



Detector controls meets JEE on the web

ICALEPCS 2015

Frank Glege



Outline

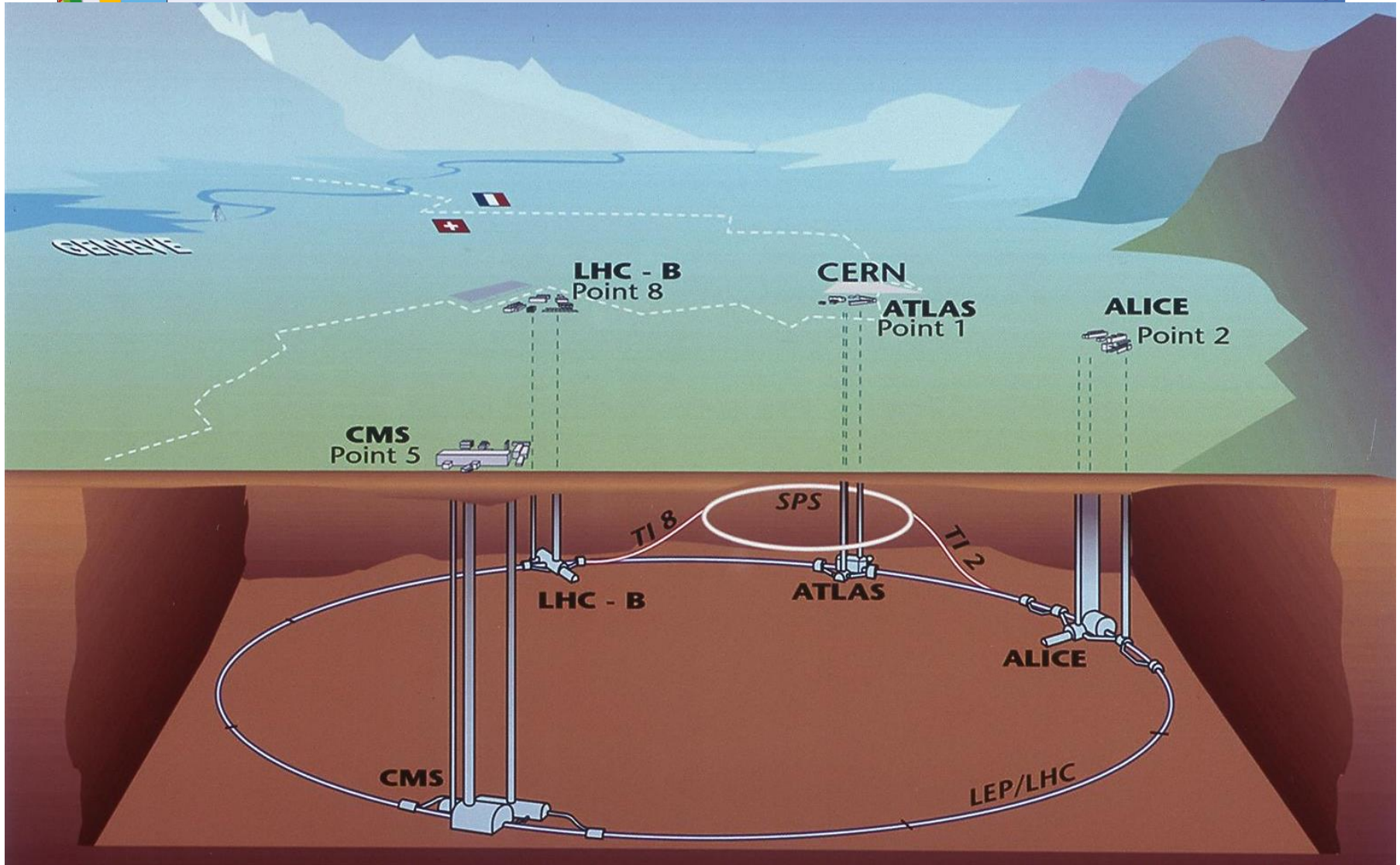


Part 1: Web based Remote access to
controls systems

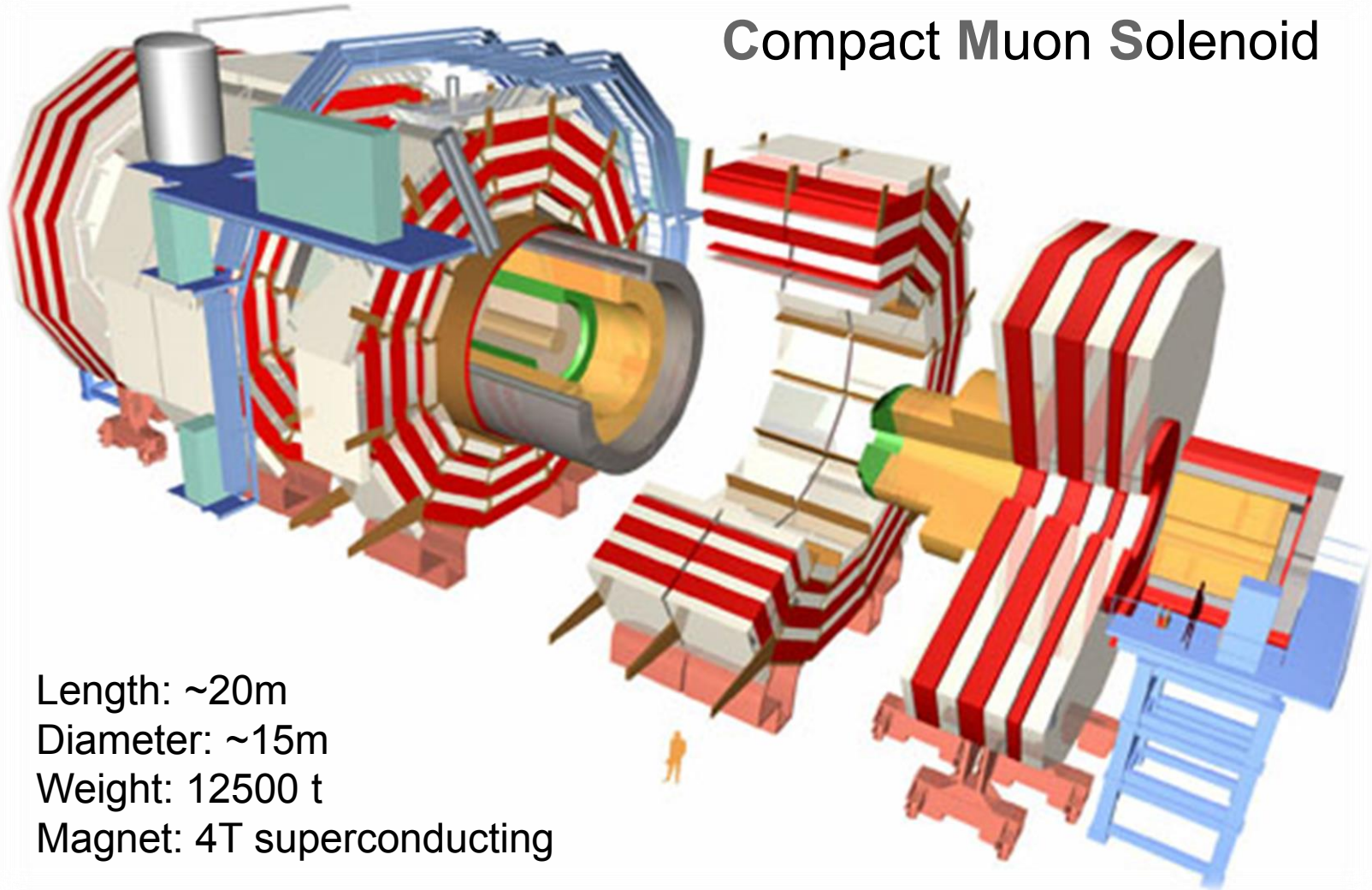
Part 2: JEE for controls



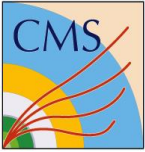
About CERN



Compact Muon Solenoid



Length: ~20m
Diameter: ~15m
Weight: 12500 t
Magnet: 4T superconducting

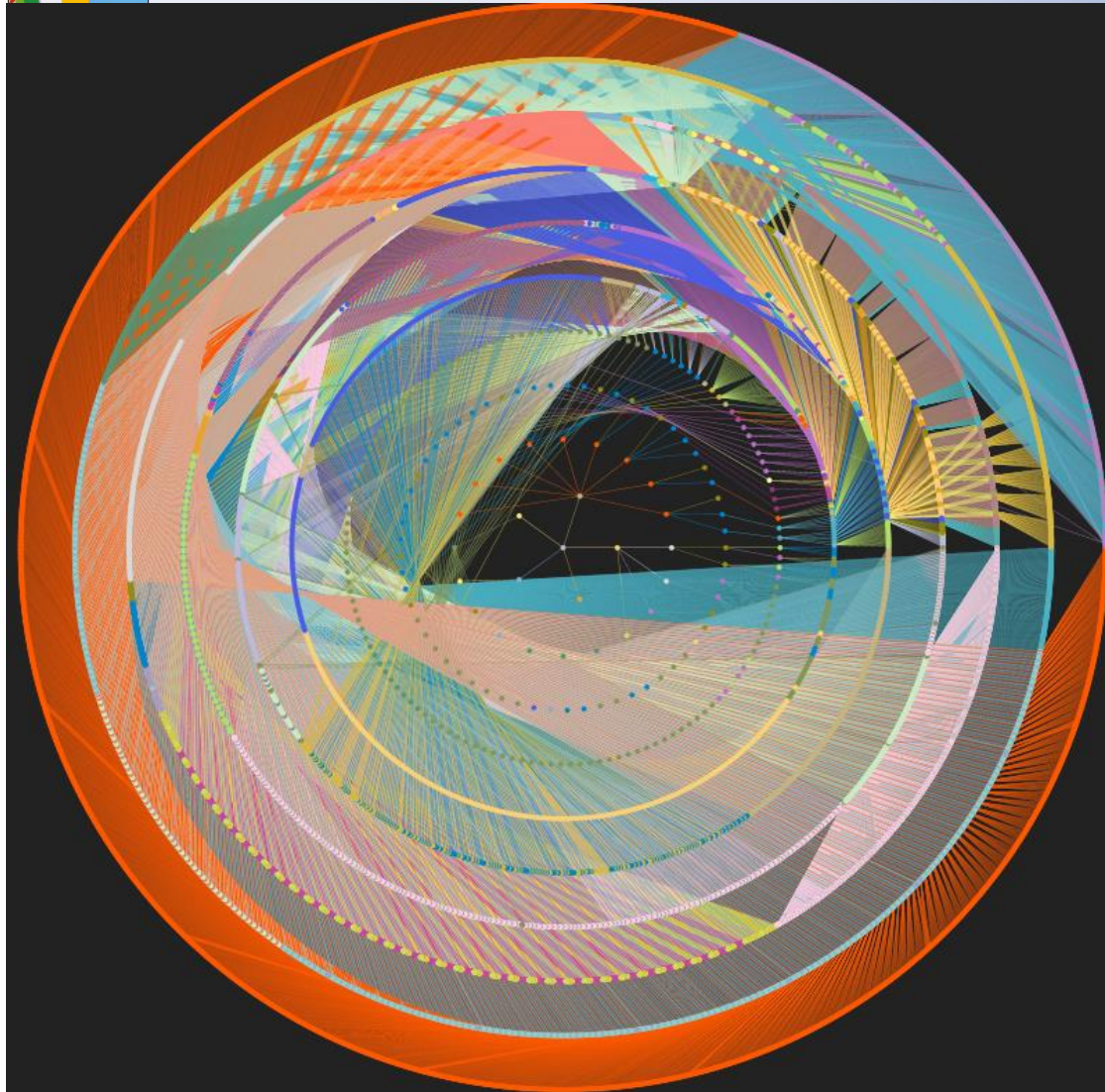


CMS DCS facts



- Working since several years at high efficiency.
- SCADA: WinCC OA developed by ETM
- ~3 million parameters
- ~700.000 lines of code
- ~35000 finite state machine nodes
- ~34 SCADA systems
- 29 redundant PC pairs (Windows)
- ~50 DB schemas (ORACLE)
- O(TB) of data in schemas

SCADA: supervisory control and data acquisition



The logical structure of the system is built with a hierarchy of finite state machine nodes. The image shows a circular view of this hierarchy with the top node in the center and sub nodes distributed equally on consecutive circles



Remote control



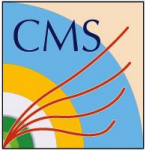
- 4000 collaboration members should be able to access the DCS information
- All collaboration members should be able to read information
- Experts should be able to access information about their system in read/write mode
- Visualization should be live
- Authentication and authorization is a must



Visualization in WinCC OA



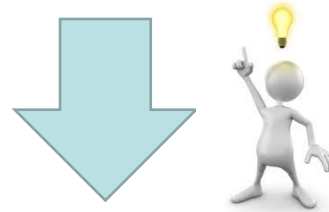
- In WinCC OA visualization is done through so-called panels.
- Panels are developed using a graphical editor allowing to position graphics elements (text, buttons, lines, etc.)
- Each element can be enhanced by scripts
- The scripts have access to process data
- Panels are visualized by a WinCC OA application using Qt



Bringing it to the Web

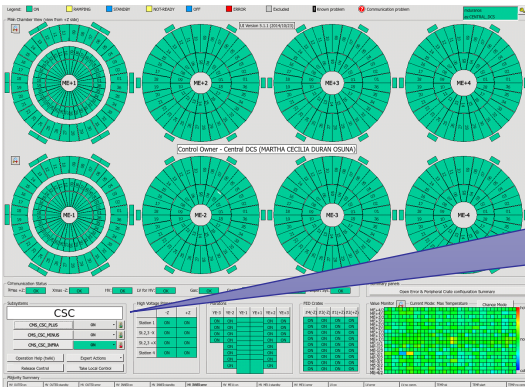


- Thousands of panels have been created
- Redoing panels in HTML is not an option
- Panels should be visualized on the WEB without any modification



- Intercept drawing commands in Qt and forward them to an HTML5 canvas
- Forward HTML5 canvas events to Qt

Layout manager



Graphics element

CMS CSC PLUS

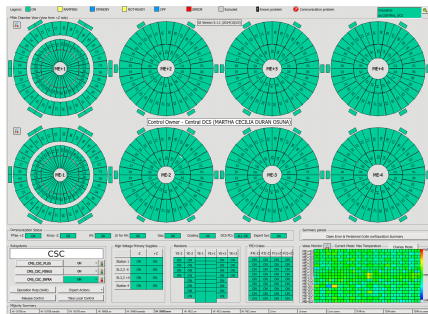
Graphics element components

CMS_CSC_PLUS

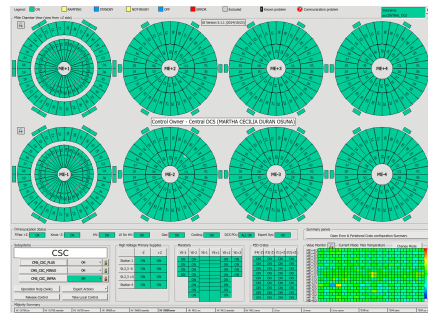
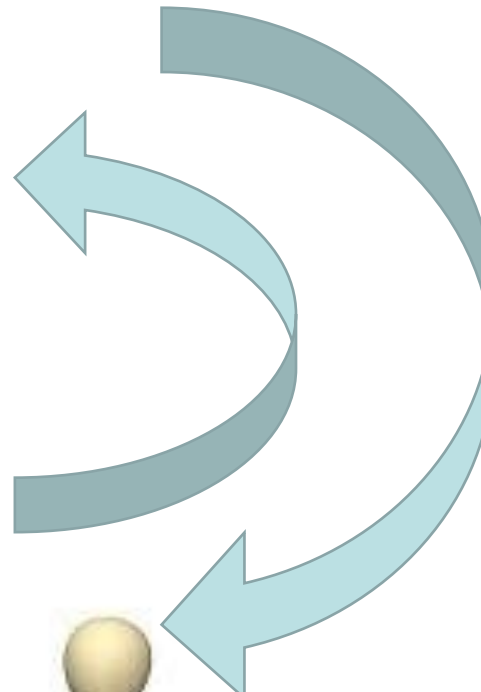
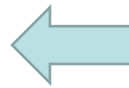
Graphics element painting

1. Reserve space
2. Draw rectangle
3. Color rectangle
4. Draw text

CMS_CSC_PLUS



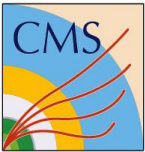
```
HTML  
canvas  
...  
clip  
draw rectangle  
Stroke  
draw line  
...
```



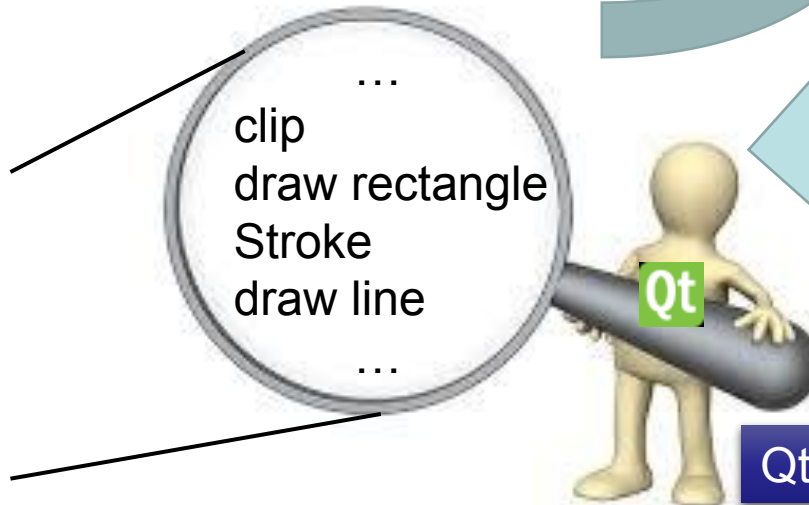
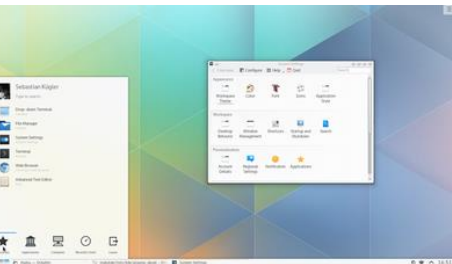
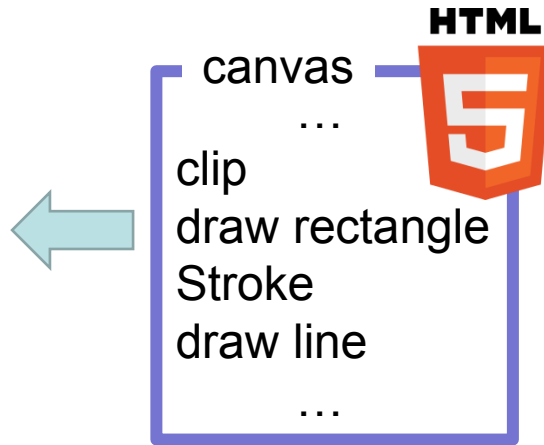
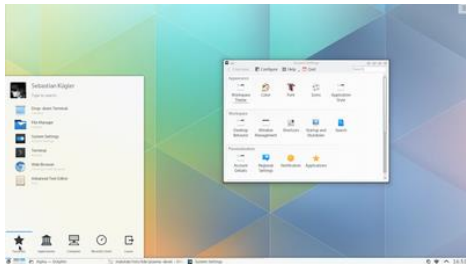
```
...  
clip  
draw rectangle  
Stroke  
draw line  
...
```



Qt platform abstraction

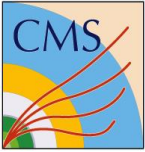


Command redirection



Qt platform abstraction





Web server as gateway



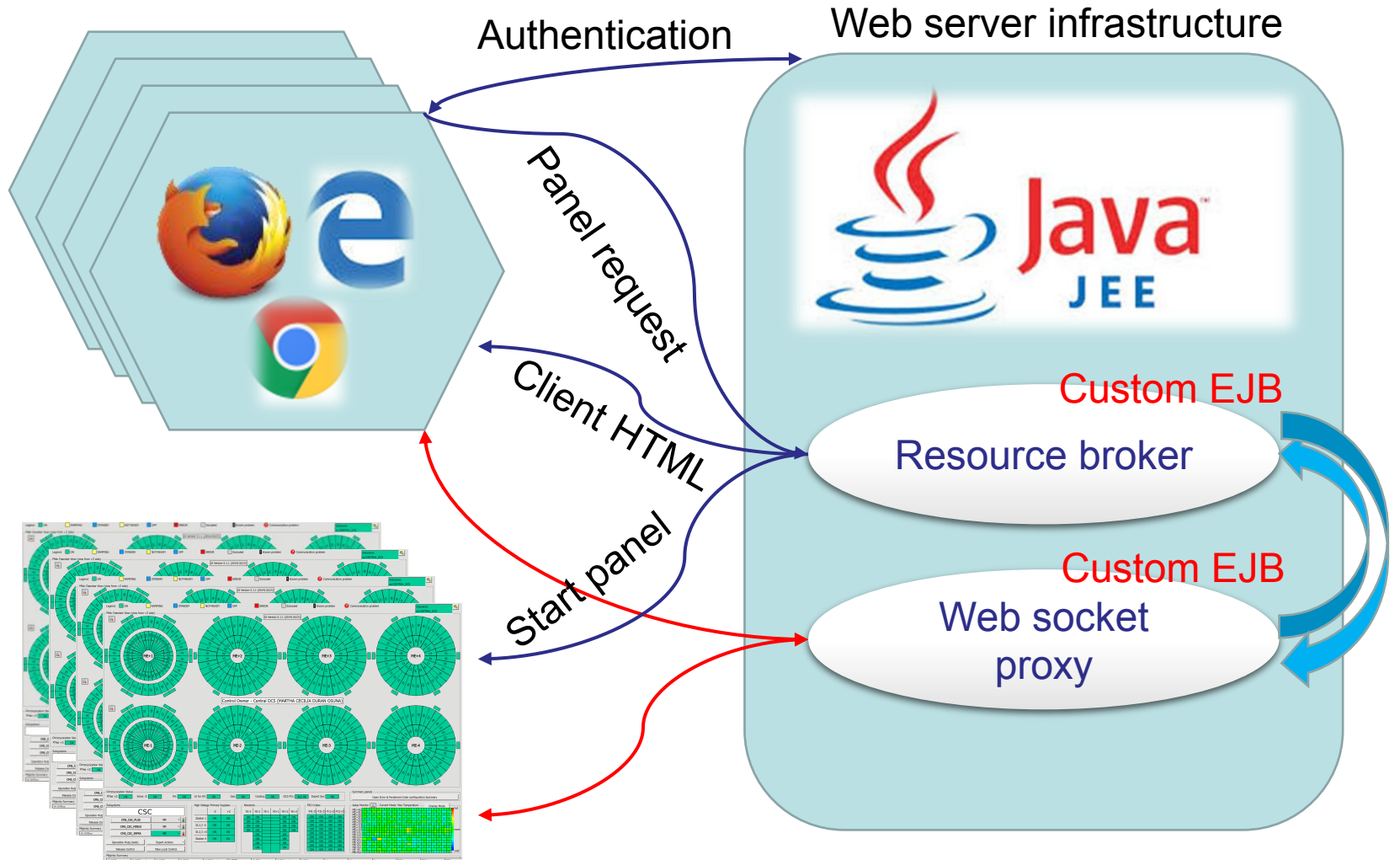
- Using a web server as interface between Qt and the HTML5 canvas allows for
 - Easy authentication and authorization
 - Multi user access
 - Fire walling using well tested applications
- Additionally required components:
 - Resource broker
 - Fan out
- Single user read/write
- Multi user read only



Why JEE?



- JEE (JAVA enterprise edition) provides authorization
- JEE provides EJBs (Enterprise Java Beans):
 - EJBs model the business logic of a JEE application
 - EJBs are not limited to a request
 - EJBs provide intercommunication
 - EJBs allow modularity and scalability
 - EJBs allow for distributed systems





Performance



- Without optimization not all panels provided a sufficiently low latency in rendering due to high data rate.
- For a reference panel the data rate from Qt to the browser could be optimized as follows:
 - Before optimization: 1.1MB/s required
 - After optimization: 20kB/s required



Optimizations



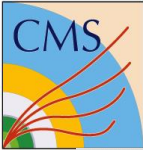
- Command sequence caching
- Command indexing
- Image caching
- Optimize TCP packet usage
- Optimize (reduce) event sending
- Reduce update frequency to human perceivable rate



Next step



- Allow to add pure HTML objects to visualization
 - Allows for navigation and simple animation
 - Enables restricted multi user read/write access
 - Will further improve performance
 - Allows for object based authorization



Adding pure HTML objects



Legend: ■ ON ■ RAMPING ■ STANDBY ■ NOT-READY ■ OFF ■ ERROR Excluded ! Known problem ? Communication problem

UI Version 5.1.1 (2014/10/23)

Control Owner - Central DCS (MARTHA CECILIA DURAN OSUNA)

Buttons

Text

Color coded fields

High Voltage Primary Supplies	Station 1	Station 2	Station 3	Station 4
-Z	ON	ON	ON	ON
+Z	ON	ON	ON	ON
St.2,3 -X	ON	ON	ON	ON
St.2,3 +X	ON	ON	ON	ON
Station 4	ON	ON	ON	ON

High Voltage Secondary Supplies	YE-3	YE-2	YE-1	YE+1	YE+2	YE+3
YE-3	ON	ON	ON	ON	ON	ON
YE-2	ON	ON	ON	ON	ON	ON
YE-1	ON	ON	ON	ON	ON	ON
YE+1	ON	ON	ON	ON	ON	ON
YE+2	ON	ON	ON	ON	ON	ON
YE+3	ON	ON	ON	ON	ON	ON

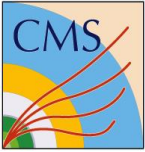
LCB-Crates	#4(-Z)	#3(-Z)	#1(+Z)	#2(-Z)
#4(-Z)	ON	ON	ON	ON
#3(-Z)	ON	ON	ON	ON
#1(+Z)	ON	ON	ON	ON
#2(-Z)	ON	ON	ON	ON
ME-4/2	ON	ON	ON	ON
ME-4/1	ON	ON	ON	ON
ME-3/2	ON	ON	ON	ON
ME-3/1	ON	ON	ON	ON
ME-2/1	ON	ON	ON	ON
ME-2/2	ON	ON	ON	ON
ME-1/3	ON	ON	ON	ON
ME-1/2	ON	ON	ON	ON
ME-1/1	ON	ON	ON	ON
ME-4/3	ON	ON	ON	ON
ME-4/4	ON	ON	ON	ON
ME-3/3	ON	ON	ON	ON
ME-3/4	ON	ON	ON	ON
ME-2/3	ON	ON	ON	ON
ME-2/4	ON	ON	ON	ON
ME-1/4	ON	ON	ON	ON



Final goal



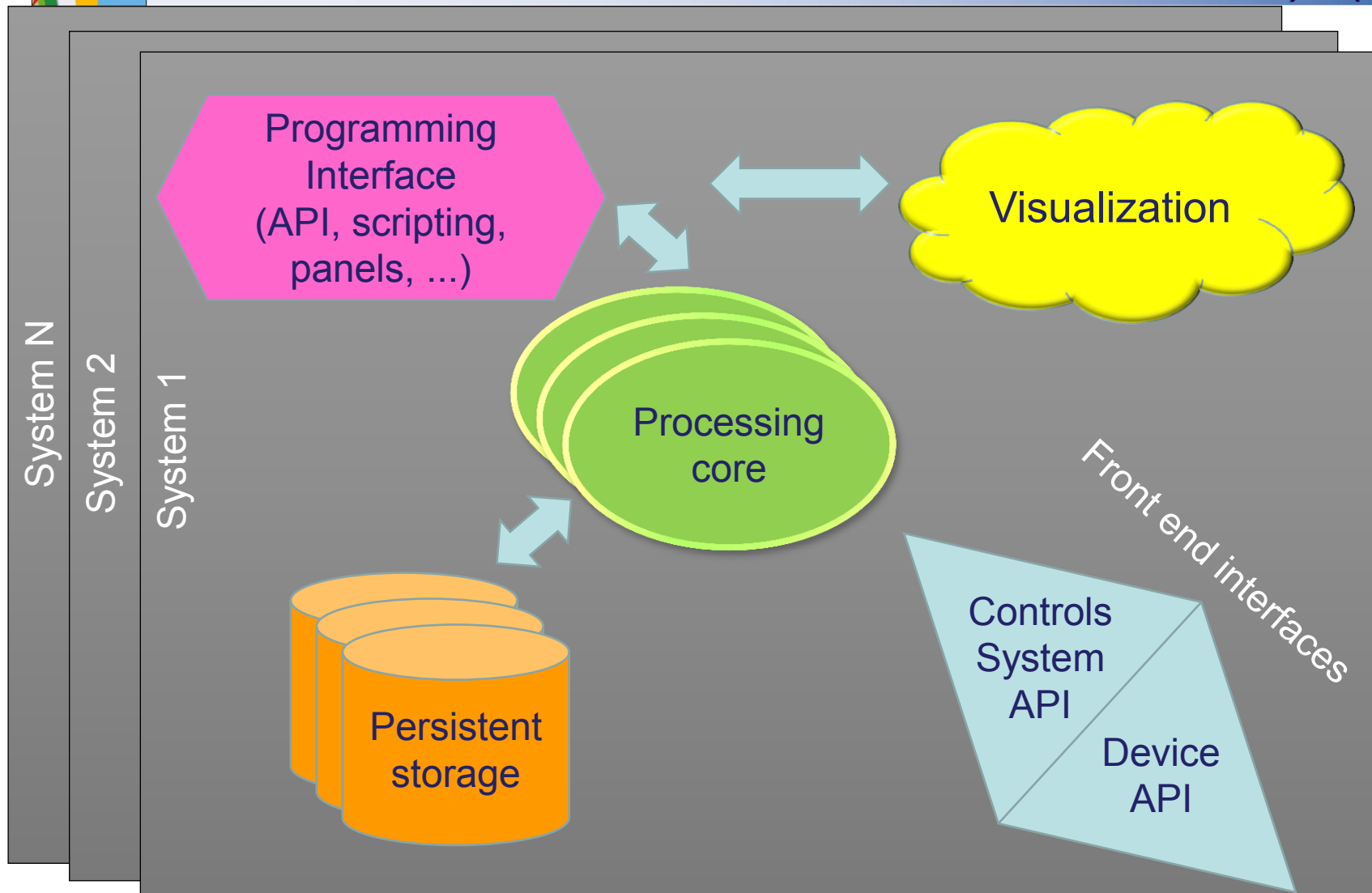
- Pure HTML visualization
 - Requires reworking or new creation of PVSS panels
 - Enables full multi user read/write
 - Will provide maximum performance
 - Requires object based authorization
 - Feasibility still to be proven (can all panel designs be reproduced with pure HTML?)

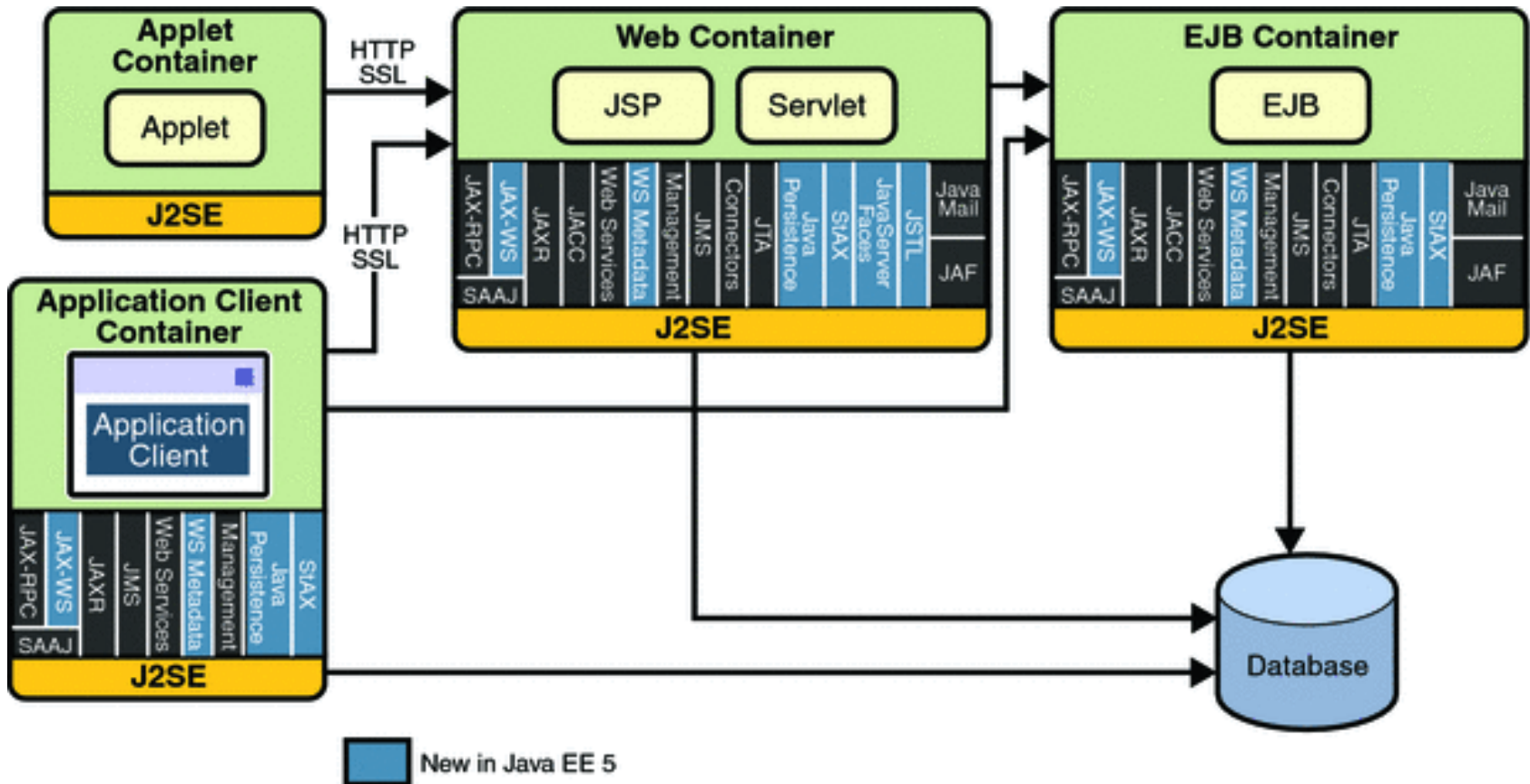


Summary of part 1

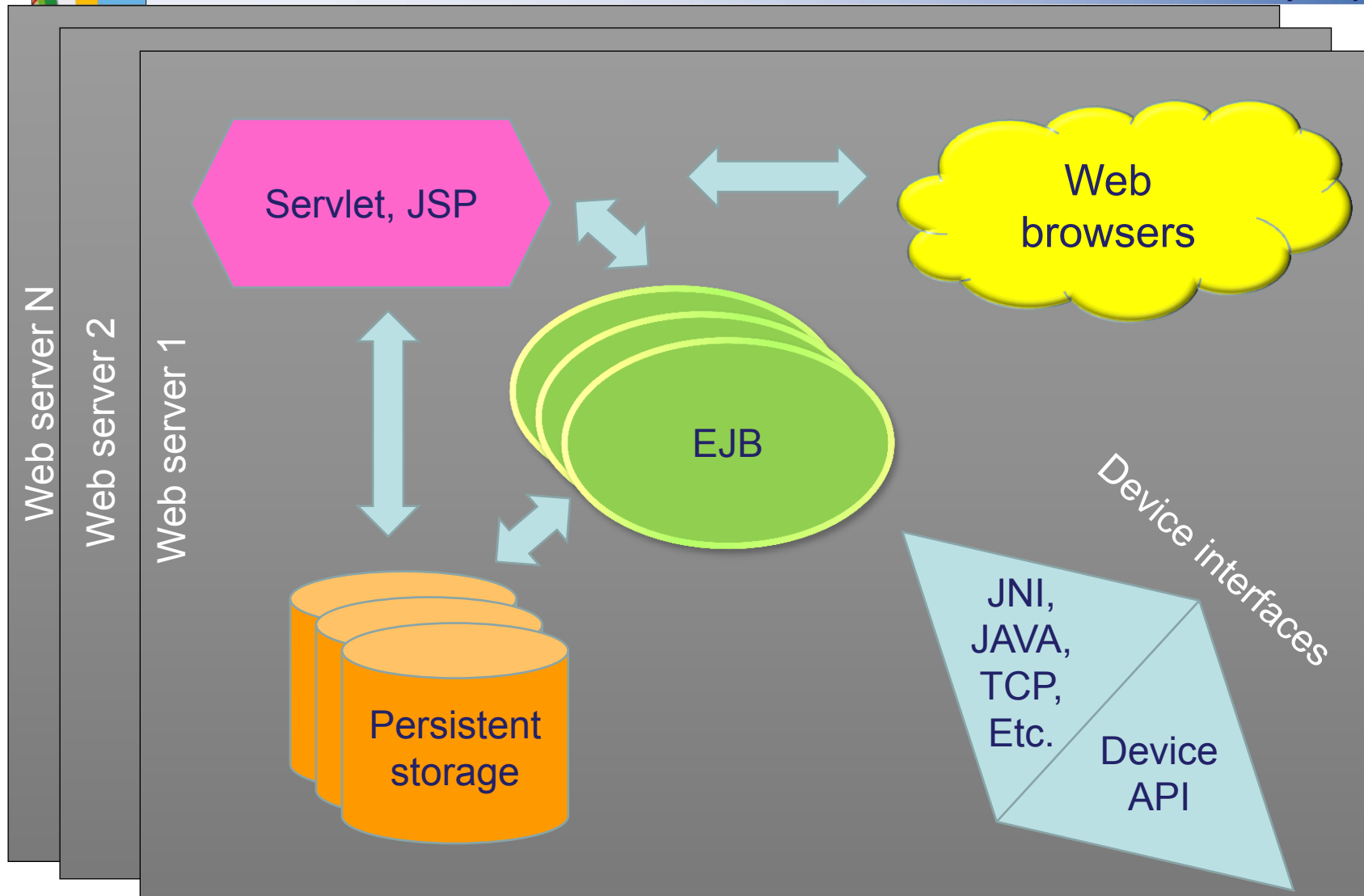


- We implemented a solution for web based remote control mirroring WinCC OA panels using Qt platform abstraction
- No modification of panels is needed to provide single user read/write or multi user read only in a first step with sufficient performance
- An evolution towards a fully HTML based remote visualization is possible and foreseen





Extract from the ORACLE JEE documentation





JEE for controls?



- The concept fits
- The visualization is quite powerful and provides many ready to use components
- Access to different persistent storage systems is built in and uses a common API
- Different communication mechanisms between JEE components and towards the outside are provided
- Provides authentication and authorization
- Programmable in JAVA



JEE for controls?



- JEE is not a fully functional controls software
- JEE is a concept for which different implementations exist
- JEE provides many components and interfaces required to build a controls system
- JEE is well documented, widely used and often free of charges

JEE seems well suited as a basis for the development of a new controls system