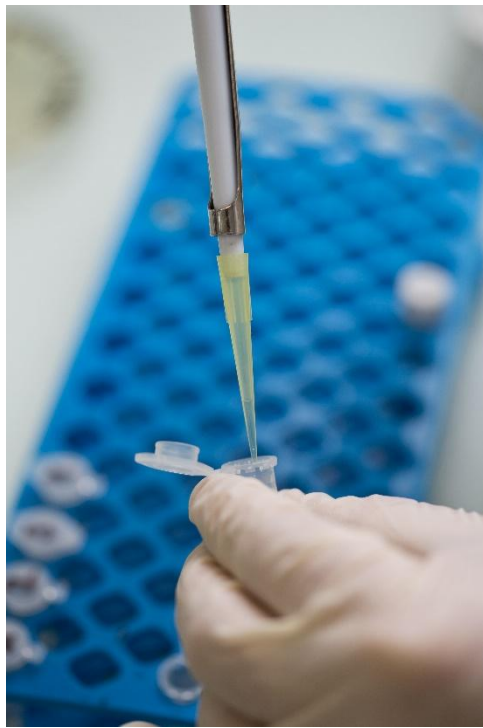


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# F. Hoffmann-La Roche

*Thorsten Ulbricht, Philipp Sutter, Piero Steinger*



# Roche Overview

# Roche - a global pioneer in pharmaceuticals and diagnostics



94 052 employees\* worldwide

22 major R&D sites in pharma and diagnostics worldwide

CHF 9.9 billion invested in innovative R&D

CHF 50.6 billion sales

- Direct Roche commercial presence
- Commercial distributors

● Roche Group Headquarters in Basel, Switzerland

● R&D sites in Pharma and Diagnostics

● Genentech, R&D and commercial operations US

● Chugai, R&D and commercial operations Japan

\* Employee numbers in FTE (full time equivalent)

# Advancing science to improve people's lives since 1896

*Focused on innovative tests and medicines*

## History of firsts since 1896



Digalen (heart tonic) – Synthesized  
Vitamin C – Librium, Valium  
(Benzodiazepines, CNS) – CobasBio  
Diagnostics product – Rocephin  
(antibiotics) – AccuCheck (diabetes  
care) – Invirase (AIDS) – Pegasys (Hep  
C) – Herceptin, Avastin (Monoclonal  
antibodies, cancer) – Actemra (Arthritis)  
– HPV-testing – **more...**

## Industry-leading pipeline



**74** new molecular entities  
in 2016

**9** Next generation diagnostics  
instruments launched in 2016

## Portfolio along full cycle of care



**Prevention** **Diagnosis**  
**Treatment** **Monitoring**

Blood Screening – Cardiology – Clinical  
Chemistry – Diabetes Care –  
Immunology – Immunotherapy –  
Neuroscience – Oncology –  
Ophthalmology – Point of Care  
Testing – Tissue Diagnostics – Virology

## Our lasting impact on society

*Improving lives – today and tomorrow*



*27 million*

patients treated with top 25 products

*127.5 million*

patients treated with now off-patent products

*17+ billion*

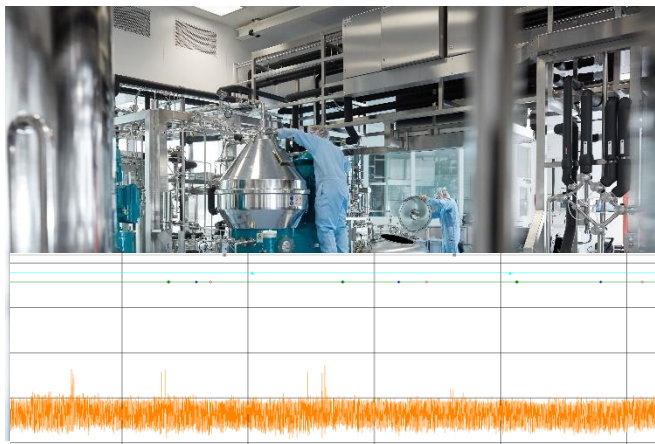
tests conducted with Roche instruments

*30 Roche medicines*

Listed on the WHO Essential Medicines List

*8 years in a row*

ranked as most sustainable healthcare  
company by Dow Jones Sustainability  
Indices



# PI usage @ Roche

# PI locations

*OSIs soft PI is used since around 2000 in no standardized way*

- Around 1 Mio Tags
- Mixture of components
- Each site has its own history
- Process Book & PI Vision (some)



\* To be phased out or divested



Roche has a majority stake in Chugai Pharmaceuticals, Japan

Not included on graph: well-established contract manufacturing organization (CMOs) network

■ Small Molecules

■ Biologics

# Handling Dynamic Environments

## The flexible Lab Building B098

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# Roche in Basel

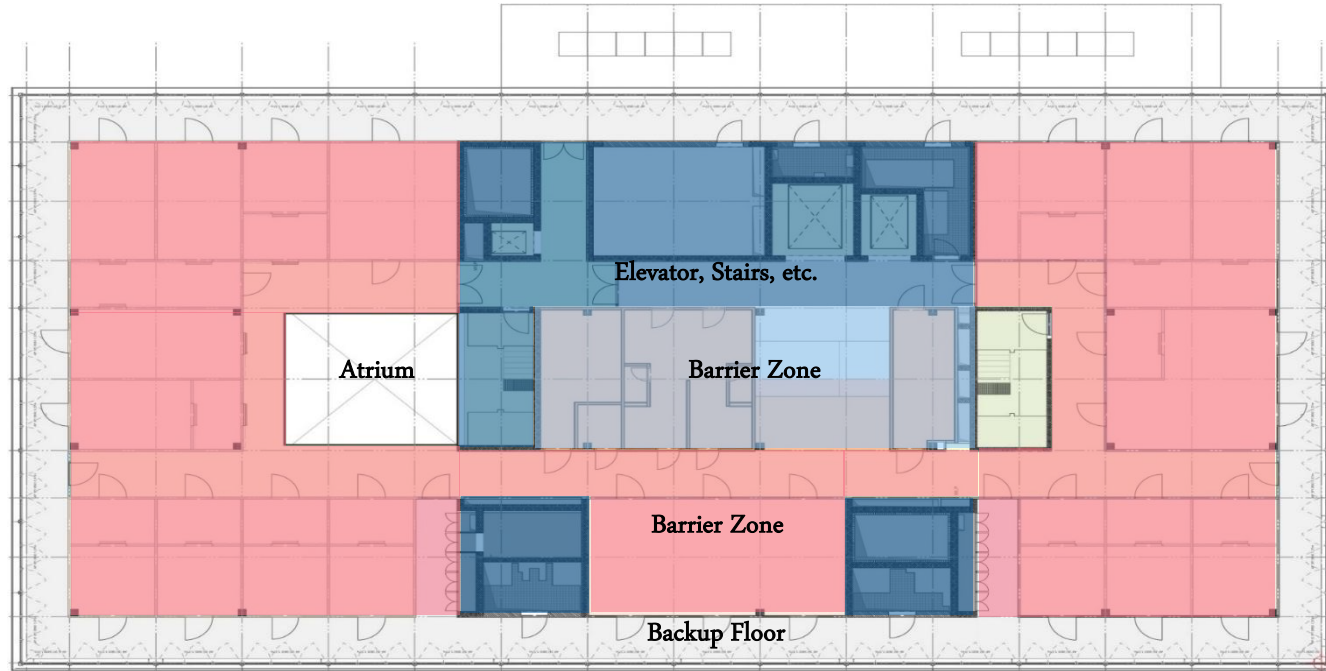
*pRED Center & B098 (2023)*



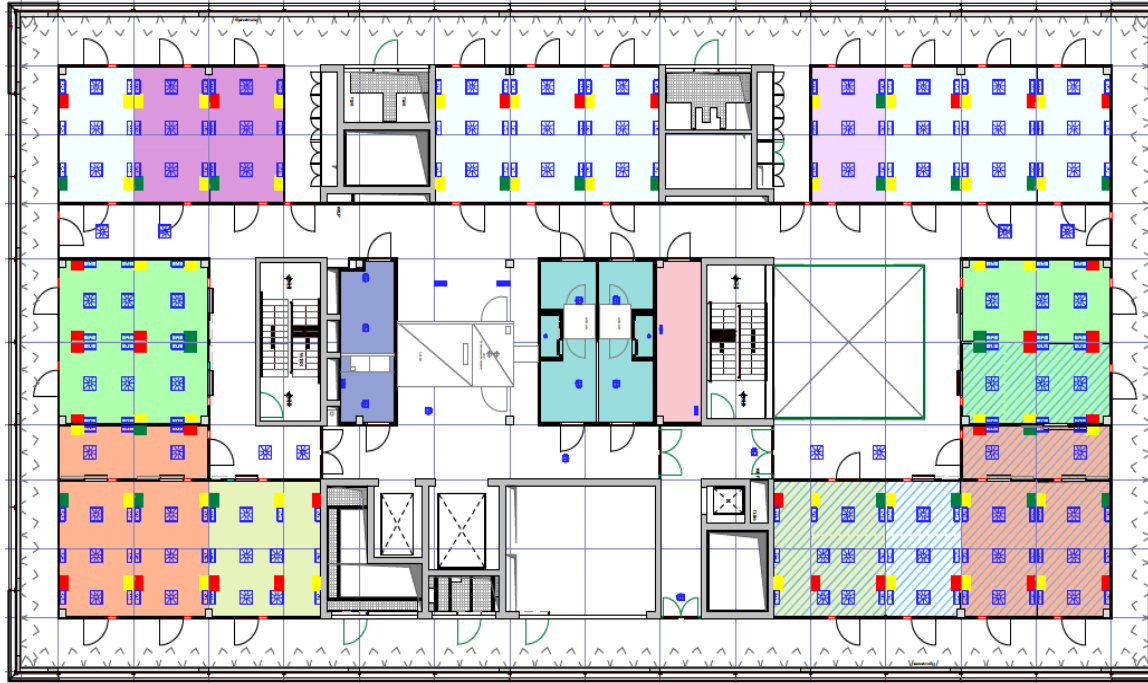
# B098 Project Visualisation



# Generic floor plan



# Flexibility / modularity



Smallest possible  
subdivision



Largest single  
rooms

# Requirements to the building infrastructure

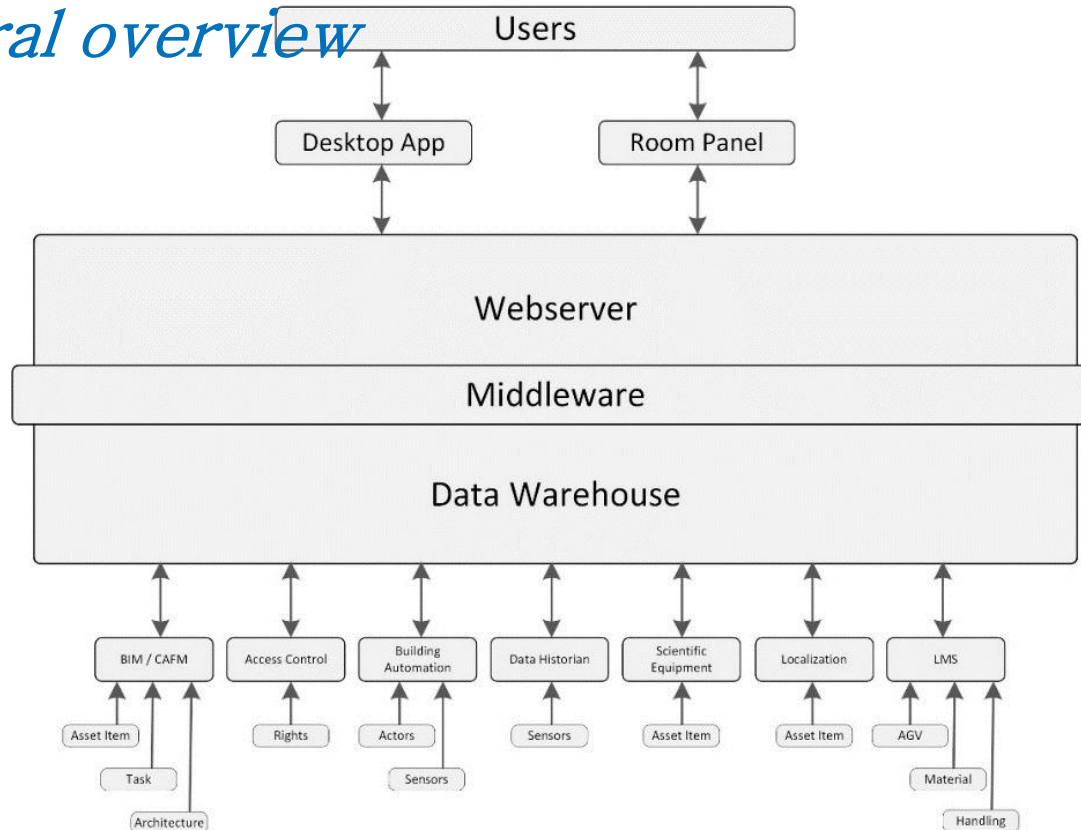
## *Overview*

- GMP/GLP compliant Environment monitoring
- Environment (Light, temperature etc.) can be controlled by user
- Customizable and reproducible environmental scenarios
- Retrospective analyses is available and fast
- Highly automated reporting



# Logical system architecture

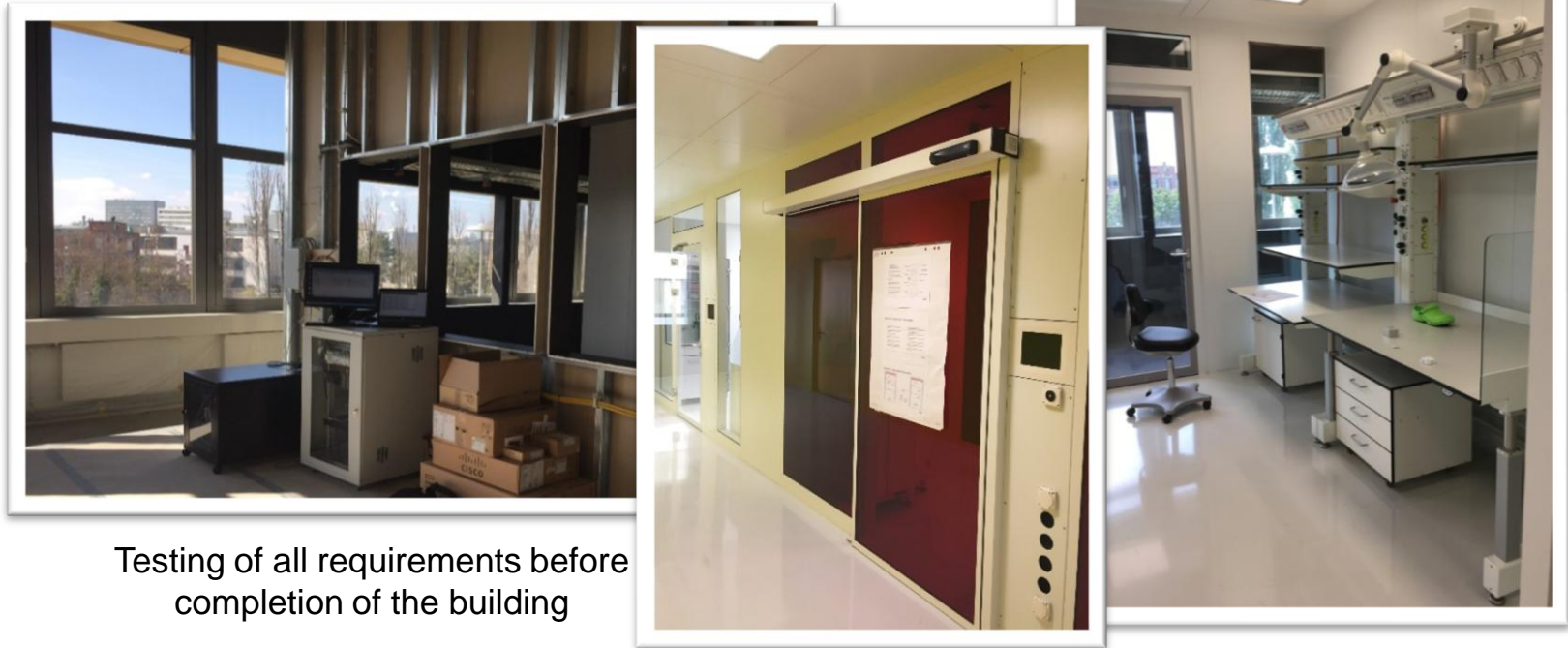
## *Architectural overview*



# IT mockup



*Architectural mockup of three lab rooms, Q1 2017 – Q2 2018*



Testing of all requirements before completion of the building

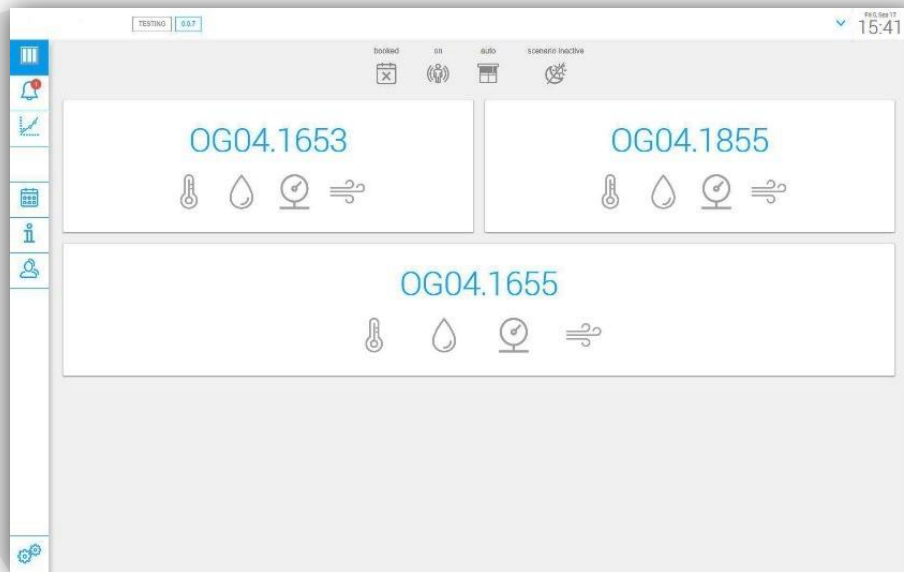
# B098 Room Panel



## *Test installation in the IT mockup*



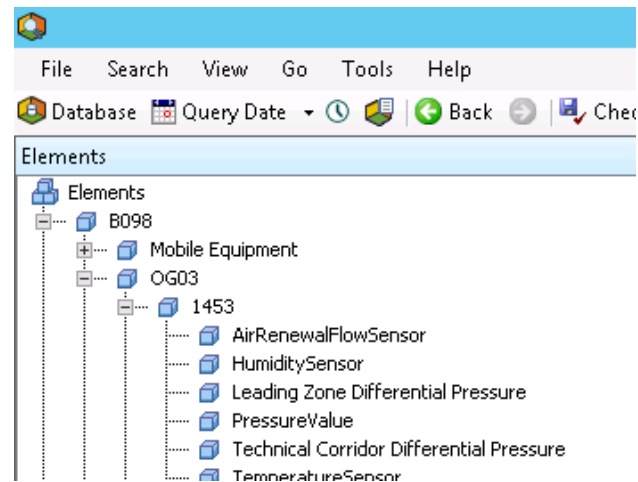
- Fully functional and access controlled room panel (light, stores, air flow, ...) at the entrance of lab rooms
- During project: complete functional tests of building control via room panels will be possible





# PI AF / Event Frames

## PI Web API



# The Building Model in AF



## The Building, Requirements:

- Floors with zones, but no rooms
- Modules/Rooms created as needed
- Monitoring data for each room
  - Temperature
  - Humidity
  - Differential Pressure
  - Etc.

## The AF Element Structure:

- Building
  - Floor



- Sensors..
  - » MVs
  - » Alarms...

# The Building Model in AF



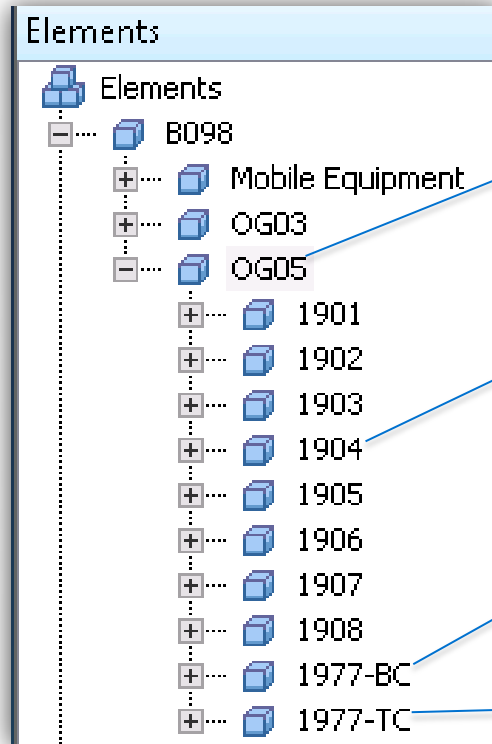
## The Building

- Zones contain all the sensors
- Zones can be temporarily combined to rooms
- Only one (leading) zone per room is relevant for data historisation

## The AF Model

- Rooms as Event Frames
- Zones as Elements in AF
- Event Frames
  - References to zone elements
  - Leading zone = primary reference

# AF Structure and Zone element



Floor

Zone

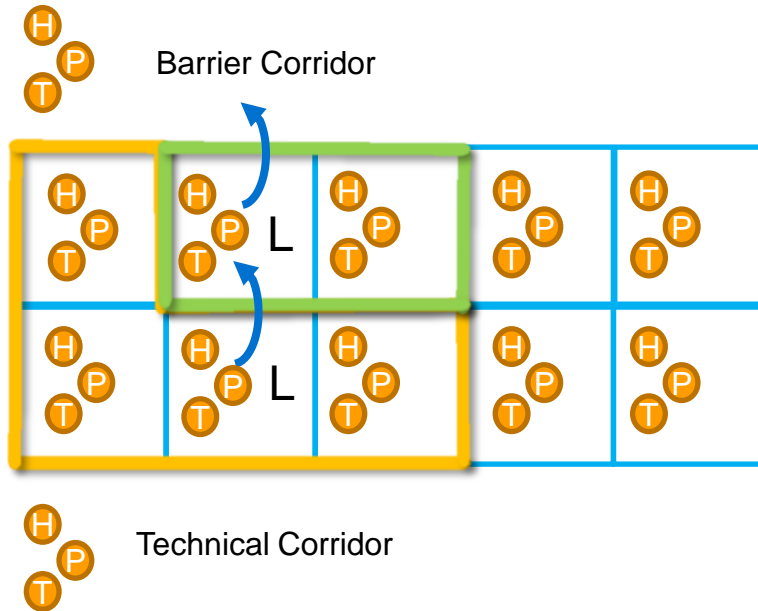
Zones contain  
the sensor elements

Barrier Corridor

Corridors are similar  
to zones but are never  
part of a room  
Used as reference for  
differential pressure

Technical Corridor

# Differential Pressure Calculation



- Sensors in all zones → PI
- Module
  - Anteroom
  - Main Room
- Each room has a leading zone
- Differential pressure:
  - Main → Anteroom
  - Ante → Barrier Corridor
- Calculations in AF

# Differential Pressure calculation

Leading Zone  
Main Room

Leading Zone  
Anteroom

No analyses in  
event frames...

Elements

- B098
  - Mobile Equipment
    - OG03
      - 1453
      - 1455
      - 1653
      - 1655
      - 1677-BC
      - 1677-TC
      - 1853
      - 1855
    - Barrier Equipment
    - OG05
      - 1901
        - DifferentialPressureSensor
        - PressureValue
      - 1902
      - 1903
      - 1904
        - DifferentialPressureSensor
        - PressureValue
      - 1905
      - 1906
      - 1907
      - 1908

DifferentialPressureSensor

Filter	Name	Value
Category: Alarm	Alarm	WarnLow
Category: Configuration	SensorCode	PD
	SensorTa...	B098.OG05.Z1901.PD.
	ZoneMinus	1904
	ZonePlus	1901
Category: Measured Value	Value	1 Pa
	ValueMinus	7 Pa
	ValuePlus	7 Pa

Myself

Anteroom  
Leading Zone

Elements

- B098
  - Mobile Equipment
    - OG03
      - 1453
      - 1455
      - 1653
      - 1655
      - 1677-BC
      - 1677-TC
      - 1853
      - 1855
    - Barrier Equipment
    - OG05
      - 1901
        - DifferentialPressureSensor
        - PressureValue
      - 1902
      - 1903
      - 1904
        - DifferentialPressureSensor
        - PressureValue
      - 1905
      - 1906
      - 1907

DifferentialPressureSensor

Filter	Name	Value
Category: Alarm	Alarm	WarnLow
Category: Configuration	SensorCode	PD
	SensorTa...	B098.OG05.Z1904.PD.
	ZoneMinus	1977-BC
	ZonePlus	1904
Category: Measured Value	Value	1 Pa
	ValueMinus	6 Pa
	ValuePlus	7 Pa

Myself

Barrier Corridor  
Zone

# Sensors and Alarming, Alarms as Event Frames

All sensors can create alarms

- Delay times
- Setpoint + offsets to alarm limits

The screenshot shows the 'Elements' tree on the left with a hierarchy: Elements > B098 > Mobile Equipment > OG03 > 1453 > 1455 > 1653 > 1655 > 1677-BC > 1677-TC > 1853 > 1855 > Barrier Equipment > OG05 > 1901 > DifferentialPressureSensor > PressureValue. The main window displays the configuration for 'DifferentialPressureSensor' with tabs for General, Child Elements, Attributes, Ports, Analyses, and Notification Rules. The 'Child Elements' tab is active, showing a list of elements with columns for Name and Value. The 'Alarm' element is highlighted, showing its configuration: Category: Configuration, SensorCode: PD, SensorTa...: B098.OG05.Z1901.PD., ZoneMinus: 1977-BC, ZonePlus: 1901. Below this, the 'Measured Value' category is expanded, showing a list of elements with columns for Name and Value. The 'Value' element is highlighted, showing its configuration: Value: 1 Pa, DH: 10 s, DHH: 20 s, DL: 10 s, DLL: 20 s, H: 15 Pa, H.Offset: 5 Pa.

The screenshot shows the 'Analyses' tab of the 'DifferentialPressureSensor' configuration window. It displays a list of analyses with columns for Name, Expression, Value at Evaluation, Value at Last Trigg, and Output Attribute. The 'Alarm' analysis is highlighted, showing its configuration: Name: Alarm, Expression: If 'Value' > 0 Then TagMin('Value', 'AlarmHigh EventFrame', 'AlarmLow EventFrame', 'AlarmHError EventFrame', 'AlarmLow EventFrame', 'CalculateDiffPressure'), Value at Evaluation: Map, Value at Last Trigg: Map, Output Attribute: Map. The 'Alarm' analysis is also shown in the 'Child Elements' tab of the 'DifferentialPressureSensor' configuration window.

The screenshot shows the 'Event Frames' configuration window. It displays a list of event frames with columns for Name, Description, Template, Start time, and Categories. The 'Alarm 1901.DifferentialPressureSensor' event frame is highlighted, showing its configuration: Name: Alarm 1901.DifferentialPressureSensor, Description: , Template: Alarm, Start time: 28.09.2017 17:06:46, Categories: . The 'Event Frame Searches' tab is active, showing a list of event frame searches with columns for Name, Description, Template, Start time, and Categories. The 'Alarm 1901.DifferentialPressureSensor' event frame search is highlighted, showing its configuration: Name: Alarm 1901.DifferentialPressureSensor, Description: , Template: Alarm, Start time: 28.09.2017 17:06:46, Categories: .

# Middleware Connection via PI WebAPI

- Middleware only uses PI WebAPI to connect to PI/AF
- Door tablet web pages have PI WebAPI calls directly embedded
- Configuration via PI WebAPI
- 3D model embedded PI data via PI WebAPI
- WebID caching in middleware:
  - Make sure that cached WebIDs are still valid
  - Cache, don't just copy and keep
  - Refresh the cache when necessary




# Room Creation by User (via PI WebAPI)

- **Create Module**
  - ➔ Create Event Frame for Module
- **Create rooms inside the module by combining zones into rooms**
  - ➔ Create child Event Frames for each room
    - Primary referenced element = leading zone
    - Add references to all other zones

➔ Configure leading zones connections for differential pressure

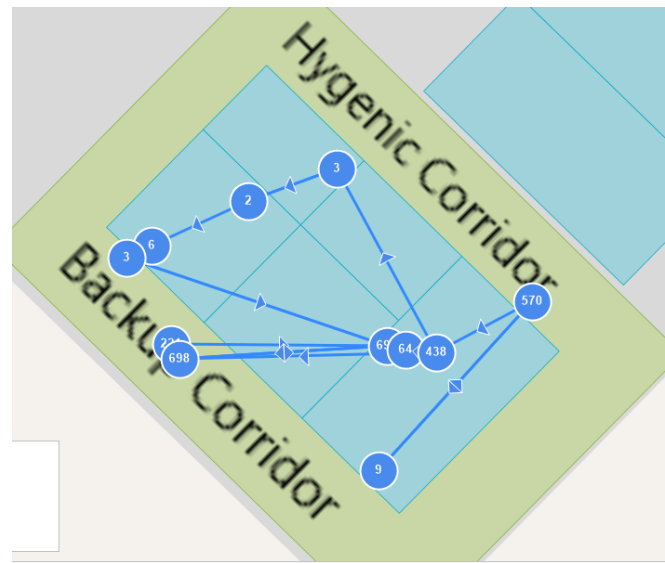
➔ Enable/Disable alarming for leading/non-leading zones

➔ ...



No support for transactions in PI WebAPI...

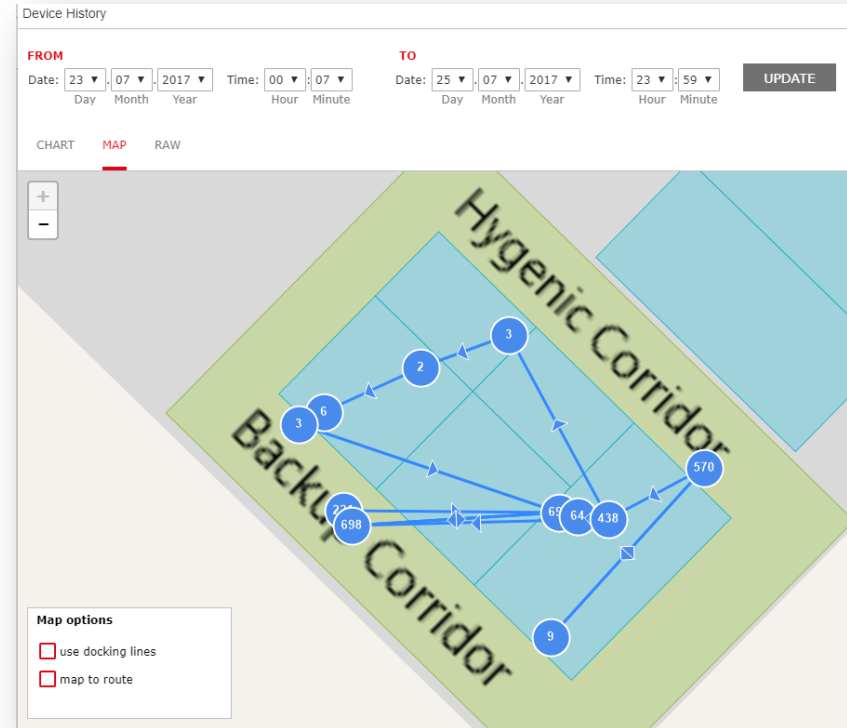
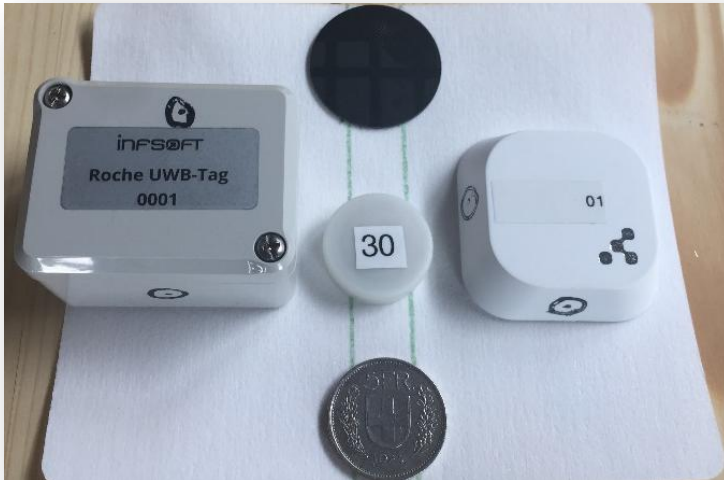
# Mobile Equipment Monitoring



# Mobile Equipment Monitoring

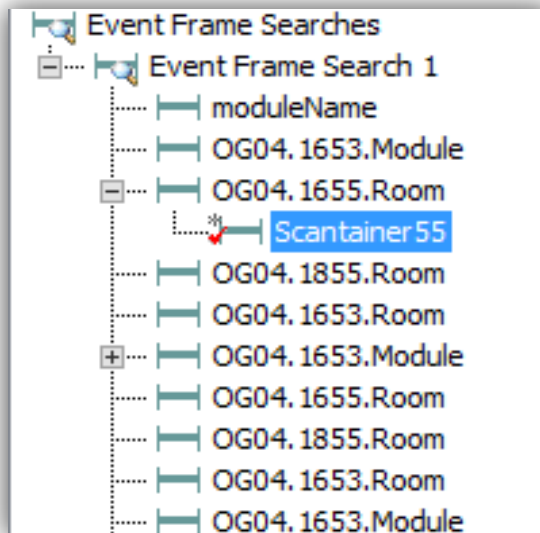
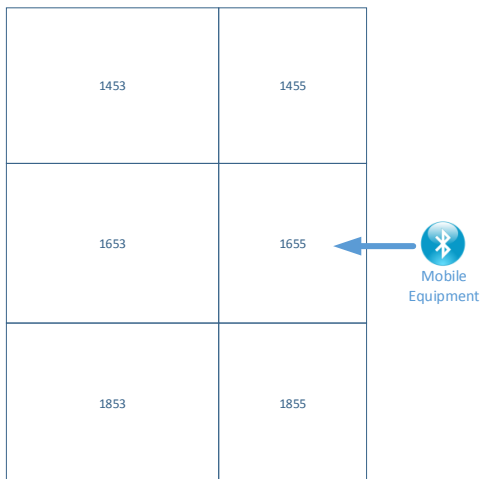


- Position of the equipment is constantly tracked
- Coordinates get mapped to zones/rooms/modules



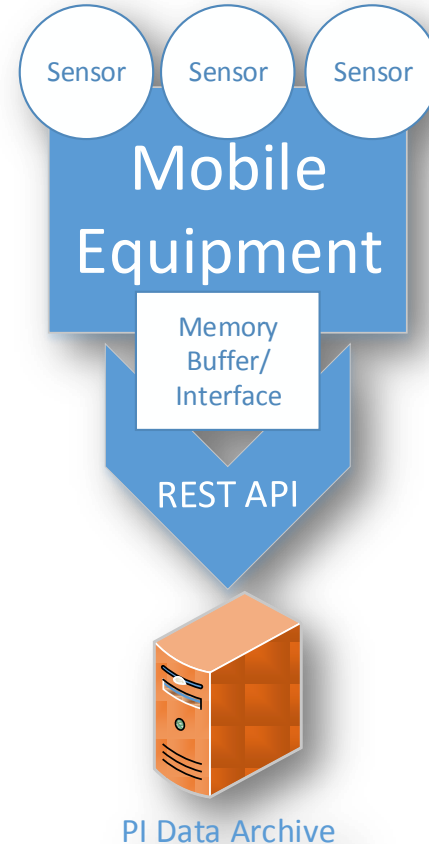
# Automated creation of the AF Structure

- Geofenced zone structure is triggering code execution



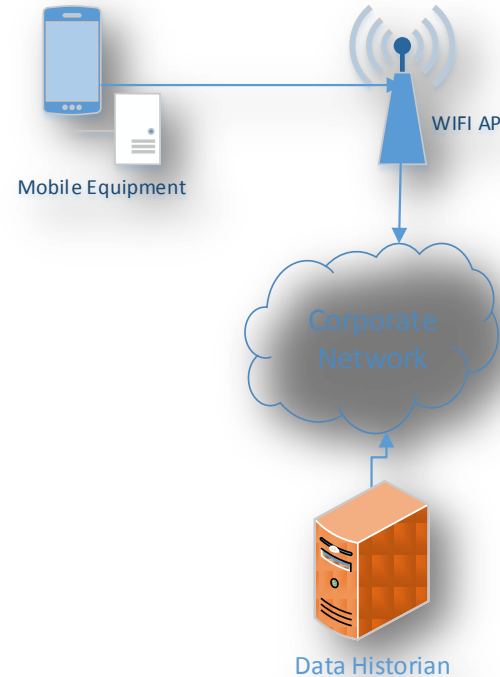
# Mobile Equipment Monitoring

- Sensor Data of Micro Environments is transferred constantly into PI Data Archive
- Collected Data can be georeferenced
  - Automated position tracking
  - Automated entering of Rooms/Modules

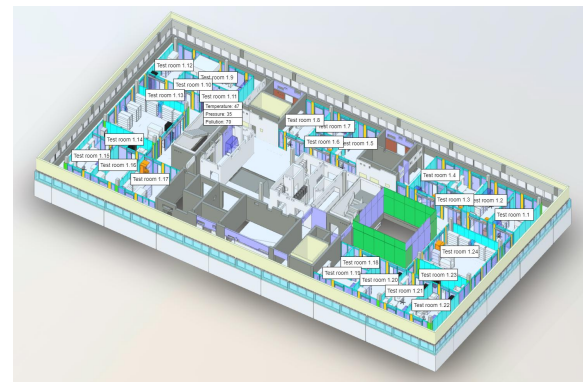


# Network Integration Mobile Equipment

- Raw data is transferred to the PI Data Archive via WiFi connection
- Data is buffered locally



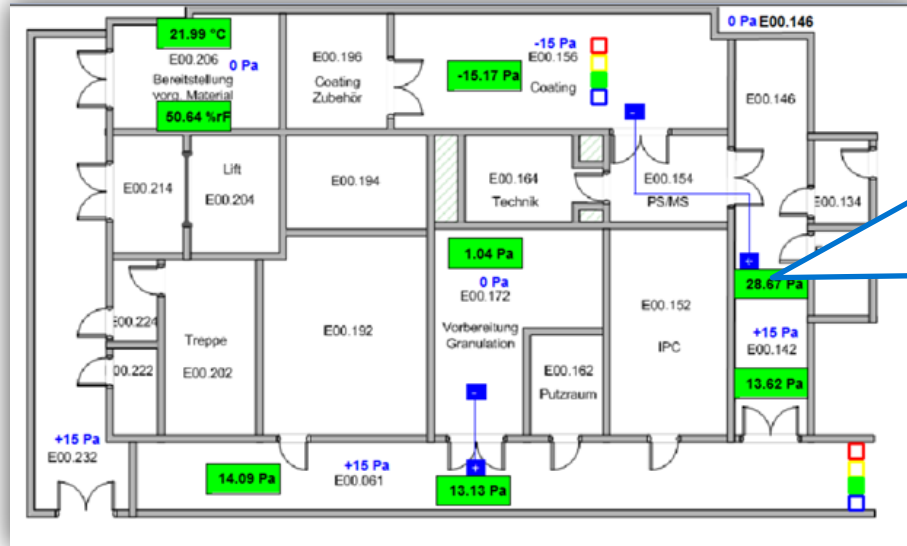
# PI Data Visualization



# B098 Data Visualization Platform



## *OLD Visualizations (not used in B098)*



*Visualization as used in other Buildings:*

Sensor Data overlaying a static backdrop. No easy change of building floorplan, every floorplan change is an IT change (implementation/test/release cycle etc.) done by an IT engineer.



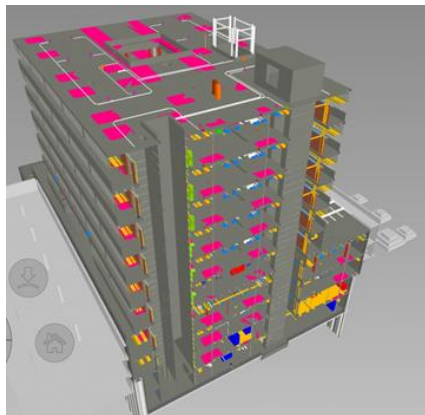
# B098 Data Visualization Platform

## *Future Visualizations with BIM Technology*

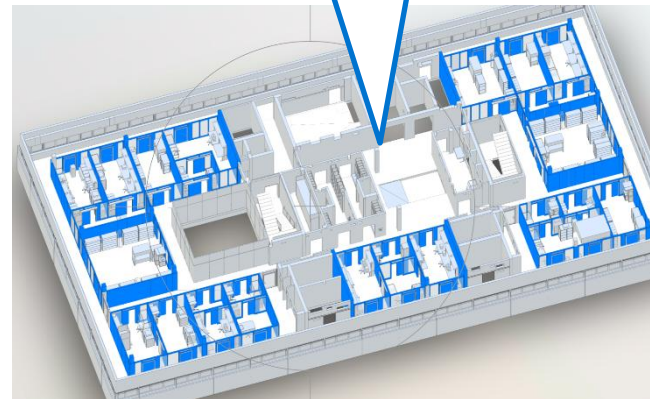


*To be Visualization*  
Dynamic linking  
between a source model  
and different Data  
Layers. Here linked to  
the environment Data.

*To be Visualization*  
3D geometry  
linked to the  
Equipment tracking  
Data in real-time



*New possibilities*  
Dynamic cross sections  
of complete structures  
can be made. This  
delivers complete new  
insight to energy  
consumption, building  
usage etc.



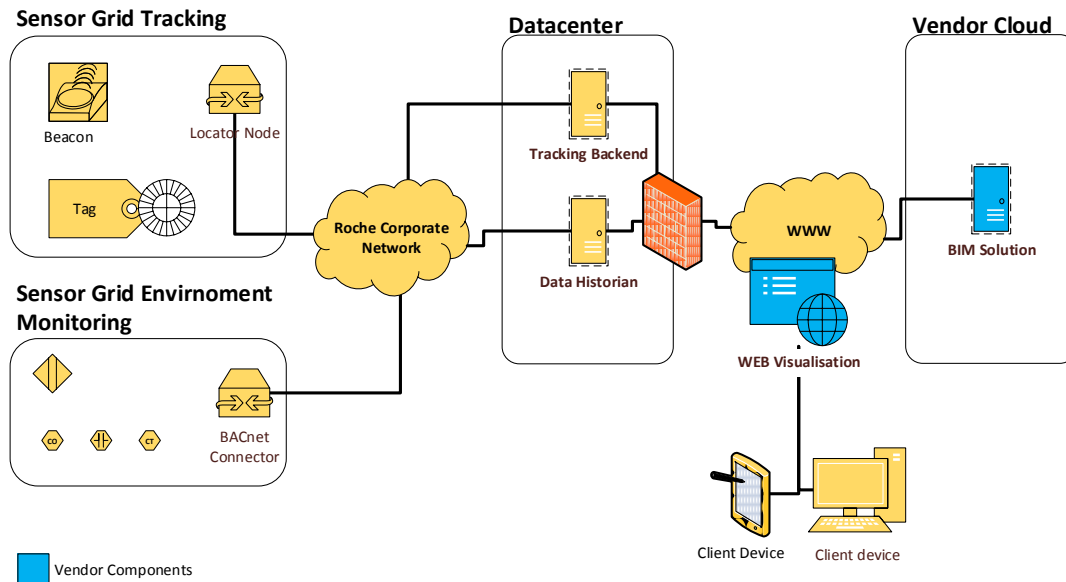
# B098 Data Visualization Platform



## *Behind the scenes*

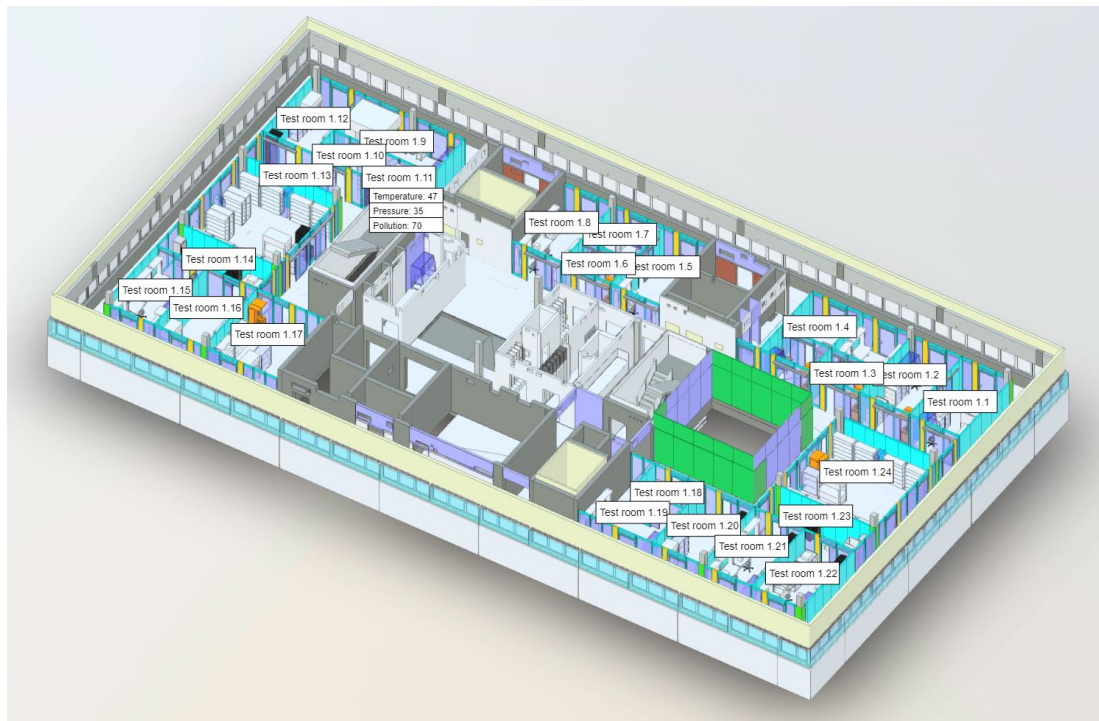
### System Overview B098 BIM

#### Visualisation



# B098 Data Visualization Platform

## *Live Demo*



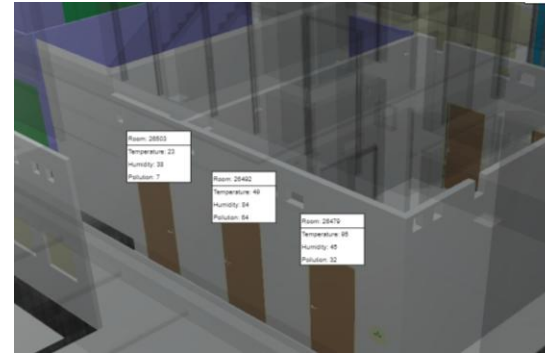
# Summary



Building 98 is the most modern laboratory building from Roche.

Monitoring and data acquisition is handled by PI/AF using event frames to model rooms.

PI Web API is used by all applications that use PI (room panels, 3D building model)



## BUSINESS CHALLENGES

- Flexible new Lab Building with no fixed room layout
- PI as the main monitoring database shall store full history

## SOLUTION

- Rooms as Event Frames
- PI WebAPI and custom UI
- PI data embedded in 3D building model

## RESULTS AND BENEFITS

- Unique User Interfaces for real-time PI data
- New ways to use PI AF modeling capabilities
- Accurate Environmental monitoring

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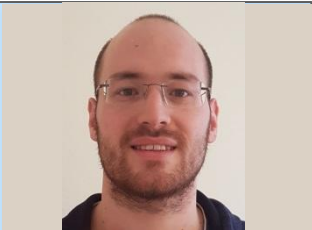
Owner, Octavesoft GmbH



## Piero Steinger

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Senior System Integration Engineer, Octavesoft GmbH



*Doing now what patients need  
next*