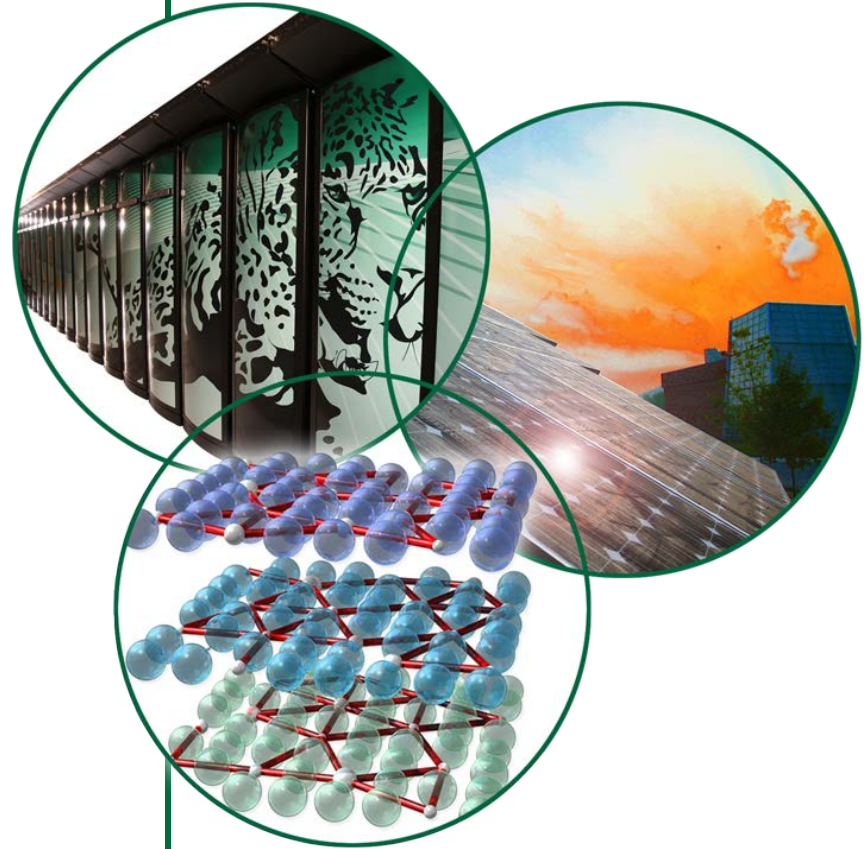


# Bringing Control System User Interfaces to the Web

Xihui Chen, Kay Kasemir

ICALEPCS 2013





# In the Age of the Web...

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- What can we do with web?

Shopping, Trading, Gaming,  
Chatting, Reading, Social,  
Entertainment, ...

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- Why web?
  - Easy and convenient

# Why does Control System UI Lag?



# Why does Control System UI Lag?

- Special Requirements for Control System UI
  - Flexible and easy UI creating
  - Real-time updating
    - Server side push

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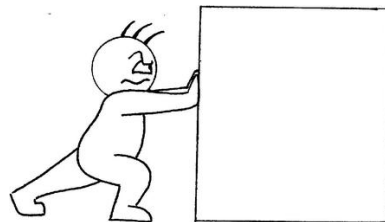
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# Limitations of traditional web technologies

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- No easy way of graphical drawing
- No standard server side push
  - HTTP Long Polling
    - Dead time between requests
    - Extra header data

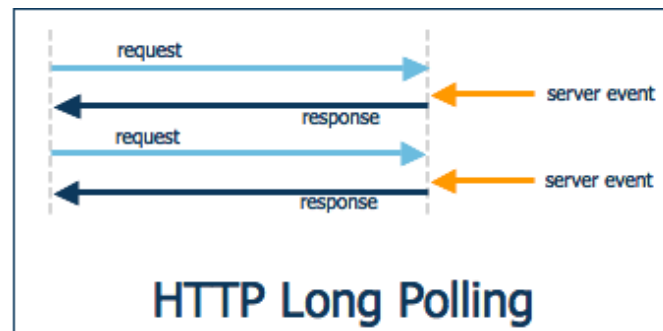
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# HTML5 to the Rescue





# HTML5 to the Rescue



- `<Canvas>` element
  - Allows easy graphical drawing in web browser
- WebSocket
  - Full duplex
  - Single TCP connection
  - Real server side push, low latency, extremely small header
- Standards of future web

# Control System *Meets* HTML5

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# WEBOP1

# Control System *Meets* HTML5

## WEBOPI

Directly run BOY OPI in web browser

# Control System *Meets* HTML5

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## WEBPDA

# Control System *Meets* HTML5

## WEBOPI

Directly run BOY OPI in web browser

## WEBPDA

Access control system data easily with WebSocket

# WebOPI

# WebOPI

- Run BOY OPI in web browser without extra effort



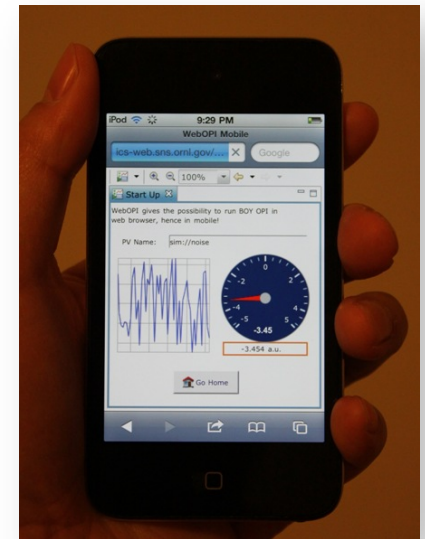
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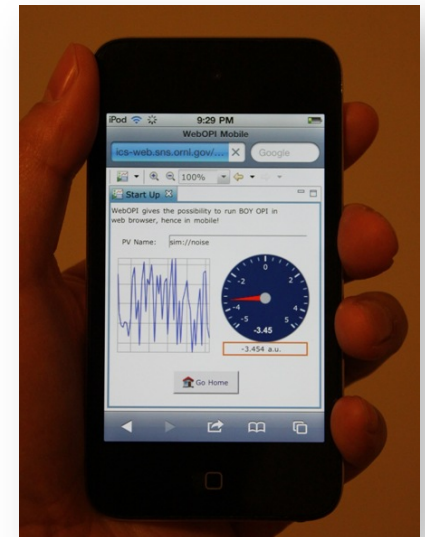
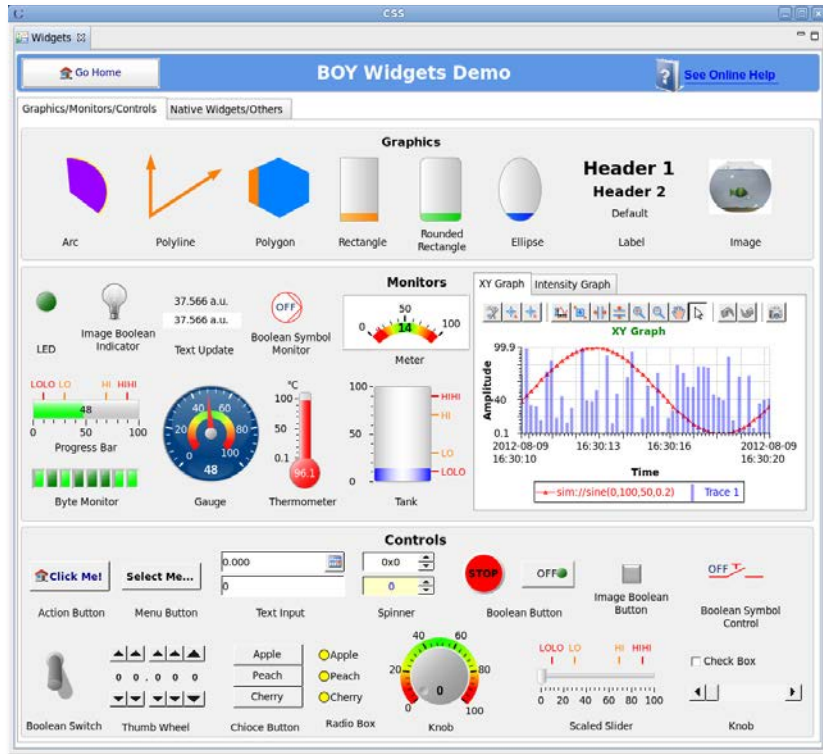
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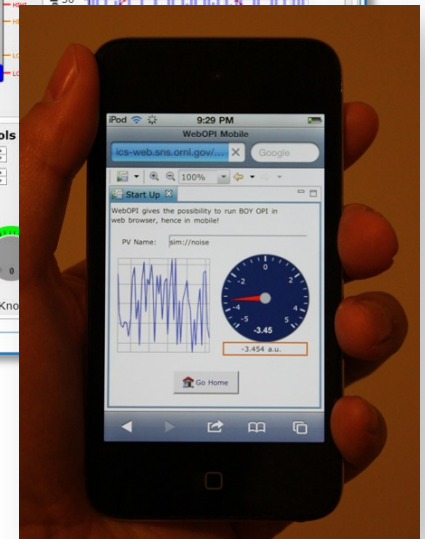
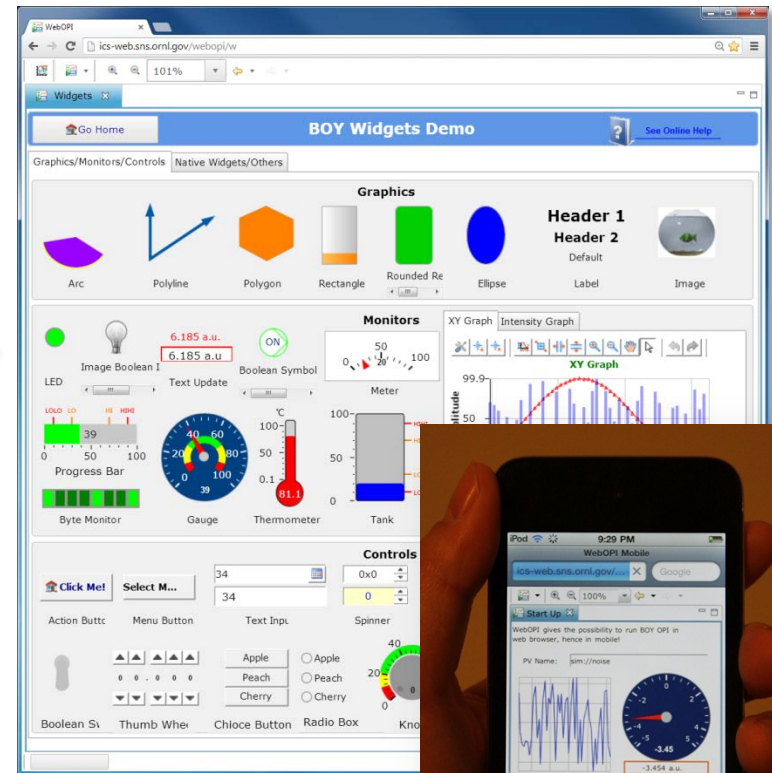
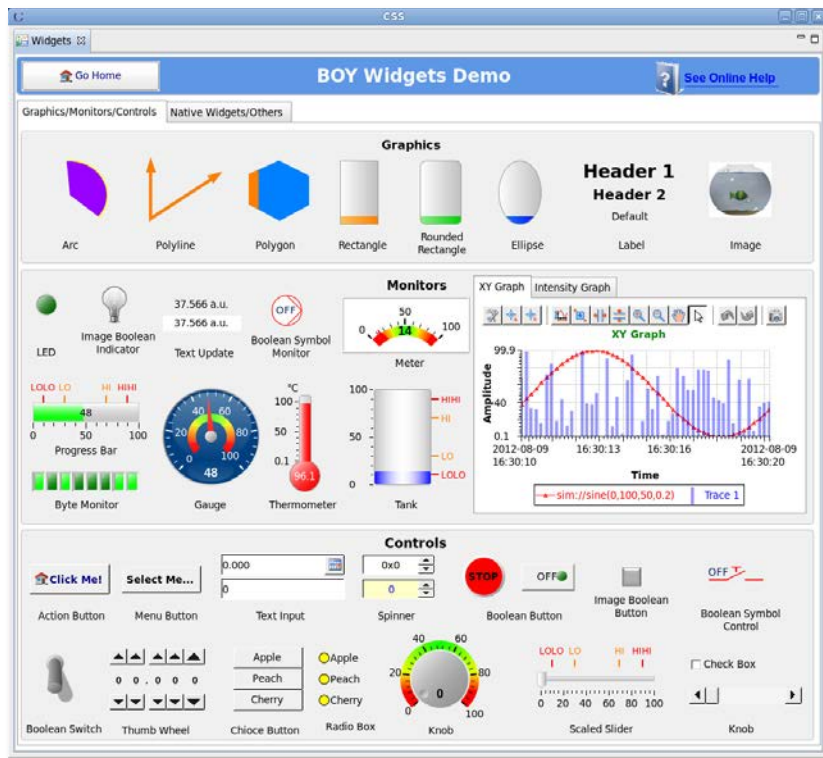
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# WebOPI - The Good Part



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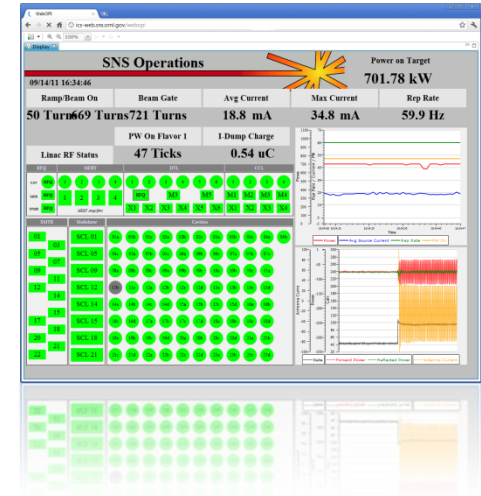


- Reusing existing BOY OPI files
- Leverage BOY OPI Editor
  - WYSIWYG
  - Drag & Drop
  - 50+ widgets
  - Programming is not necessary
  - Rules and Scripts are optional
- Single Sourcing

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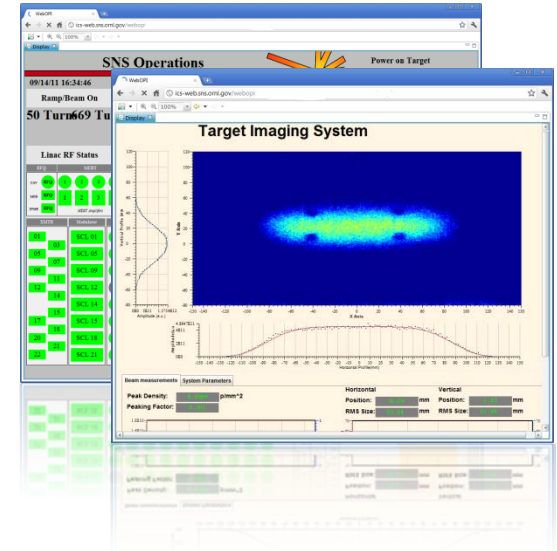
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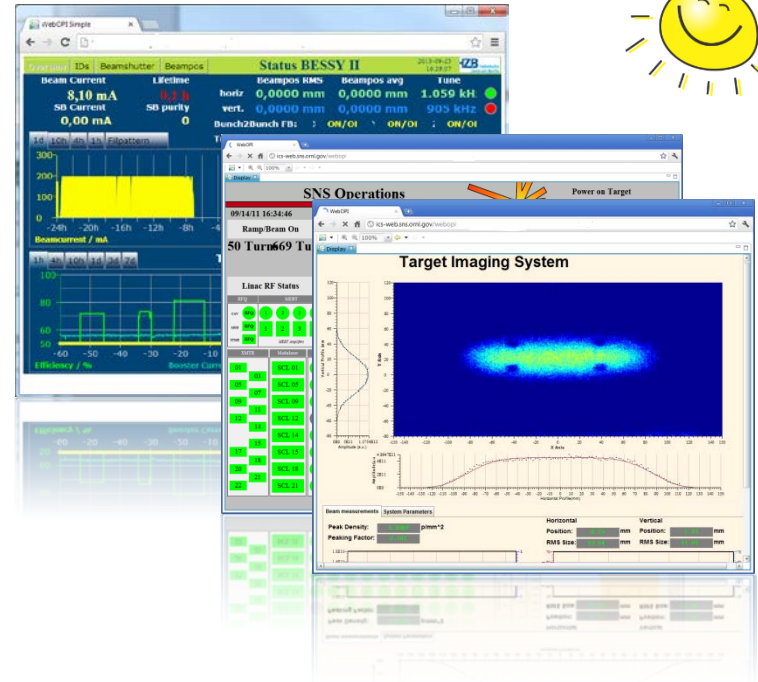




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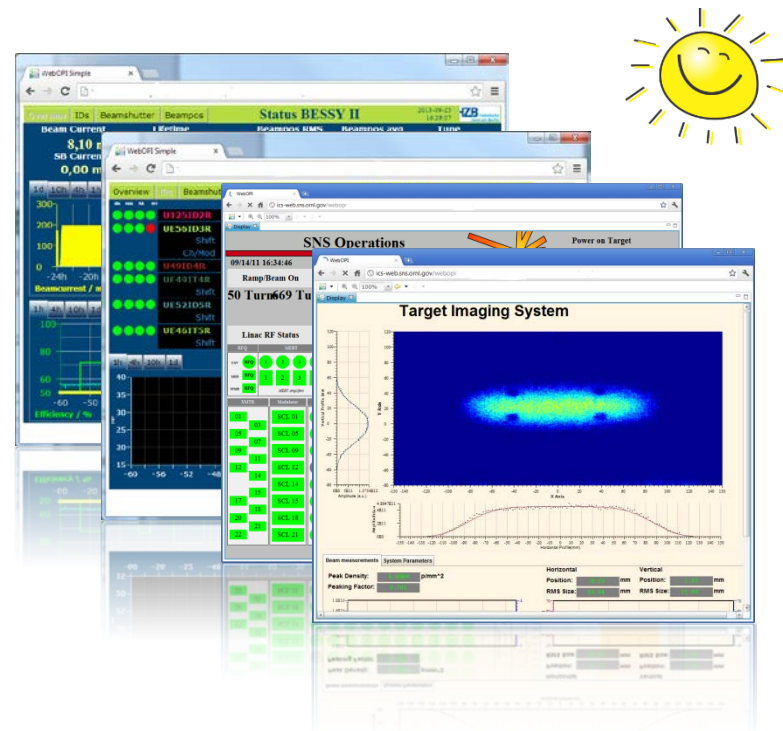


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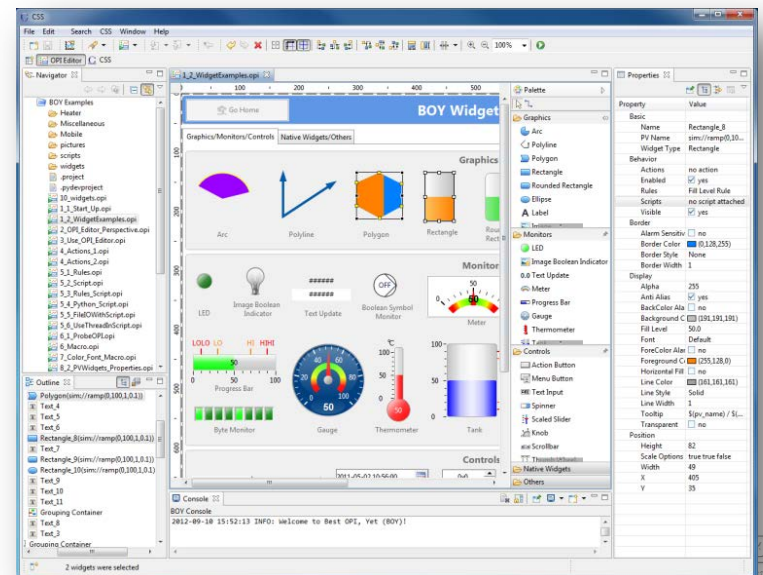
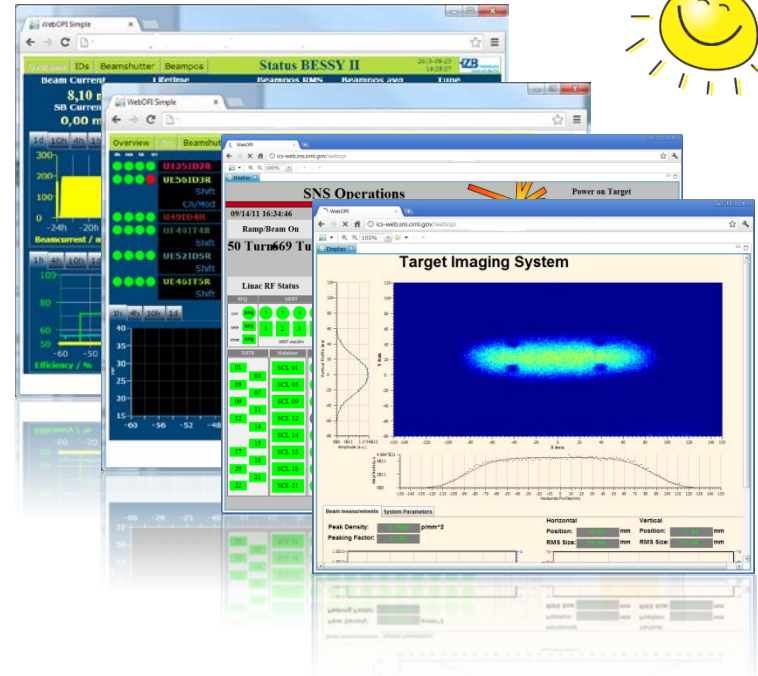
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# WebOPI – the dark side



# WebOPI – the dark side



- Behind protocol is HTTP long polling
- OPI logic is executed on the server
  - Limits the maximum number of concurrent users
- Transferring drawing info instead of control system data
  - Tremendous unnecessary data
  - HTTP Compression can help, but uses extra CPU

# WebPDA

- backbone of future control system web applications

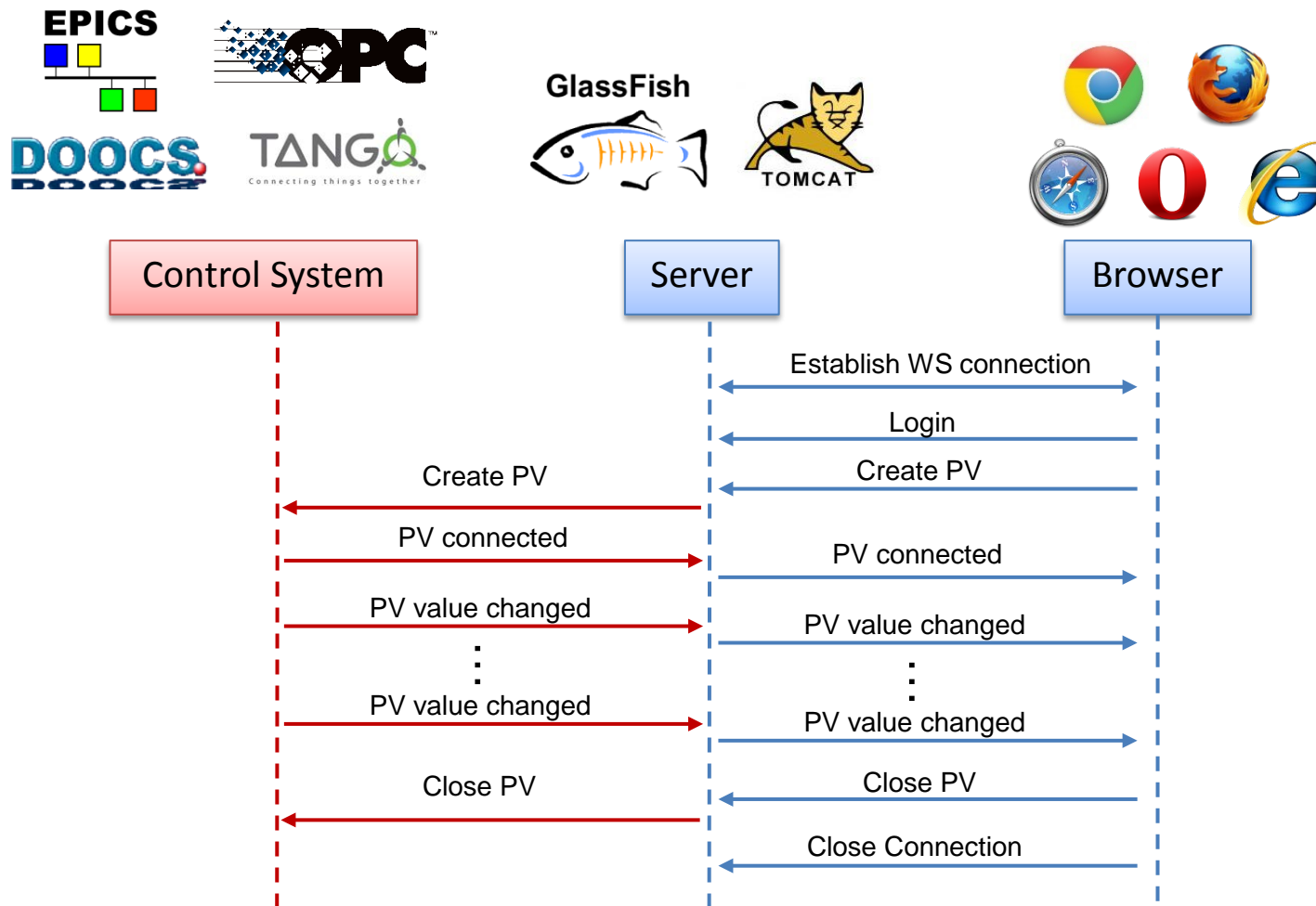
# WebPDA

- backbone of future control system web applications

- **WebSocket-based Process Data Access**

- Efficient control system data communication over the web
- Real-time server side push
- Binary format for value
  - Maximum efficiency
- JSON format for other info
  - Flexible and extensible
- Extensible to arbitrary control system or data source
- Authentication and Authorization support

# WebPDA communication sequence





# Client Side JavaScript API

- Focus on your PV instead of communication

```
var url = "ws://localhost:8080/webpda";
var wp = new WebPDA(url, "myname", "password");
var pv = wp.createPV("pvname", 1000, false);
pv.addCallback(function(evt, pv, data) {
    switch (evt) {
        case "conn": //connection state changed
            break;
        case "val": //value changed
            break;
        case "bufVal": //buffered values changed.
            break;
        case "error": //error occurred
            break;
        case "writePermission": //write permission changed.
            break;
        case "writeFinished": //writing finished.
            break;
        default:
            break;
    }
});
```

# Even Simpler: Pre-wrapped Widgets

- Bind a widget with PV in **one** line of code

```
<div class="webpda-widgets" data-widget="rgraph-gauge"  
data-pvname="sim://noise"></div>
```



# Security



# Security

Please login! ✕

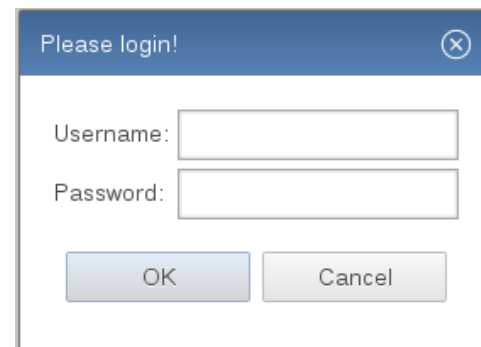
Username:

Password:



# Security

- WebOPI
  - Authentication with JAAS
  - No authorization per user.
    - EPICS Channel Access security may help
- WebPDA
  - Authentication with JAAS
  - Authorization support for each user
- Encrypt data with TLS
  - https://
  - wss://



Please login!

Username:

Password:

OK Cancel



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*“It Depends”*

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- Extremely easy to create rich UI
- No programming
- Reuse existing BOY OPI
- slow on mobile, limited number of users

- WebPDA

- Highly efficient, super fast
- Supports large number of users
- Responsive on mobile
- Needs HTML, JavaScript programming



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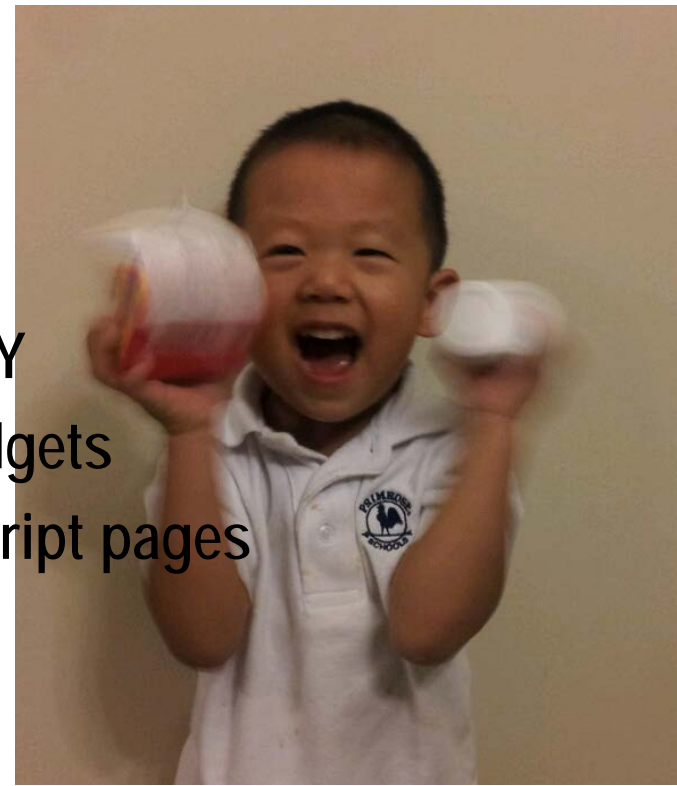


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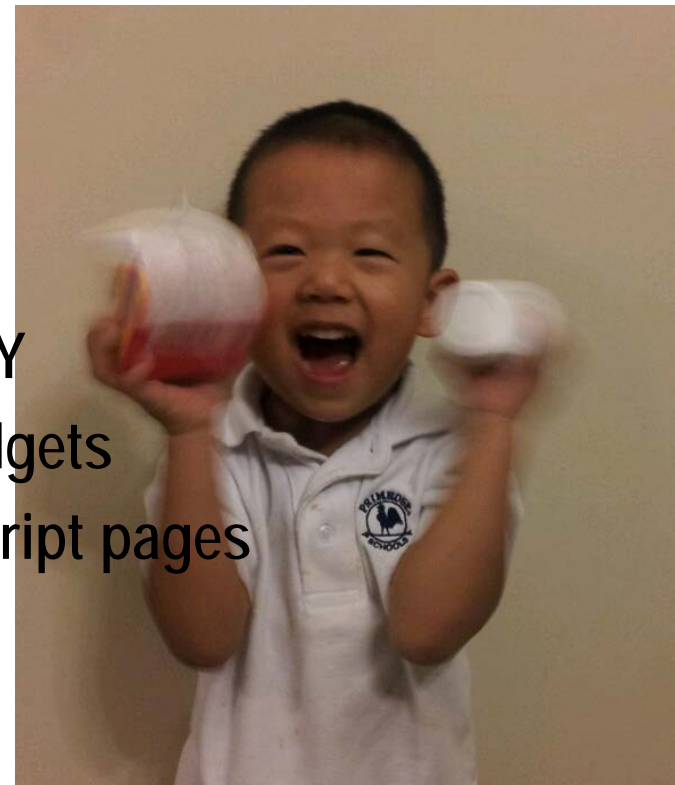
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- Combine the best of two worlds
  - A drag & drop based UI editor as in BOY
  - Build UI with pre-wrapped WebPDA widgets
  - Automatically generates HTML+JavaScript pages
- A dream of the future



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- <http://sourceforge.net/apps/trac/cs-studio/wiki/webopi>

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# THANKS!

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