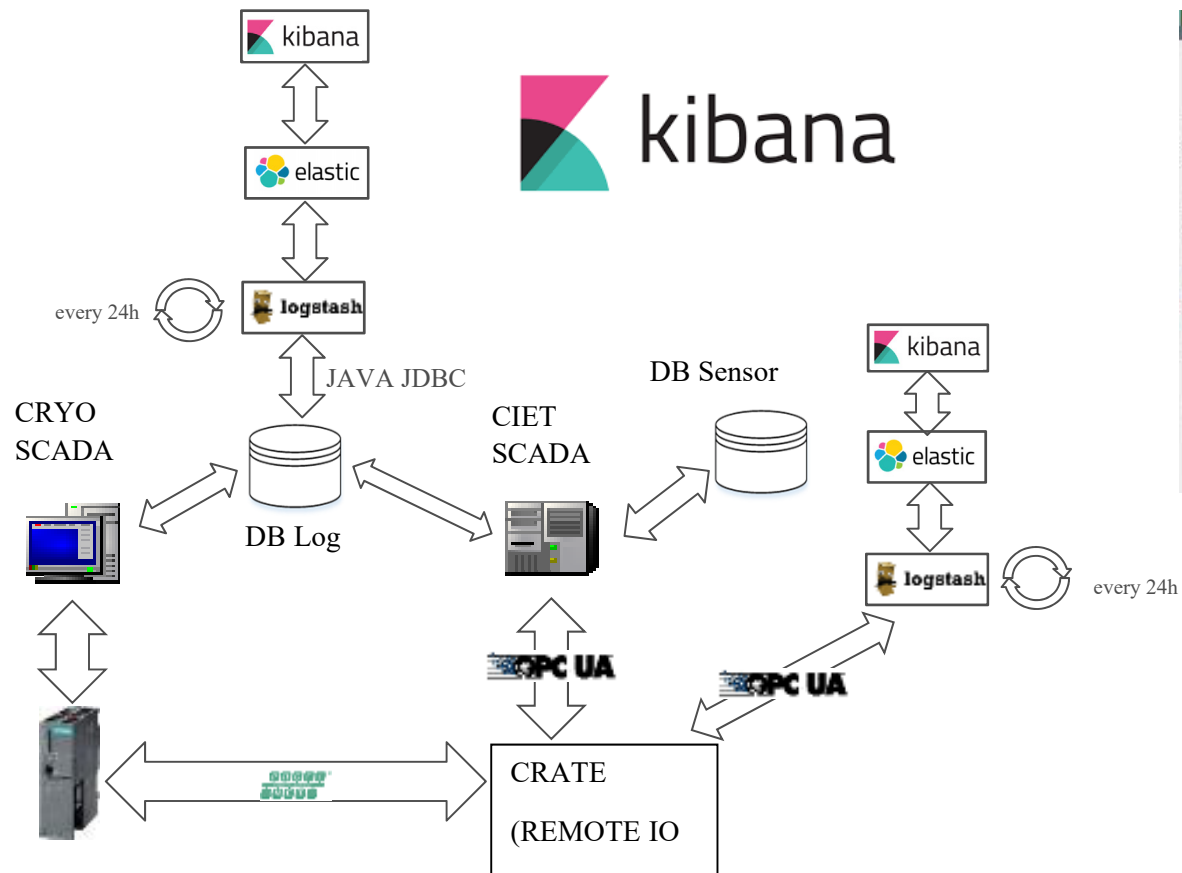


Current solution



THPHA009 B.Farnham
12-Oct-17 16:45 – 19:00
[link to the paper](#)

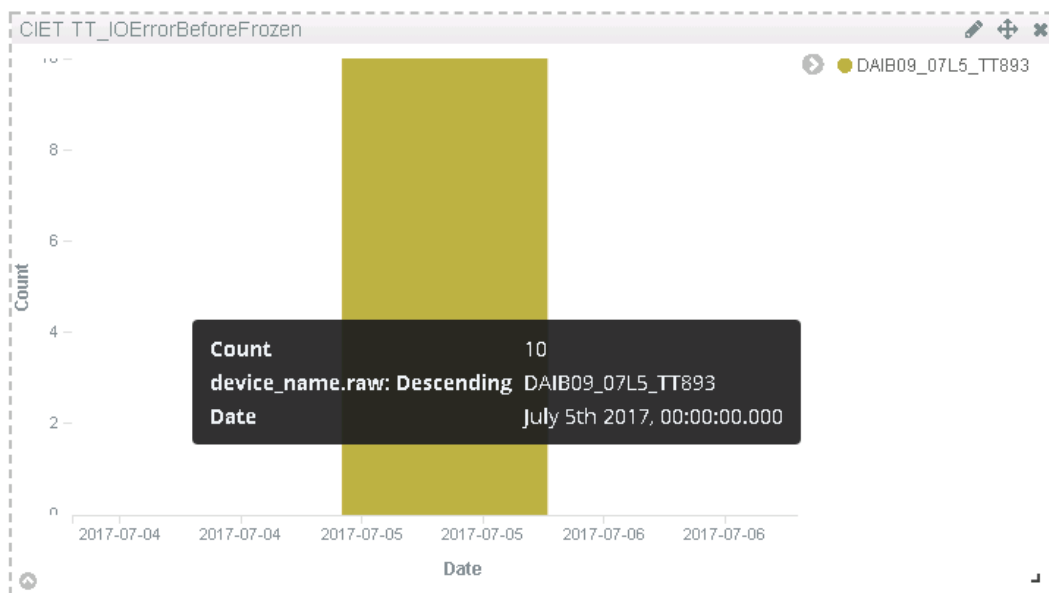
Elasticsearch/KIBANA cloud data analysis



TUPHA034 J.A.G. Hamilton
10-Oct-17 16:45 – 19:00
[link to the paper](#)

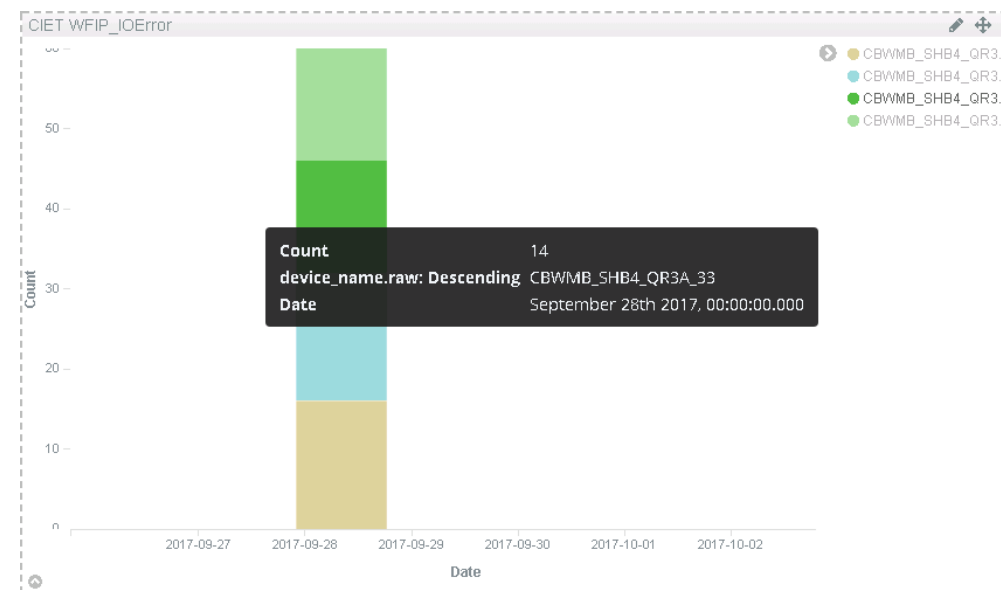
Kibana detection examples

Temperature channel intermittent losses detection



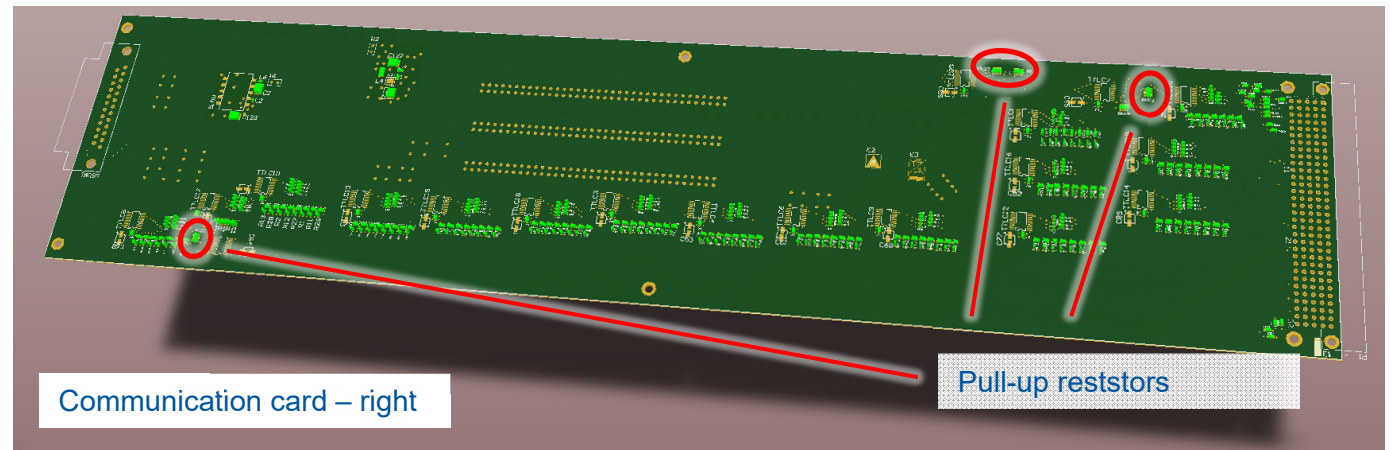
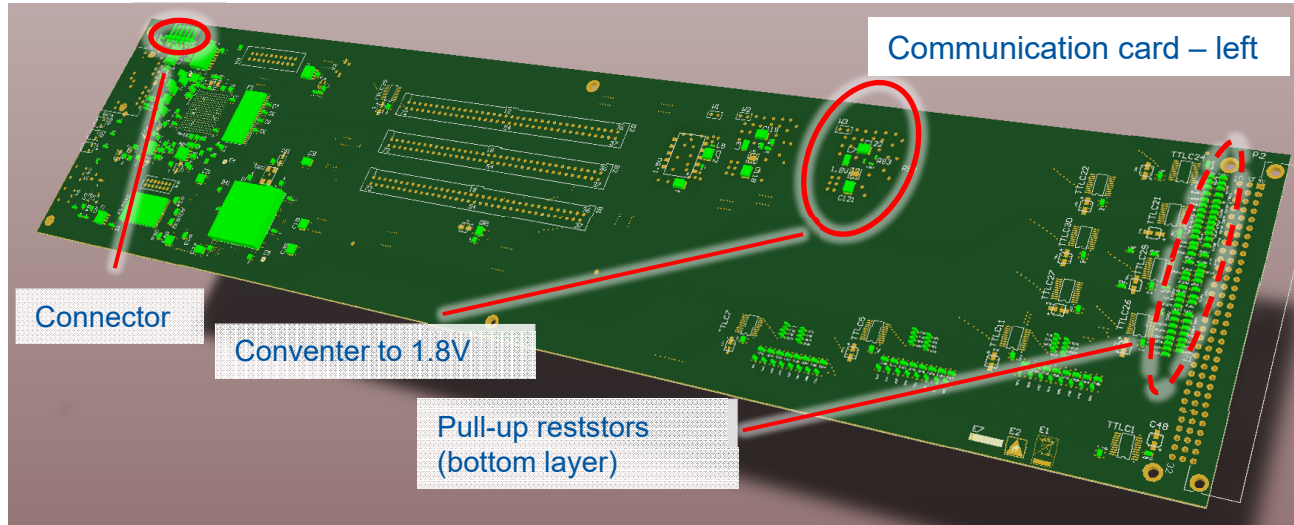
- In field diagnostics revealed bad soldering contact problem.
- Problem consolidated before channel was lost.

Intermittent losses on 4 WorldFIP communication units



- Sporadic losses led to field actions.
- Suspected field-bus faulty component replaced.

Electronics - minor updates



Conclusion

- Simplified architecture of the system
 - Calculations done in one chip without intermediate computer.
 - Supporting Profinet industrial protocols.
- IoT – direct data analysis Kibana, communication OPC UA™.
- Easy integration with cloud analysis systems.

ACKNOWLEDGEMENTS

- ITER ("The Way" in Latin) - support and funding of the initial development phase of the project.
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- James Hamilton (CERN-BE-ICS) – Elastic Stack support.

Thank you for your attention.
Please do not hesitate to ask questions.



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