Bringing Control System User Interfaces to the Web

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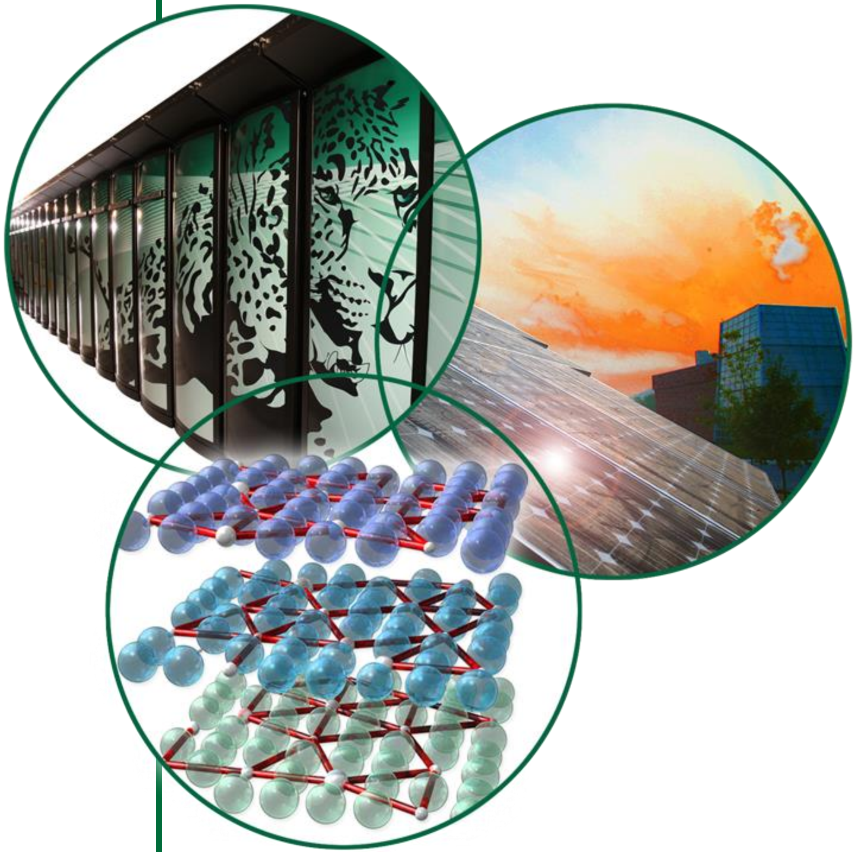
ICALEPCS 2013



U.S. DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY

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In the Age of the Web…

- What can we do with web?

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

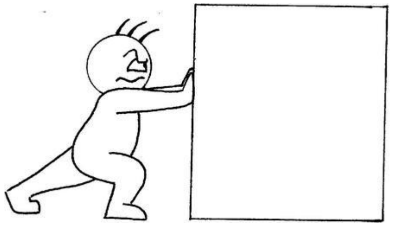
- Why web?
  - Easy and convenient

http://www.newfangled.com/stuff/contentmgr/files/1/c1f7d2c4ad78741b63693113c3ace2a4/misc/mobile_devices.jpg
http://bocsupportnetwork.com/wp-content/uploads/2012/05/convenient-christian.jpg

Why does Control System UI Lag?

- Special Requirements for Control System UI
  - Flexible and easy UI creating

  - Real-time updating
    - Server side push

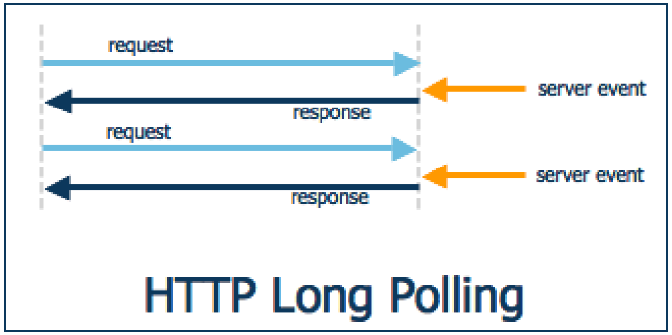


http://www.simplesharebuttons.com/wp-content/uploads/2013/03/simple1.png
http://www.theladiezlounge.com/wp-content/uploads/2012/09/0f7ee160befabe76c7dd009c9a7dd291.gif
http://media.techtarget.com/tss/static/articles/content/WhatistheAsynchronousWeb/HttpPolling.gif

Limitations of traditional web technologies

- No easy way of graphical drawing

- No standard server side push
  - HTTP Long Polling
    - Dead time between requests
    - Extra header data



http://4.bp.blogspot.com/-xsECcAfoQeo/T4UIznG-Q6I/AAAAAAAAQqs/ftsHi0XfoAc/s1600/finger-painting-2.jpg
http://media.techtarget.com/tss/static/articles/content/WhatistheAsynchronousWeb/HttpPolling.gif

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

http://cached.imagescaler.hbpl.co.uk/resize/scaleWidth/460/?sURL=http://offlinehbpl.hbpl.co.uk/News/OMC/F149B3D4-FA76-A45B-BDA16FE293691B96.jpg

Control System *Meets* HTML5

WEBOPI

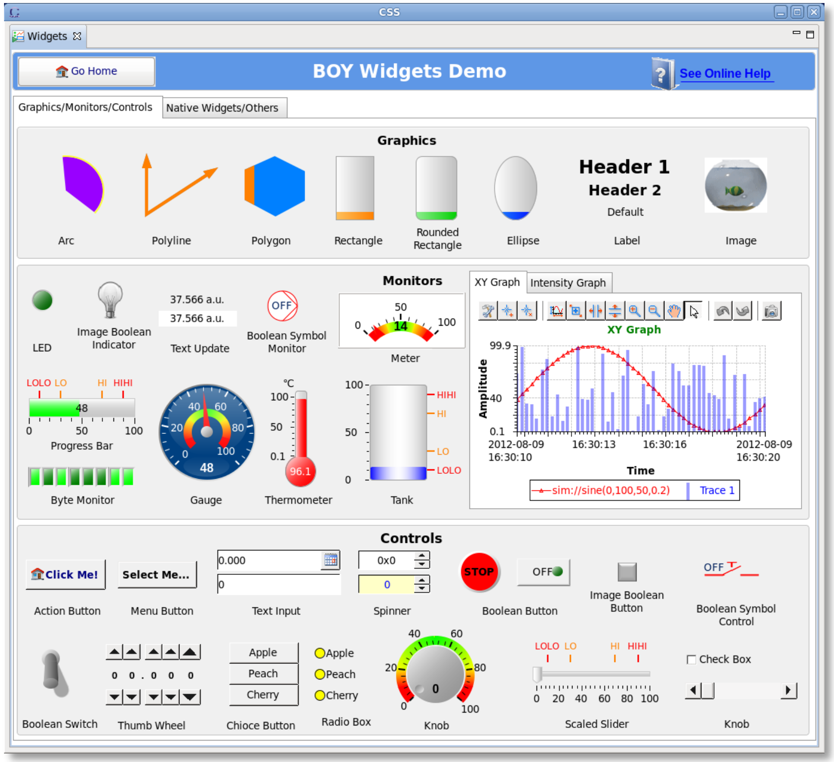
Directly run BOY OPI in web browser

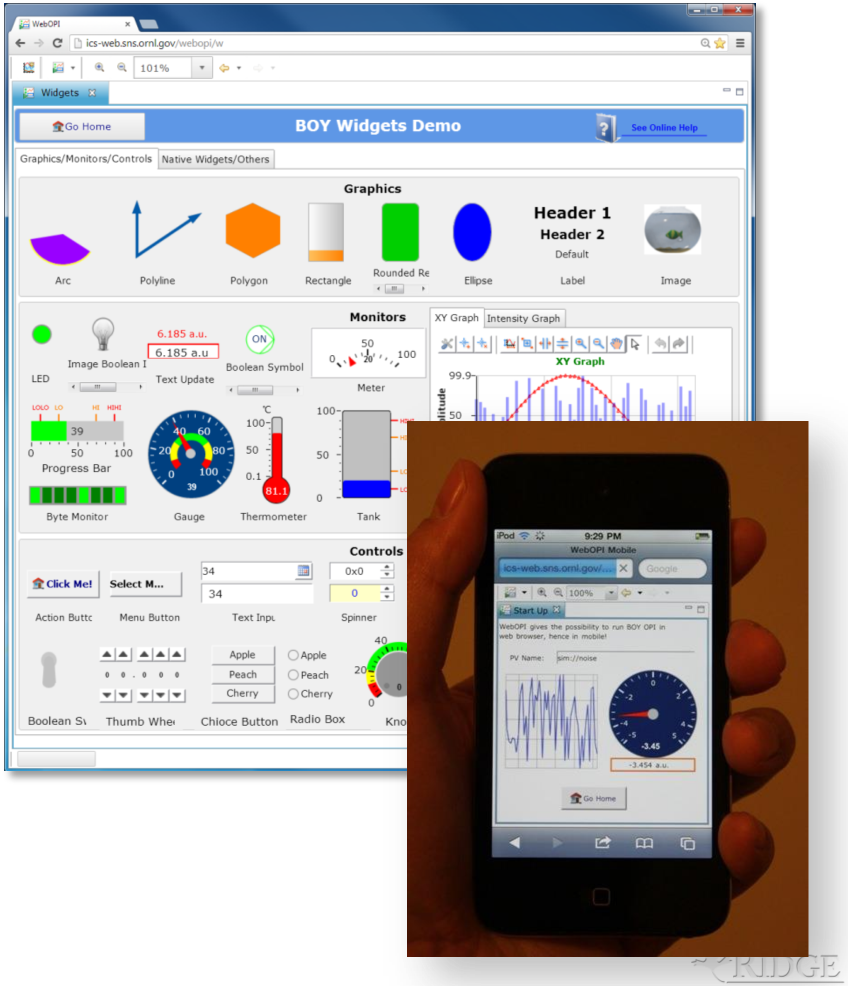
WEBPDA

Access control system data easily with WebSocket

WebOPI

- Run BOY OPI in web browser without extra effort



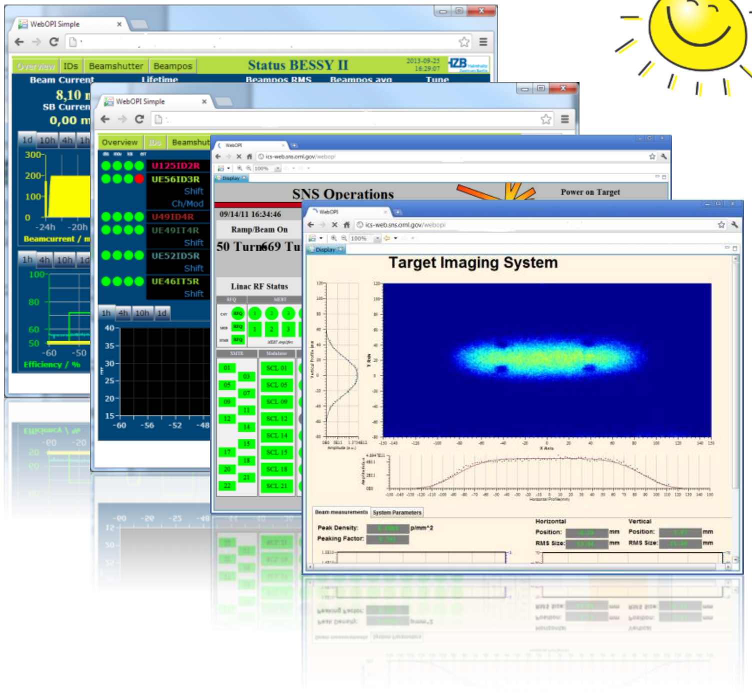


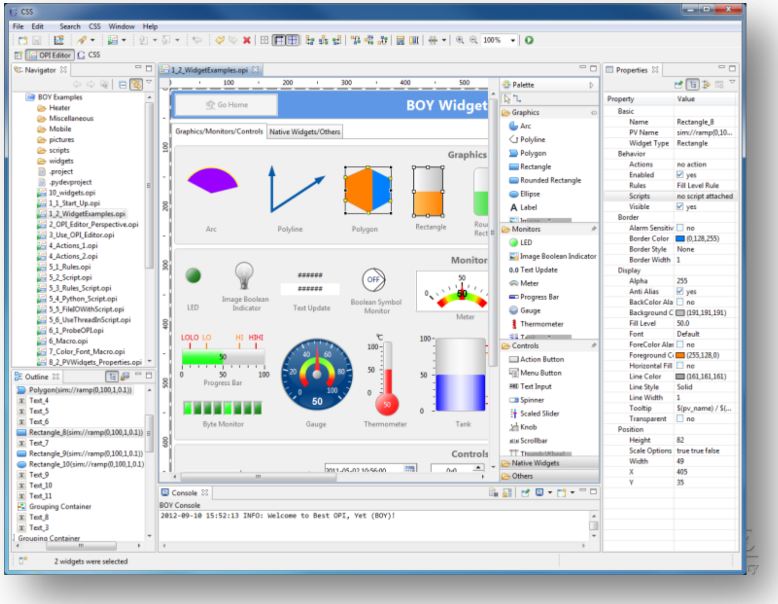
WebOPI - The Good Part

- 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





BOY Console

```
2012-09-10 15:52:13 INFO: Welcome to Best OPI, Yet (BOY)!
```

2 widgets were selected

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

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

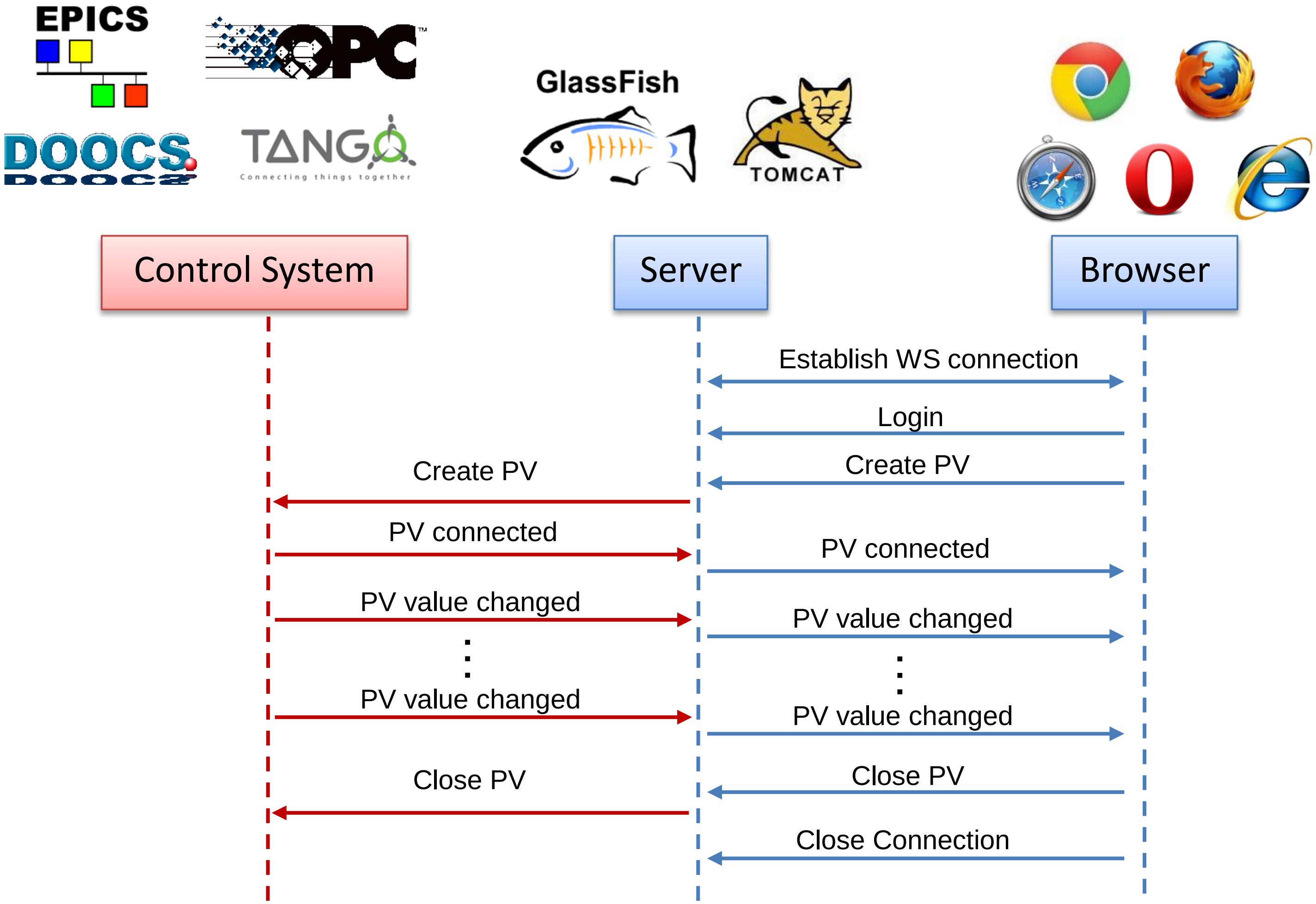
http://matchbin-assets.s3.amazonaws.com/public/sites/275/assets/mostlycloudy_copy.jpg

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



Control System

Server

Browser

Establish WS connection

Login

Create PV

Create PV

PV connected

PV connected

PV value changed

PV value changed

⋮

PV value changed

PV value changed

Close PV

Close PV

Close Connection

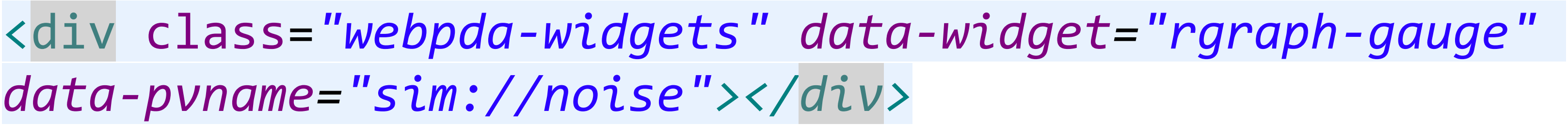
Client Side JavaScript API

- Focus on your PV instead of communication

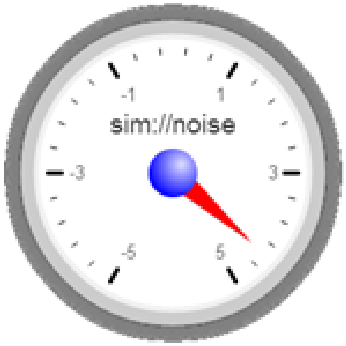
```
var url = "ws://localhost:8080/webpda";
var wp = new WebPDA(url, "myname", "password");
var pv = wp.createPV("pvname", 1000, false);
pv.addCallback(function(evt, pv, data) {
    switch (evt) {
    case "conn": //connection state changed
        break;
    case "val": //value changed
        break;
    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

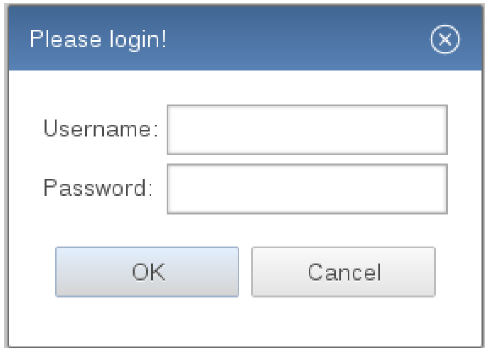


```
<div class="webpda-widgets" data-widget="rgraph-gauge"
data-pvname="sim://noise"></div>
```



Security

- 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:

http://www.motionsecurity.co.za/wp-content/uploads/2013/06/url.png

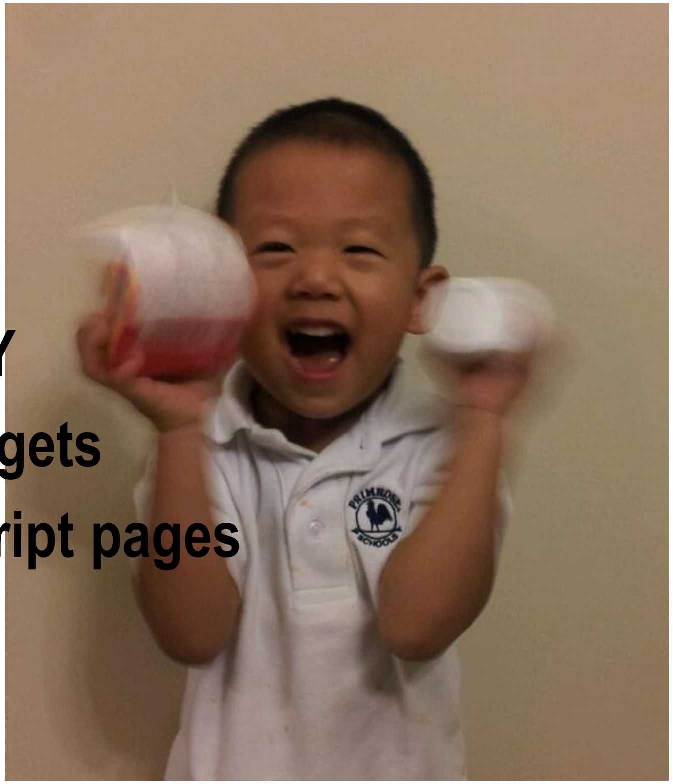
WebOPI or WebPDA?

> *"It Depends"*
>
> -Socrates

- 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

http://www.sqlsoldier.com/wp/wp-content/uploads/2011/04/ITDepends.jpg

Want Both?



- 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

http://cdn.staticsfly.com/inspiration/storytelling/archives/tips-for-photographing-a-sleeping-baby/jcr:content/leftPar/slideshow.slideshowimg.670.0.png/1326132908863.jpg

THANKS!

- WebOPI
  - http://sourceforge.net/apps/trac/cs-studio/wiki/webopi
- WebPDA
  - http://webpda.org/