Bringing Control System User Interfaces to the Web

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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?
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- Special Requirements for Control System UI
  - Flexible and easy UI creating
  - Real-time updating
    - Server side push
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![ABC blocks](http://www.simplesharebuttons.com/wp-content/uploads/2013/03/simple1.png)

![Figure of a person pushing a big box](http://www.theladiezlounge.com/wp-content/uploads/2012/09/0f7ee160befabe76c7dd009c9a7dd291.gif)

![Async web](http://media.techtarget.com/tss/static/articles/content/WhatistheAsynchronousWeb/HttpPolling.gif)
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
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- `<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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WEBOPI
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

• Run BOY OPI in web browser without extra effort
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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
WebOPI - The Good Part

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http://1.bp.blogspot.com/-itKZ_CwP6eQ/Tx09UYqNWDI/AAAAAAAAeDs/NCs1cmpPK8A/s1600/sunny_happy_day.png
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• Single Sourcing
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
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– 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

Control System → Server → Browser

Control System:
- Create PV
- PV connected
- PV value changed
- Close PV

Server:
- Establish WS connection
- Login
- Create PV
- PV connected
- PV value changed
- Close PV
- PV value changed

Browser:
- PV value changed
- Close Connection
- PV value changed
Client Side JavaScript API

• Focus on your PV instead of communication

```javascript
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

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

Please login!

Username: [input field]
Password: [input field]

[OK] [Cancel]
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://
WebOPI or WebPDA?

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“It Depends”
-Socrates
WebOPI or WebPDA?

**WebOPI**
- 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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Want Both?
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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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• WebOPI

• WebPDA
THANKS!

- WebOPI

- WebPDA
  - http://webpda.org/