



WIR SCHAFFEN WISSEN – HEUTE FÜR MORGEN

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WICA: an *extra* tool in our Control System Toolkit

PSI Controls Section Lightning Talks November 2022

Introduction

Several years ago a friend of mine working in industry told me:
“the days of the desktop client application are over”
“nobody makes applications that way any more, everything is in the browser”

That got me thinking:

- Are we somehow *missing a trick* at PSI, should we be making controls applications using the web ?
- Is our scientific environment so *special* that we can ignore what's going on in software engineering elsewhere ?
- What would be the *benefits* and *challenges* of bringing our control system to the web?

This talk is far too short to present that topic in any detail. Instead I will present briefly my very early experiences looking into this.

Then, to make things more concrete I will present a new tool called WICA.

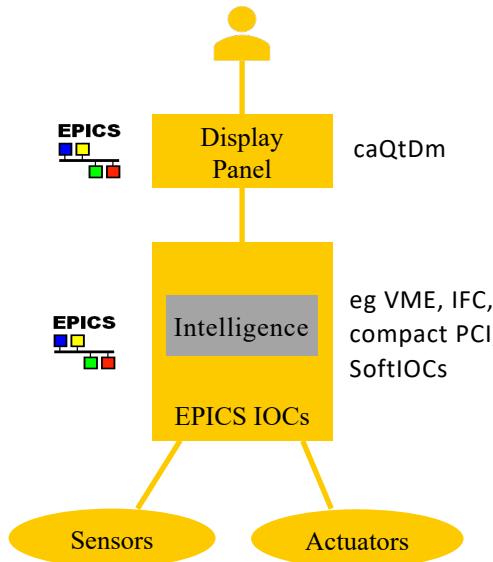
Sunset on Desktop Client Applications



...we loved you, but is it time to move on ?

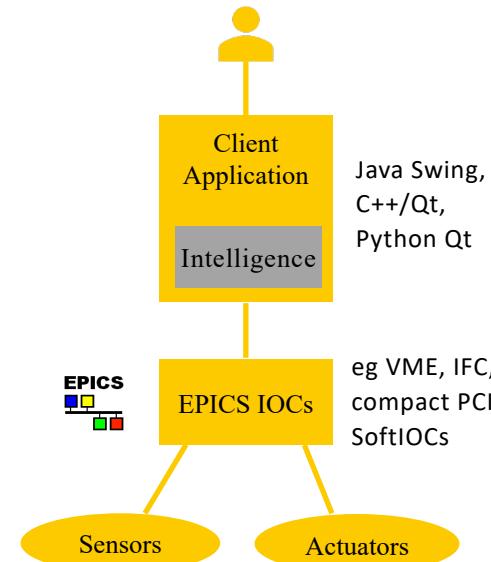
Desktop Client Applications – wtf ?

SLS and SwissFEL were designed from the start to use EPICS



Fat IOC / Thin GUI Client

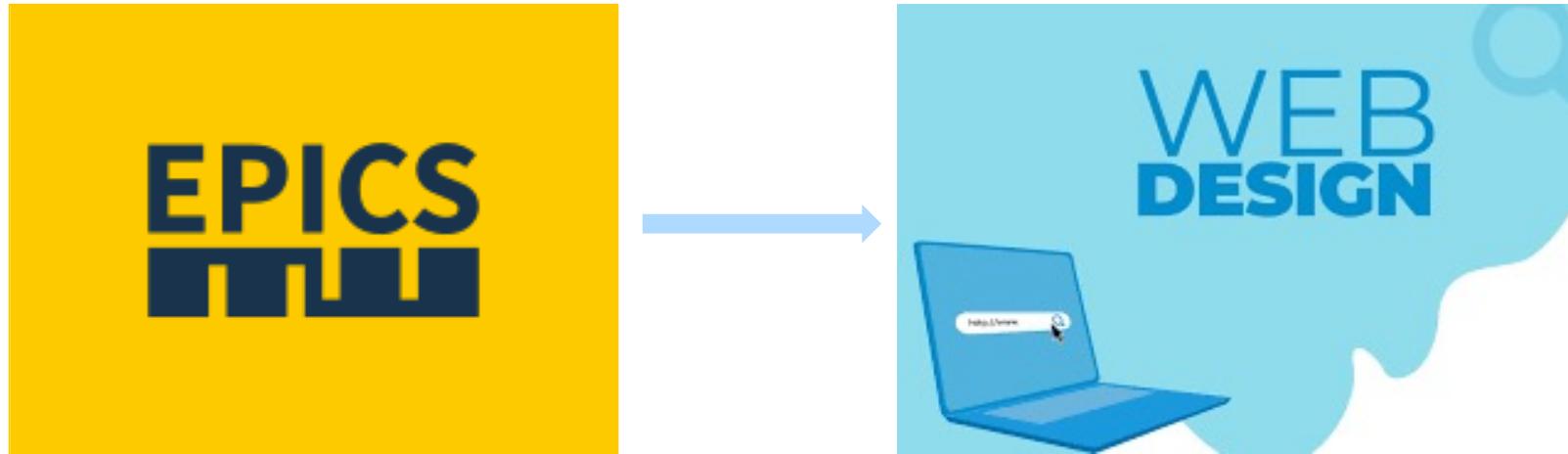
HIPA and PROSCAN started with a different control system architecture (ACS) and were migrated to EPICS later



Thin IOC / Fat GUI Client

=> today's GUI architectures have been determined by design decisions > 20 years ago !

Control System → Web: an *impossible* task ?
Control System → Web: a *pointless* task ?
Control System → Web: an [*insert adjective*] task ?

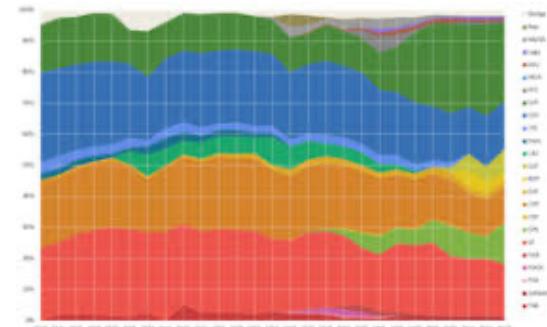


...The use of web technologies at PSI has invoked strong feelings on both sides

The web can bring benefits, when used *appropriately*, but doesn't come for free

...during the last couple of years I have been looking at some of the trade-offs

A short interrupt...

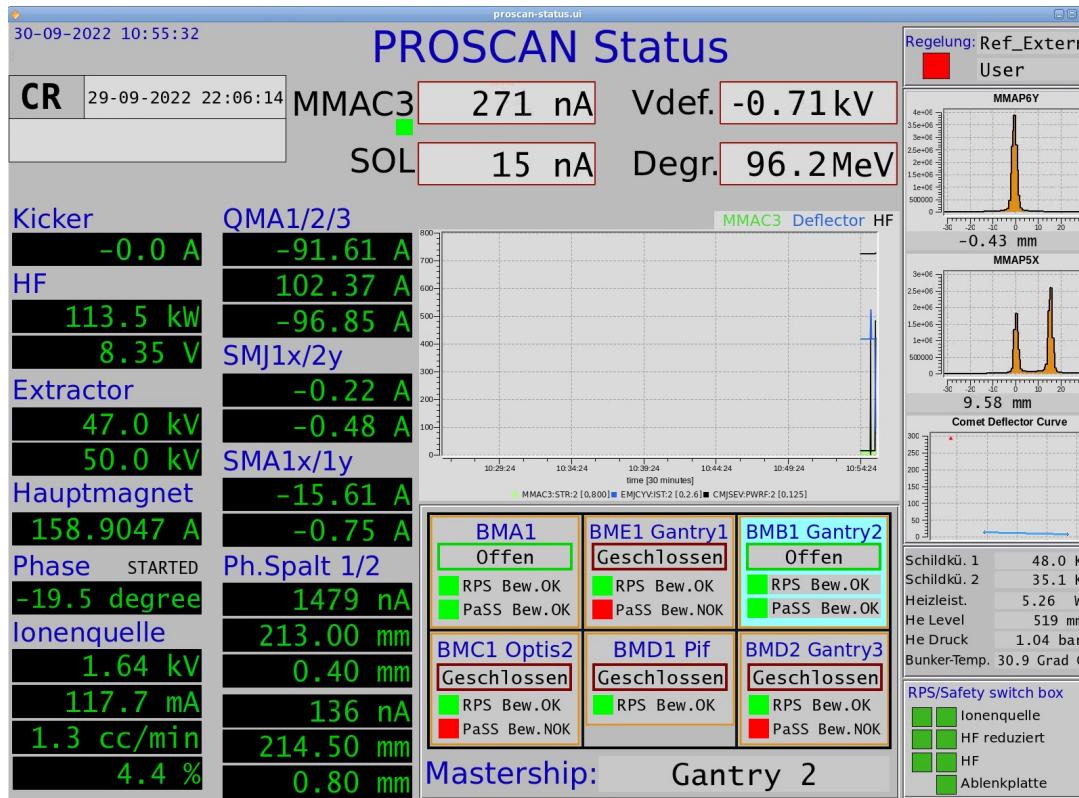


...a Party Political Broadcast on behalf of the web community !

Web Project - Benefits

- Web technologies offer the leading paradigm for today's software development. If we ignore them our controls solutions will be perceived as increasingly outdated and stuck in a timewarp ! Or worse, our users may simply choose to go elsewhere.
- Richer state-of-the-art UX possibilities are now achievable... animations, sound, speech-synthesis, messaging... can be integrated quickly with powerful libraries.
- Web technologies help our on-site staff respond quickly to issues in our facilities.
- Web technologies fit the demands of modern society: remote working flexible/hybrid work models; access anywhere on multiple platforms, onsite, whilst travelling, or at home.
- Web technologies help our *Pikett* support staff diagnose faults more quickly and efficiently, reducing down time.
- The pool of trained web developers is much larger than the pool of, say, EPICS or TANGO developers. Using web technologies should make our recruitment easier.

A Pilot Web Project - PROSCAN Status Page



The original display page made with caQtDm

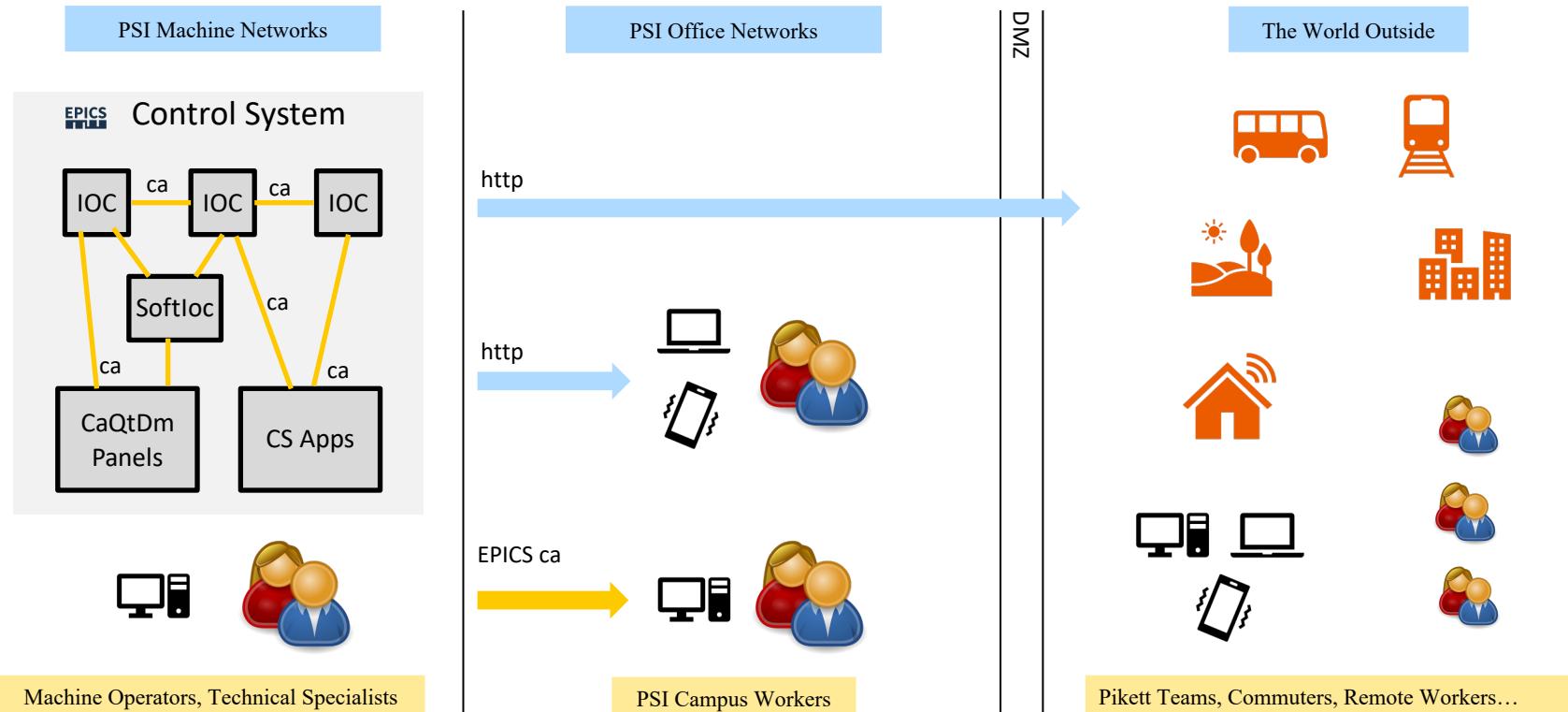
Ugly, but used effectively by many people !

Goal: make something just as ugly, but available on the web

Do The Simplest
Thing That
Could Possibly
Work.

Kent Beck

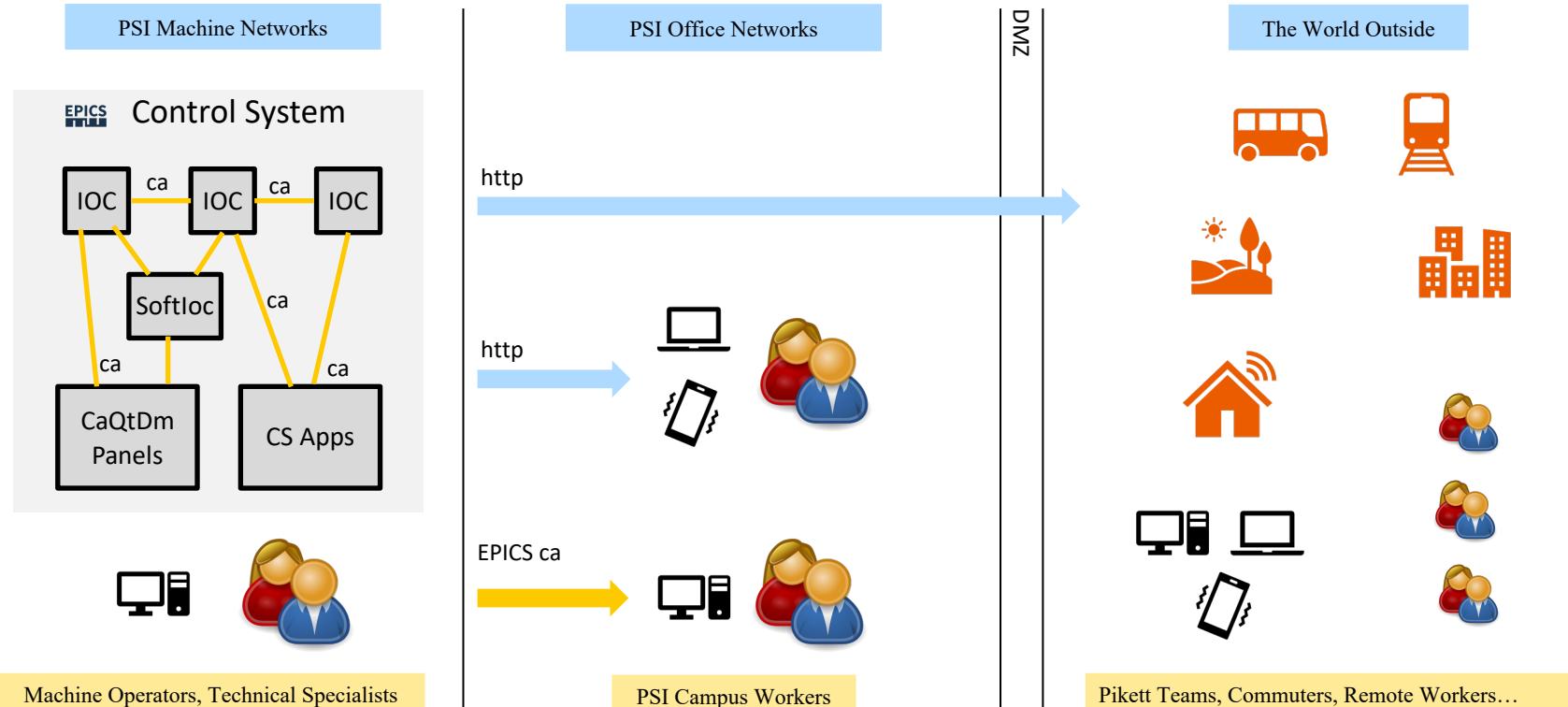
Where to Start 1 – Network Protocols



...if you want to speak to a wide audience it helps if you speak in the user's language !

=> we need an **EPICS->HTTP Gateway**

HTTP: the lingua-franca of our connected world



...if you want to speak to a wide audience it helps if you speak in the user's language !

=> we need an **EPICS->HTTP Gateway**

Where to Start 2 – PSI GUI Review

- Status: Text Only
- Status: Plots (time series, X-Y, barchart, piechart etc...)
- Status: Graphical
- Status: Images (camera)
- Control and Status (eg vacuum displays)
- Applications (eg PROSCAN Ball, HIPA Interlock Display)

...our applications are diverse, the web now has solutions for everything

⇒ don't try to do too much !

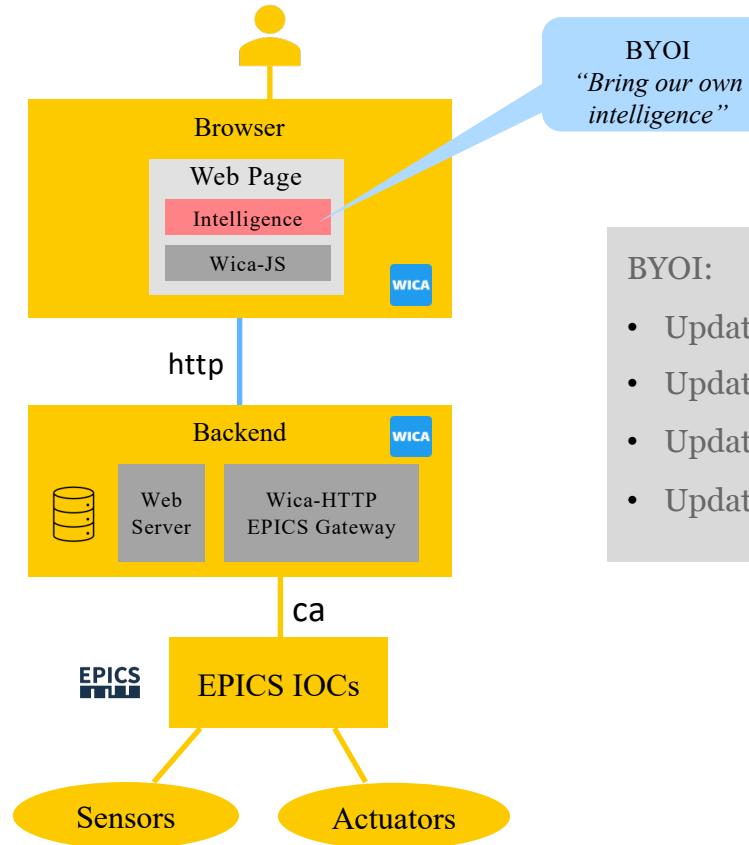
⇒ bring the **live control system data to the user's web page**

⇒ use **standard techniques** to create the user interface (html, CSS, Javascript)

⇒ WICA is **not** a caQtDm replacement !

WICA – Less is more

- WICA brings control system data directly to the attributes on the user's web page.
- What you do with it is up to you !

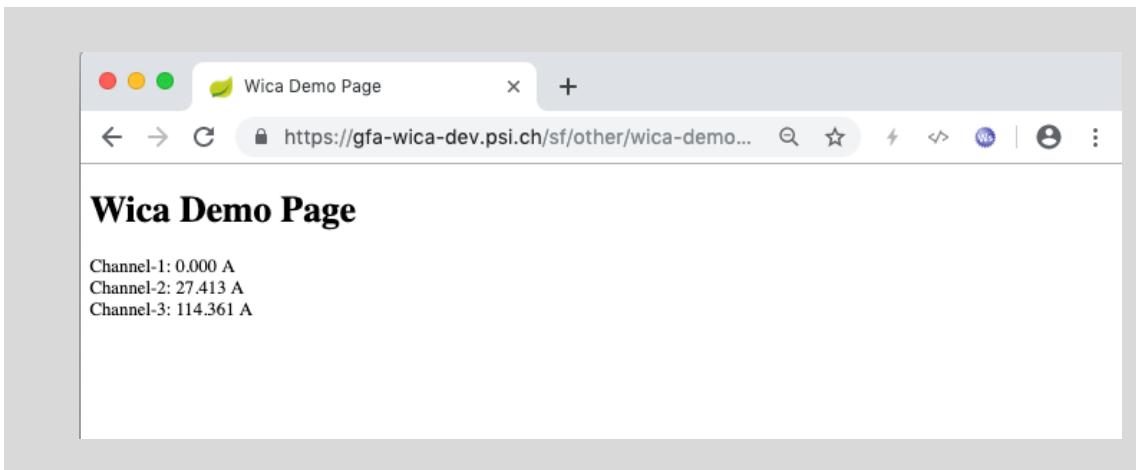


BYOI:

- Update Text Widgets
- Update Plots
- Update SVG Graphics
- Update Images

Wica – the simplest web page

```
<!doctype html>
<html lang="en">
<head>
    <meta charset="utf-8"/>
    <title>Wica Demo Page</title>
    <script src="/wica/wica.js" type="module"></script>
</head>
<body>
    <h1>Wica Demo Page</h1>
    <label>Channel-1:</label> <span data-wica-channel-name="SINEG01-MBND300:I-READ"></span> <br>
    <label>Channel-2:</label> <span data-wica-channel-name="SINLH02-MBND100:I-READ"></span> <br>
    <label>Channel-3:</label> <span data-wica-channel-name="SINBC02-MBND100:I-READ"></span> <br>
</body>
</html>
```



Attempting the risky – a live demo of WICA ?



WICA Resources

The screenshot shows the GitHub repository page for [paulscherrerinstitute/wica-http](https://github.com/paulscherrerinstitute/wica-http). The repository has 1,764 commits, 38 releases, and 2 contributors. It uses Java, HTML, and Shell. The repository is public and contains code for a Web Interface for Controls Applications.

Code

- simondelabici Fix #108: ENHANCEMENT: switch to multistage builds which... 9 hours ago
- .github/workflows Fix #108: ENHANCEMENT: switch to multistage builds which includes... 9 hours ago
- .idea Fix #91 Make miscellaneous small improvements. Update IntelliJ targ... 2 months ago
- docker Fix #108: ENHANCEMENT: switch to multistage builds which include... 9 hours ago
- docs Fix #103: DOC: Add talk from CERN GUI Workshop Autumn 2022 13 days ago
- src Fix #100 BUG FIX: fix regression bug - disappearance of admin page. 13 days ago
- .gitignore updated .gitignore 3 years ago
- CHANGELOG.md Fix #104: CHORE: Create release 1.12.2 19 hours ago
- DEVELOPER.md Fix #31: Miscellaneous improvements for release 1.5.0. 2 years ago
- EPICS.md Improving the documentation. 3 years ago
- LICENSE Initial commit 3 years ago
- README.md Add badge for Javadoc pages status. 8 months ago
- pom.xml Create release 1.12.2 20 hours ago

README.md

Overview

This is the Wica-HTTP git repository, one component of PSI's WICA software suite.

WICA stands for *Web Interface for Controls Applications*. The basic idea is to support the streaming of live data from a distributed control system to update a user's web pages in real-time.

Wica comprises two main components:

- **Wica-HTTP** – this is a backend HTTP server which receives incoming requests from the web and which generates live data streams containing information for the control system points of interest.
- **Wica-JS** – this is a frontend Javascript library which scans a user's web page for HTML5 tags defining points of interest in the control system. The library then generates requests to the backend server to obtain the necessary data and to update the user's web pages in real-time.

GitHub Projects

<https://github.com/paulscherrerinstitute/wica-http>

<https://github.com/paulscherrerinstitute/wica-js>

PSI External Server

<https://wica.psi.ch>

PSI Internal Server

<https://gfa-wica.psi.ch>

Summary

WICA provides a mechanism for accessing live control system data both in and outside PSI

WICA works on phones, tablets, laptops, desktops without the need to install anything

Creating text displays can be done very easily and quickly

Richer user experiences are possible but require extra programmatic effort

Given our resource situation we need to think carefully about where they makes sense

If you want to find out more please get in touch

Thank you for your attention :-)

A particular thank you to
Simon Ebner for his
encouragement on my
learning journey

Also to Daniel Lauk, ex
office buddy and my web
guru !



Bonus Slides



Web Projects - Challenges

- Richer, state-of-the art user experiences don't come without effort. Are our labs willing to pay that price, or do they prefer to invest the effort elsewhere ?
- Rich web applications tend to be created programmatically by software developers rather than by domain experts. Software engineers are not an easily scalable resource !
- Currently at PSI, we have no Web GUI builder tools to offer to our users. Such a tool would be necessarily complex (if we hope to deliver richer UX) or rely on simplifying abstractions (where we throw away some of the advantages of the web).
- Users may be reluctant to give up their old GUIs, even bad ones: “better the devil you know” ! The users sometimes resist our upgrade attempts unless there is a tangible payoff for them.
- We have no automatic conversion tool for our existing 5000+ caQtDm panels. Should we even create a tool which would only clone the user interface experiences of the past with their more limited richness ?
- The web is still in its infancy: as we try out and discard new approaches the rate of change is far higher than with our classical software development paradigms. There is an “impedance mismatch” between the lifecycle of web technologies and the lifecycle we would wish for the components used on our machines.

Leveraging WICA – supported workflows

Text-only Display Page

Write some html to define your control points

WICA will render the text content of your elements directly - no JS required.

Display Page with Text and Plots

Write some html to define your control points

Choose a JS plot library eg *Plotly* or *Highcharts*

Write some JS to update the plot using the received data

Display Page with Text and SVG

Write some html to define your control points

Use an SVG or text editor to create your graphic.

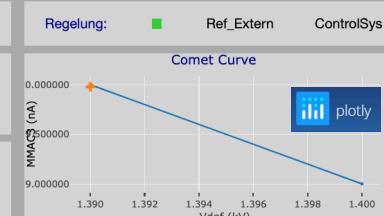
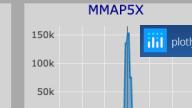
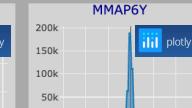
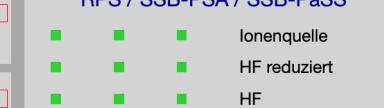
Write some JS to update the graphic using the received data

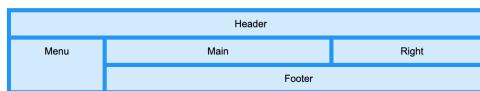
Display Page with Camera Images

Obtain a Web Component that supports rendering camera image data.
At PSI we use *Lit*

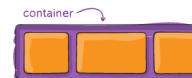
Write some html to define the control points associated with each web component

PROSCAN Status Page – Mixed Text & Plot Example

30-09-2022 02:29:24		Proscan Status			Regelung: Ref_Extern ControlSys	
Main Control Room Messages		MMAC3	10 nA	Vdef	-1.32 kV	Comet Curve
29-09-2022 22:06:14		SOL	10 nA	Degr	200.0 MeV	
Kicker	QMA1/2/3	MMAC3 / Deflector / HF				MMAP5X MMAP6Y
-0.0 A	-92.47 A	MMAC3 (nA)	HF	101.85 A	150k	200k
HF	113.4 kW	700	101.85 A	-97.96 A	50k	50k
113.4 kW	8.35 V	600	-97.96 A	SMJ1x/2y	0 -30 -20 -10 0 10 20 30	0 -30 -20 -10 0 10 20 30
8.35 V	SMJ1x/2y	500	-0.15 A	-0.15 A	0.44 mm	-0.34 mm
Extractor	SMA1x/1y	400	-0.49 A	-0.49 A		
47.0 kV	Hauptmagnet	300	-15.37 A	-15.37 A	Schildkü 1:	48.1 K
50.0 kV	158.8927 A	200	-0.77 A	-0.77 A	Schildkü 2:	35.0 K
158.8927 A	Phase	100	Ph.Spalt 1/2	76 nA	Heizleist.	5.30 W
-18.3 degree	Ionenquelle	0	BMA1	Geschlossen	He Level:	517 mm
-18.3 degree	213.00 mm	76 nA	BME1 Gantry 1	Geschlossen	He Druck:	1.04 bar
1.64 kV	0.05 mm	213.00 mm	BMB1 Gantry 2	Geschlossen	Bunker:	30.8 Grad C
1.64 kV	-52 nA	0.05 mm	BMC1 OPTIS 2	Geschlossen	RPS / SSB-PSA / SSB-PaSS	Ionenquelle
117.5 mA	214.40 mm	-52 nA	BMD1 PIF	Geschlossen		HF reduziert
1.3 cc/min	0.80 mm	214.40 mm	BMD2 Gantry 3	Geschlossen		HF
4.5 %		0.80 mm	BMC1 OPTIS 2	Geschlossen		Ablenkplatte
Mastership: PIF						

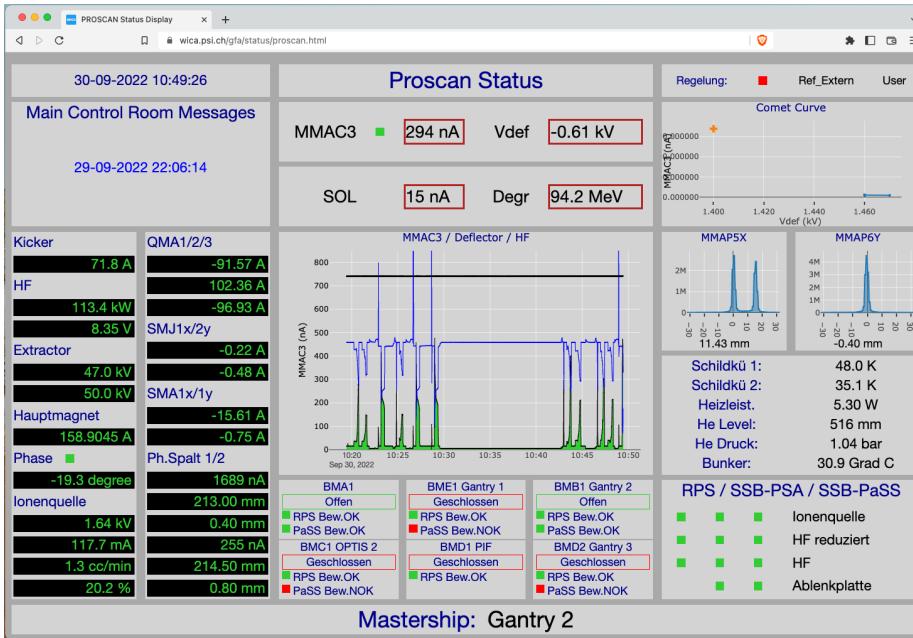


CSS3 Grid

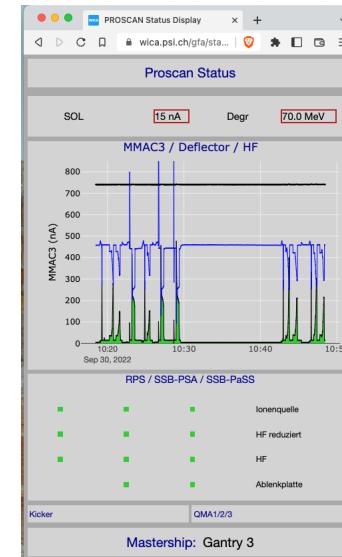


CSS3 Flexbox

PROSCAN Status Page – responsive design



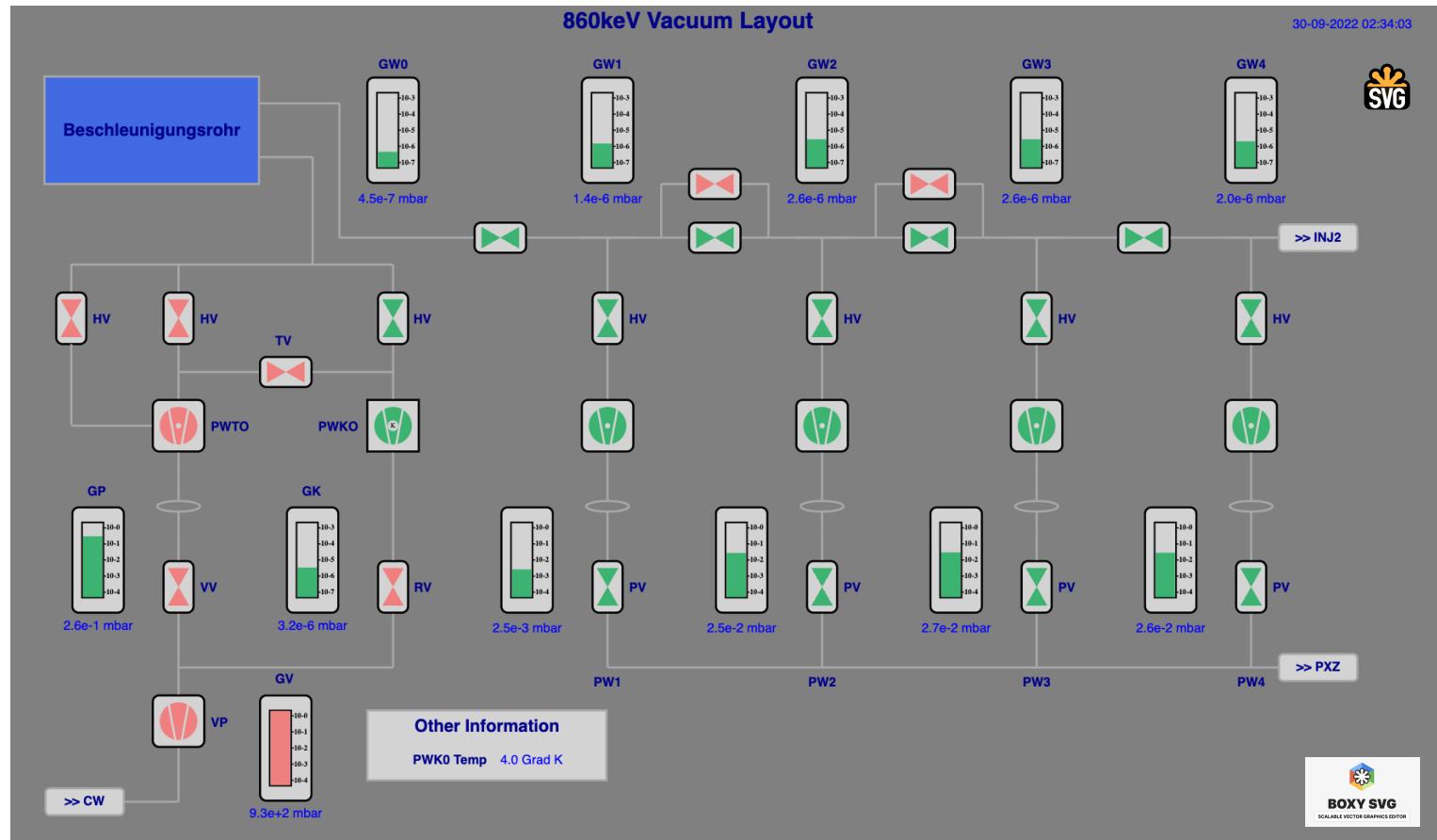
Because the pages just use normal web technology we can use CSS media queries to change the formats according to the features of the viewing device...



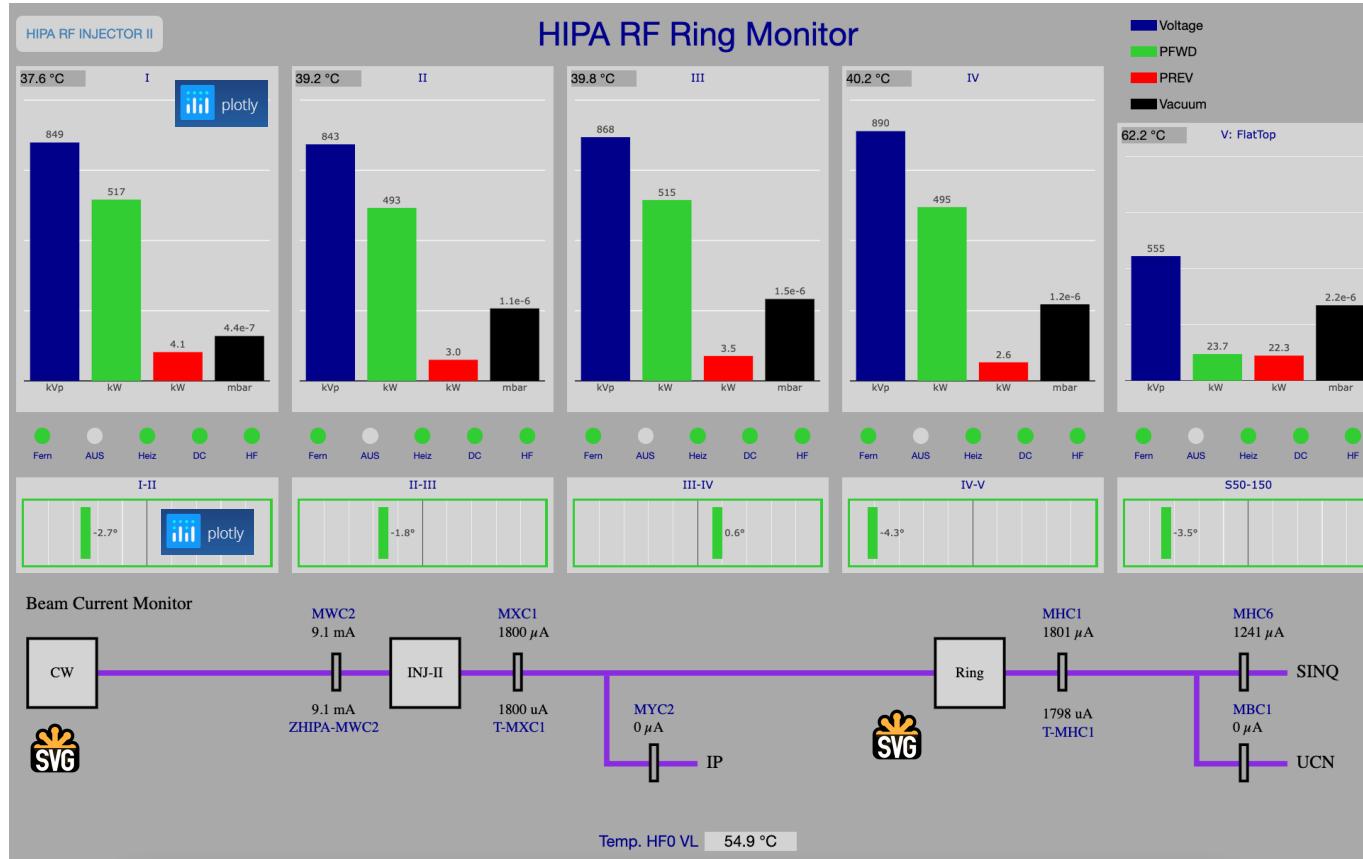
HIPA Vacuum System Page – SVG Example



30-09-2022 02:34:03



HIPA RF System Page – SVG + Plot Example



SwissFEL Camera Page – Web Component Example

GFA Wica Laser Camera Test Page

Please select camera

SLG-LCAM-C041

SLG-LCAM-C041:HEIGHT	1026
SLG-LCAM-C041:WIDTH	1282
SLG-LCAM-C041:CAPTURE_OK	38166689



The screenshot shows a test page for a GFA Wica Laser Camera. It includes a dropdown menu for selecting a camera, a section for the selected camera (SLG-LCAM-C041), and a table showing its dimensions (height 1026, width 1282) and a capture status (38166689). Below the table is a preview image of a bright circular spot on a dark background.

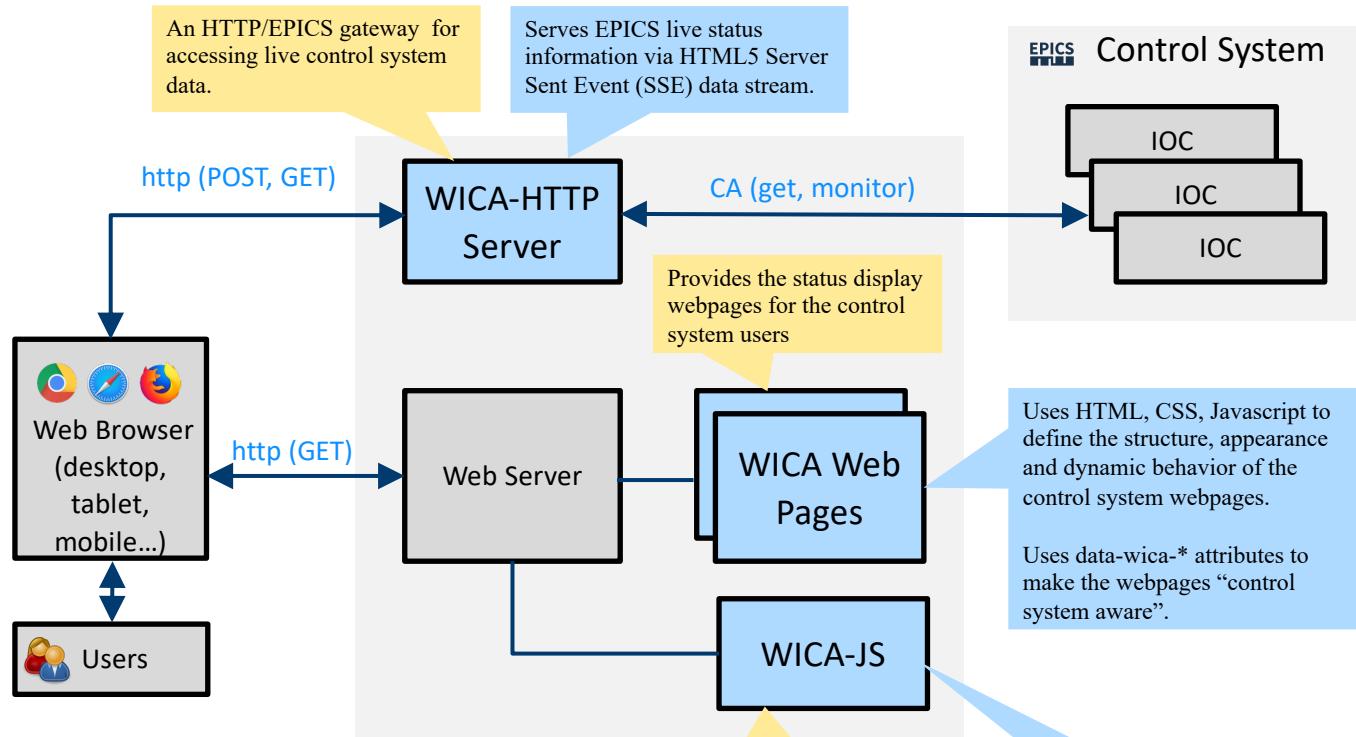


Using Web Components enable us to create very clean html pages

```
<gfa-laser-camera-basic imageWidth="300" imageHeight="300" epicsDataChannel="SLG-LCAM-C081:FPICTURE"></gfa-laser-camera-basic>
```

But creating a web component control system library would require significant effort

WICA Overview Picture



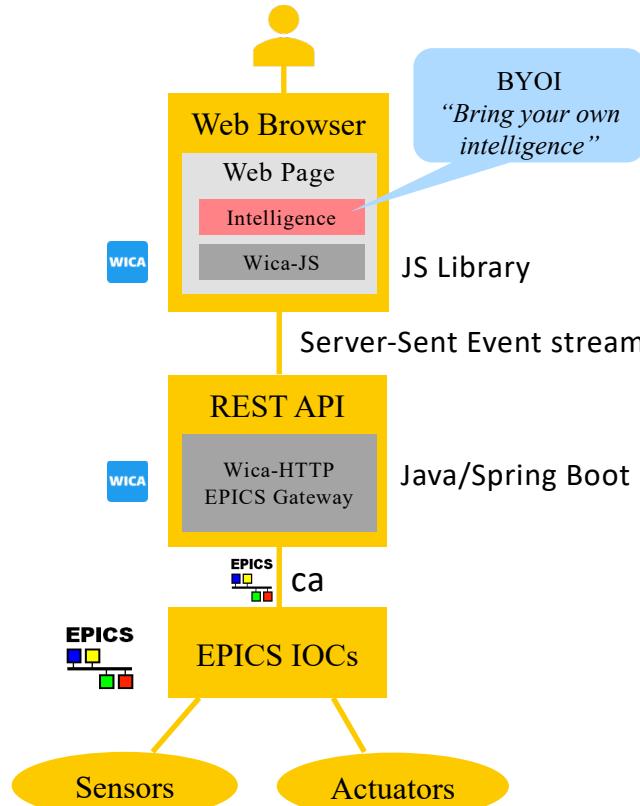
Observation: most of this technology is given to us “for free” – the goal is NOT to write lots of software!

A JS library for updating control system web pages, using data received from the WICA-HTTP service.

Renders the browser’s webpage to reflect live values received from the WICA-HTTP service.

WICA – Less is more

WICA = Web Interface for Controls Applications



Main concepts

- Reflect control system *points-of-interest* onto html element data-
* attributes
- Use the received data to update **text fields, plots, SVG displays, camera images** etc onto the users display. This can be done in many ways.
- Try to provide the users with some kind of **tool or workflow** so they can easily create their own displays

Learning Experiences

- Partial success: WICA is the only display tool that works off-site
- Getting the data to the user's webpage is easy ☺
- Providing a tool or workflow for the users (who are not programmers) has been difficult ☹