EPICS Channel Access using WebSocket

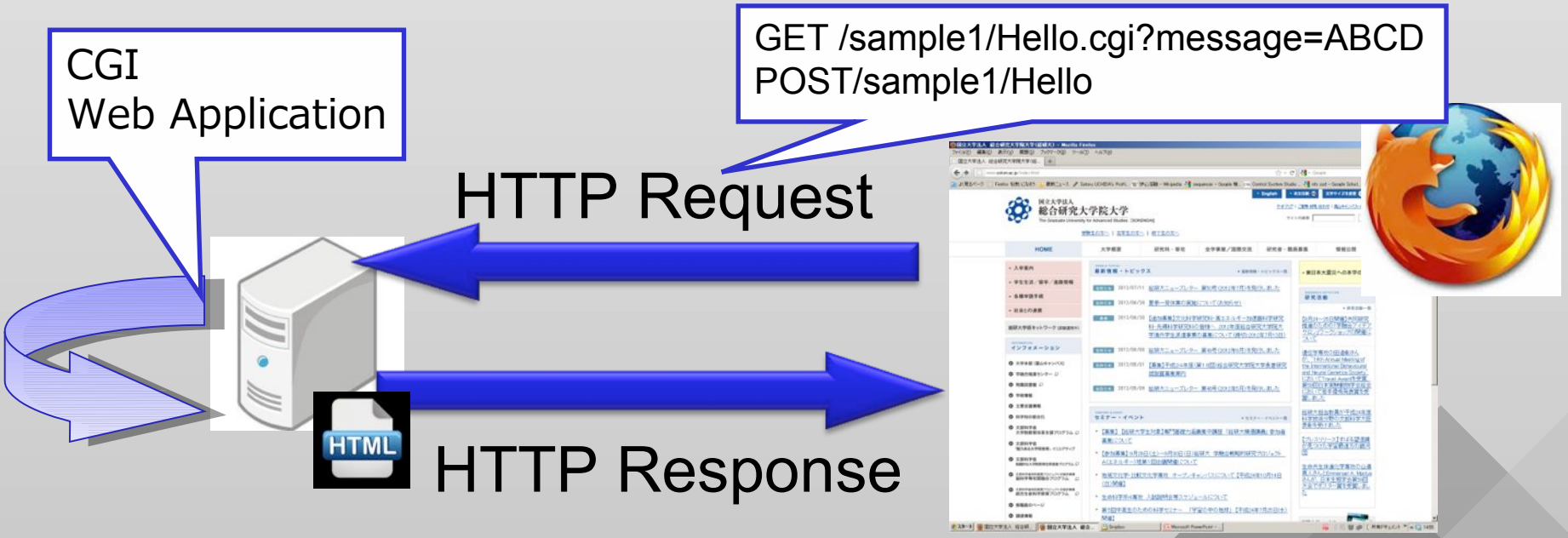
Sokendai A. UCHIYAMA
KEK K. FURUKAWA
RIKEN Y. HIGURASHI

Advantage of Web-based System

- ✓ Use of the Wide Area Network for the System
  - We can use Internet access around the world.
  - Web is already a standard protocol in the Internet.
- ✓ Not only Control Room, But also other place.
  - The maintainer operate over the web without a central control room.
- ✓ Rapid development of HTML/JavaScript
  - Development of GUIs needs human resources, for example C/C++ and JAVA.
- ✓ Unnecessary to install exclusive software.
  - No X-window System, No Java virtual machine because almost browsers are cross platform... expect IE.
  - Almost devices are installed web browsers already.

HTTP(HyperText Transfer Protocol)

A sequence from the connection to the disconnect for HTTP



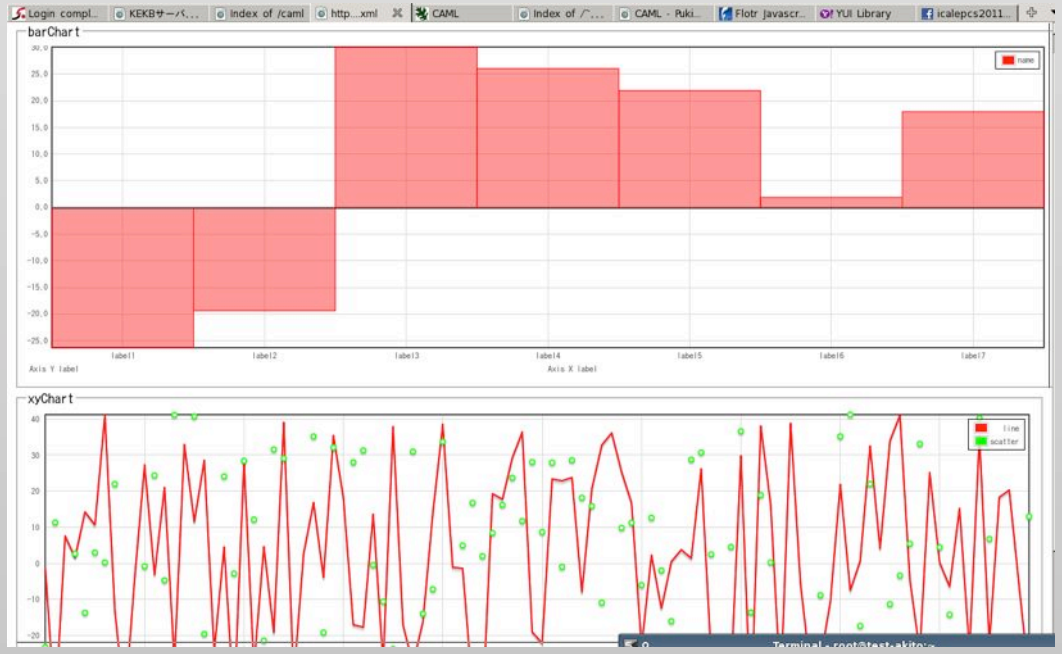
Fundamental architecture

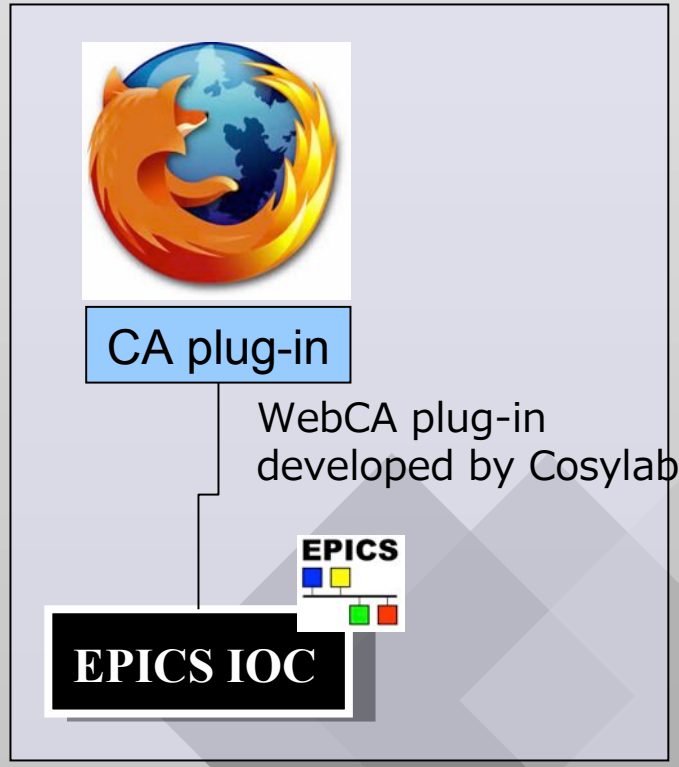
1. A browser send the HTTP request.
2. Web application is run in the server.
3. HTTP response is returned.

Web-based System Using EPICS (1)

CAML **C**hannel **A**ccess **M**arkup **L**anguage by SNS

CAML is a framework , it can control using the CA protocol from a Web browser by XML.





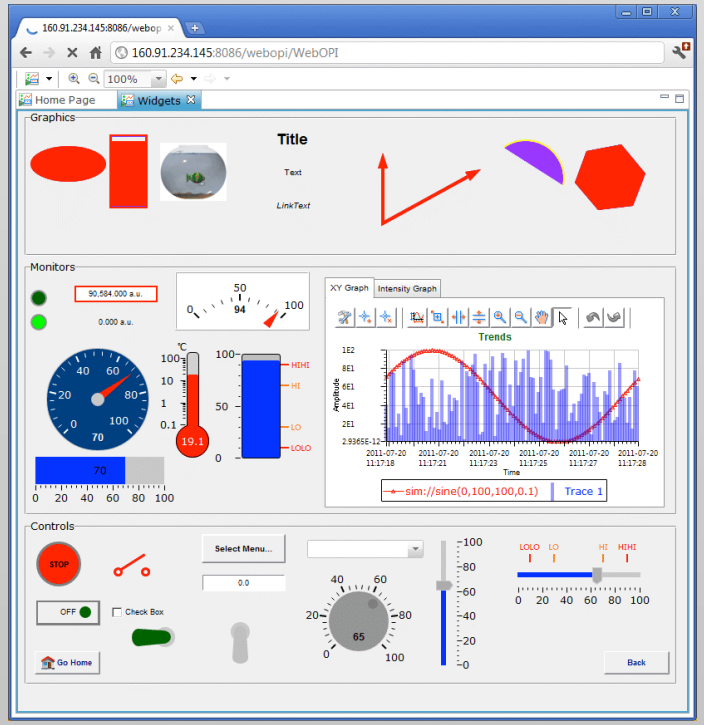
- Dependencies for browsers
  The plug-in needs for Firefox, Google Chrome, and Safari.
- A browser generates CA connection directly.
  It is difficult to use non-PC-based browser.

Web-based System Using EPICS (2)

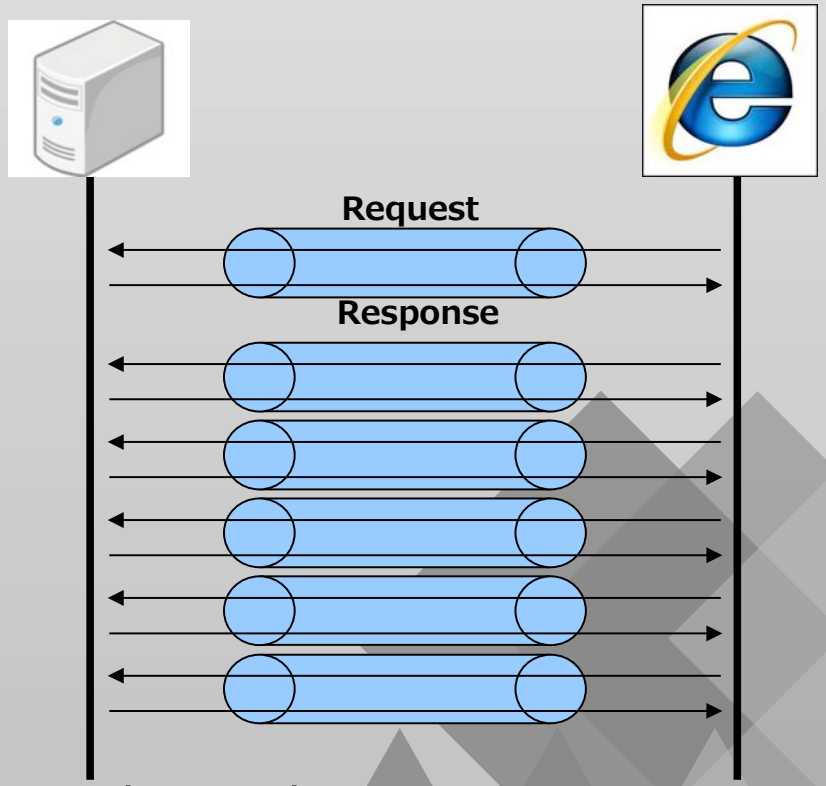
WebOPI by SNS

- WebOPI can be used to access the GUIs developed by CSS/BOY from a Web browser.

WebOPI is a useful !



Ajax (Asynchronous JavaScript and XML)

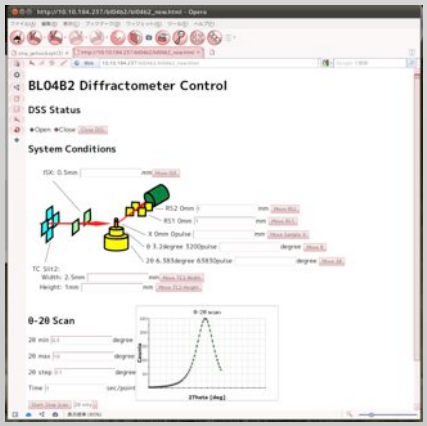


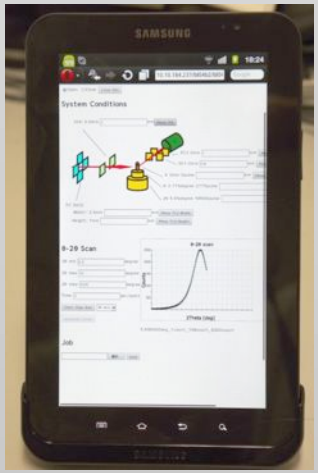
- Ajax is used for interactive action on the Web.
- Firefox Web browser could access the Web server with a cycle of ~100 ms for data transfer in our Intranet environment.

Revolution of Web-based System

ICALEPCS2011@France Grenoble 2011/10

- Y. Furukawa at SPring-8 proposed the development methods for the main OPI using WebSokect.
  - The prototype system was constructed using a MADOCA-based system.





- Web has a disadvantage about the interactive response.
- However, Real-time web has many advantages. <--- WebSocket !
- We started to develop WebSocket server for EPICS Channel Access protocol.

Reference: Proc. ICALEPCS2011, No.WEMAU10, Y. Furukawa

WebSocket（1）

New protrocol for bi-directional communication

Disadvantage of Ajax

- Must make the socket connection many time.
  - Response speed is very important for OPI.
- There is no callback function.
- We CanNot know the server status from browsers.

Put

Put … fail ? success ?

Put

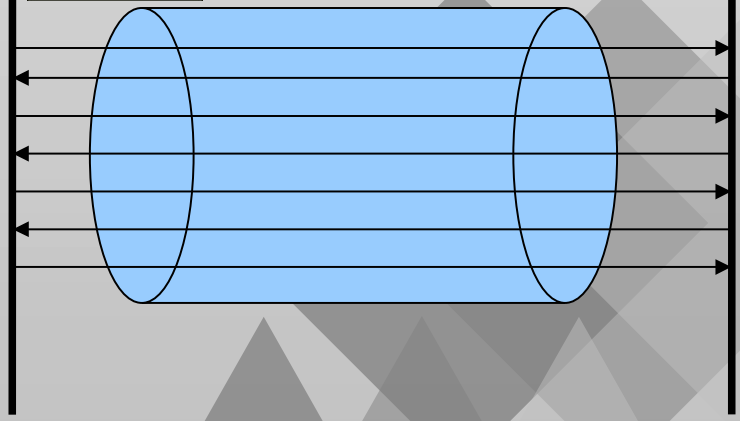
OK

Success because of OK callback

WebSocket Server

Browser

connection



Keep bi-directional communication

WebSocket（2）

Disadvantage of WebSocket

All browsers are not available.

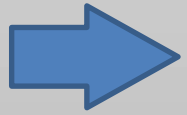

Mozilla Firefox ◎


Google Chrome ◎


Opera ◎


Internet Explorer 9 ×

Microsoft planned WebSocket-compliance in IE10



Standard Protocol

Requirement

In order to realize for EPICS, there are requirements.

1. Development of WebSocket server
   - ✓We utilized Node.js (Server-Side JavaScript)
2. Node.js has to call the CA API
   - ✓C++ add-on (Channel Access for Node.js=NodeCA)
3. Implementation of Client System
   - ✓JQuery libraries is used for visualization (chart or gauge).
   - ✓DOM coded JavaScript is used for Text update.

Node.js

Feature

The Node.js-based network application consist of simple code !

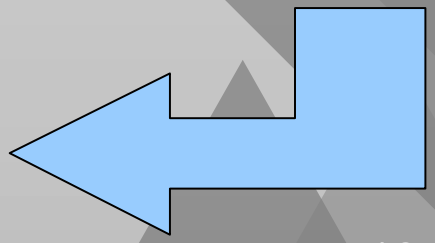
Server-Side JavaScript

- ✓ Generally, JavaScript is running on browsers.
- ✓ Using C/C++, it’s difficult to develop Websocket server from scratch.
- ✓ JavaScript is also used on the server-side as well as client-side.

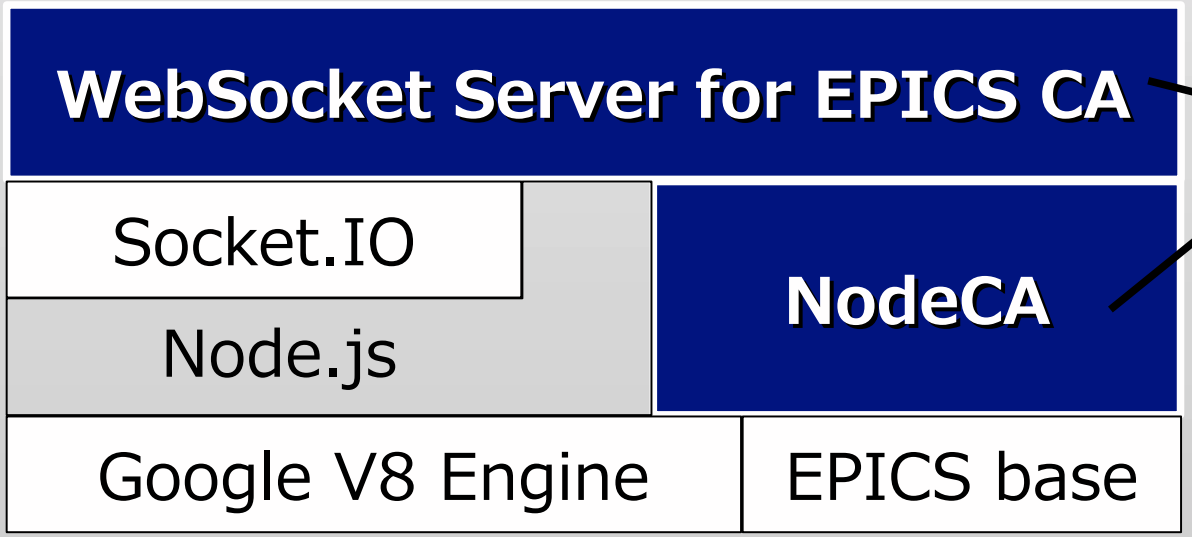
Node.js can utilize a library for WebSocket API.

- I don't want to do complicated tasks ...

Socket.IO



NodeCA・WebSocket server Overview



caget Example(server-side)

```
var pv = require("../build/Release/nodeca");
val = pv.caget("akito12:example");
console.log(val);
```

Reading add-on

EPICS PV

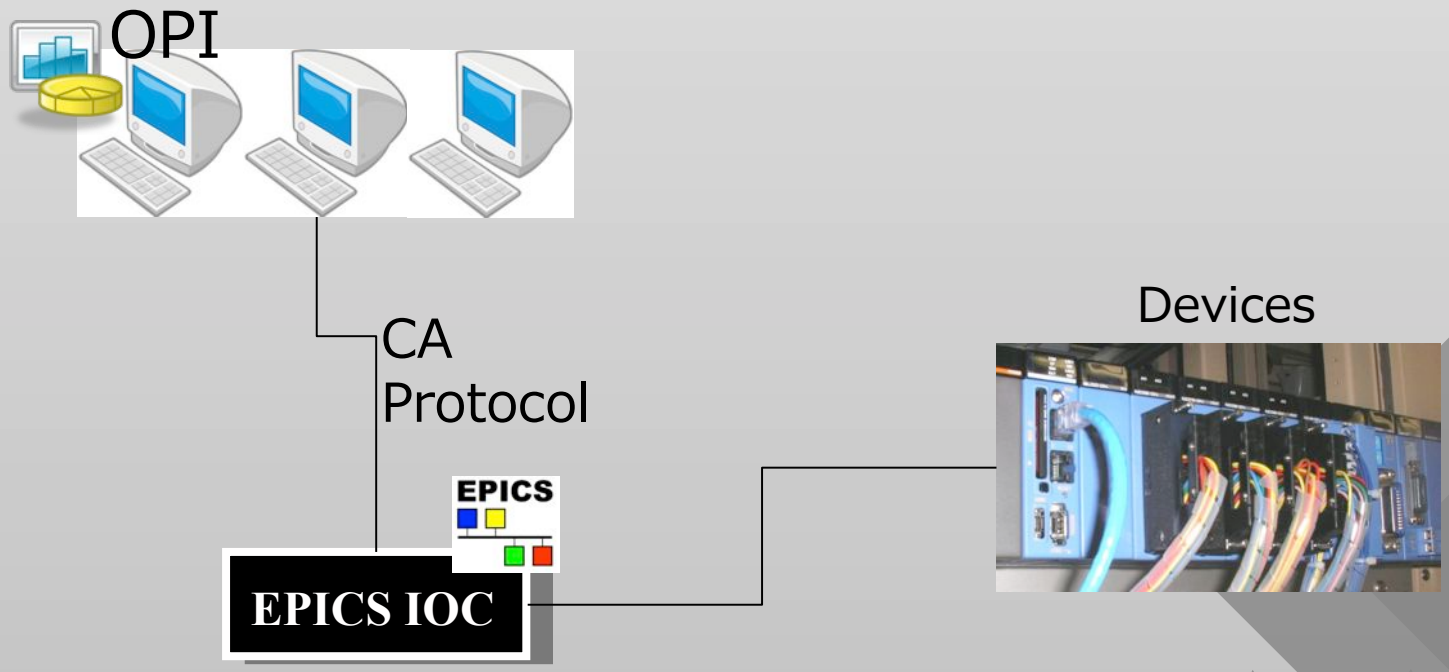
Output value

This system concept is the coding as simple as possible.

Overview of the System

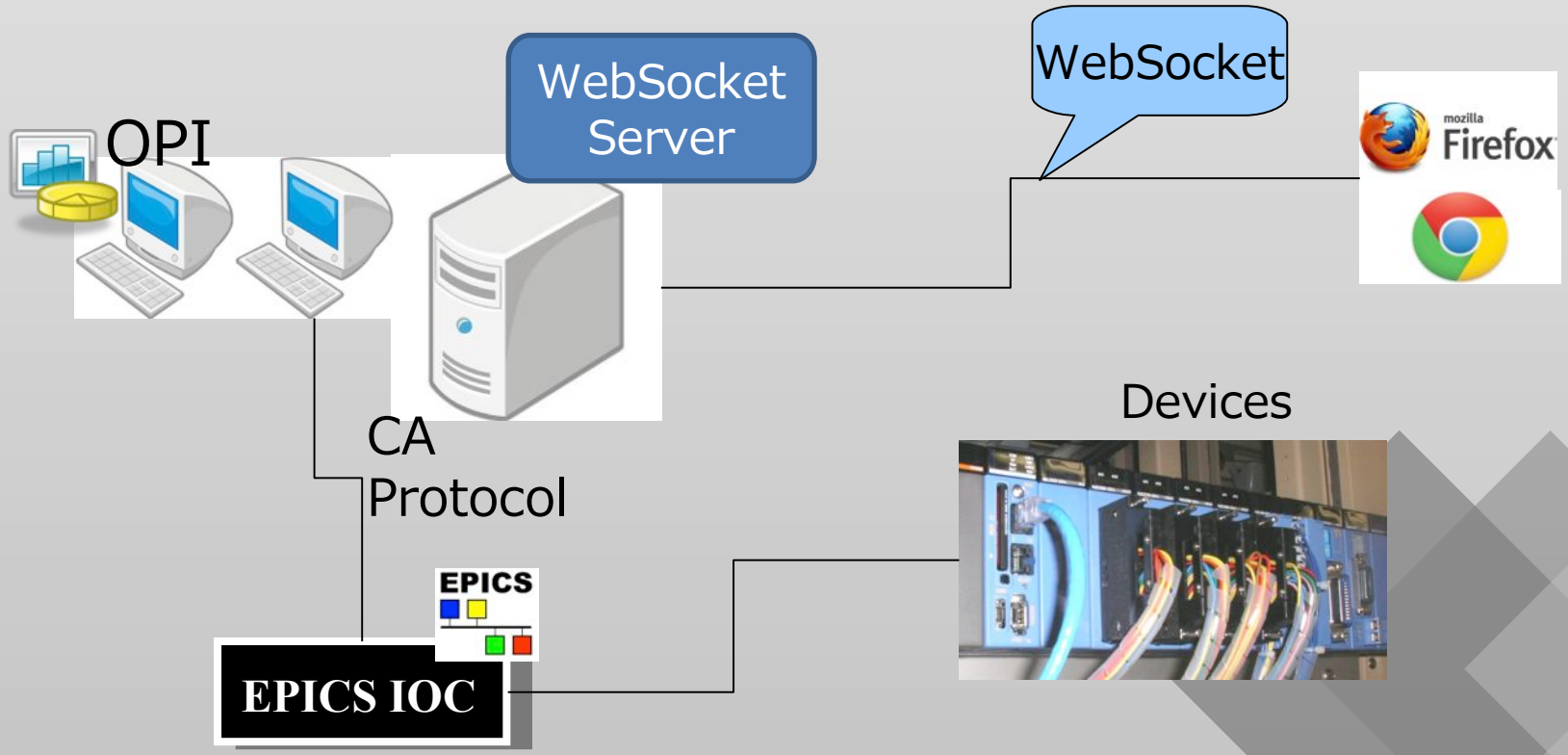
Example of EPICS-based System

- That's typical system.



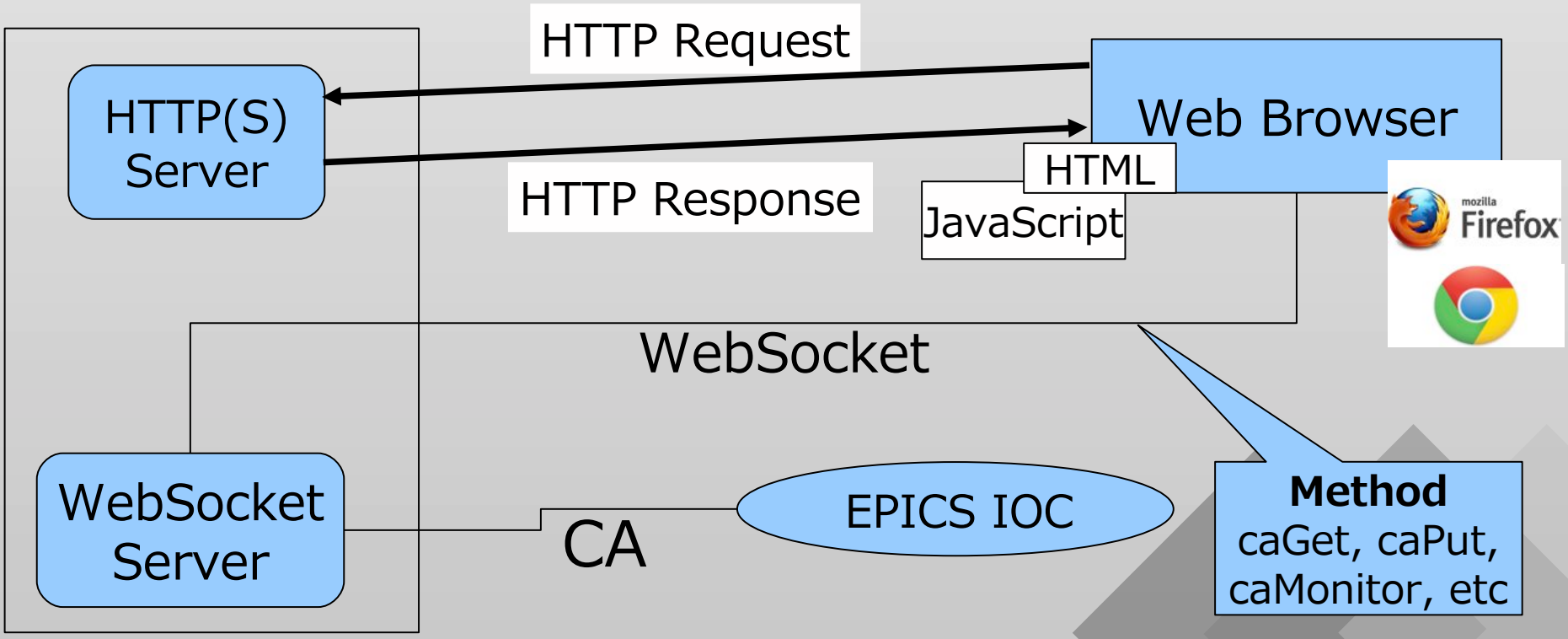
Overview of the System

WebSocket server and OPI are same layer.



WebSocket Overview

- In our system, WebSocket server and Web server use same port. (80)



1. Web browser sends HTTP request and get HTTP response.
2. Web browser connects to WebSocket server after handshake response.
3. Client-side JavaScript sends some methods to WebSocket server.
4. WebSocket server connects to EPICS IOC and get/put the value.
5. WebSocket server returns the value to Web browser.

Implementation of client-side JavaScript (1)

```
/* send */
var socket =io.connect('/ca/gauge');
    socket.emit('caMonitor',{
        pv: 'akito12Host:ai1',
        data_name: 'ai'
})

/* recieve */
socket.on('ca', function(data){
     var value = data.ai;
});
```

EPICS PV

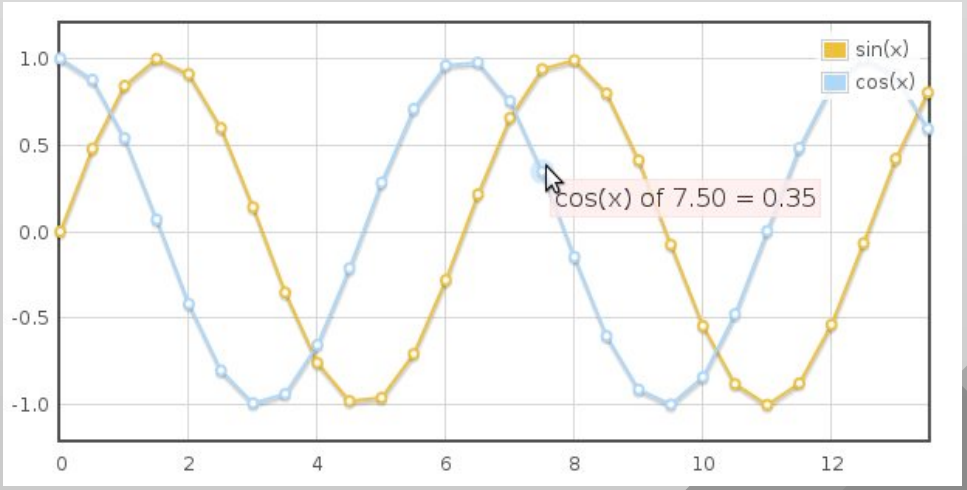
Defined data name

Receive data

Implementation of client-side JavaScript (2)

JavaScript libraries are used for visualization of real-time data.

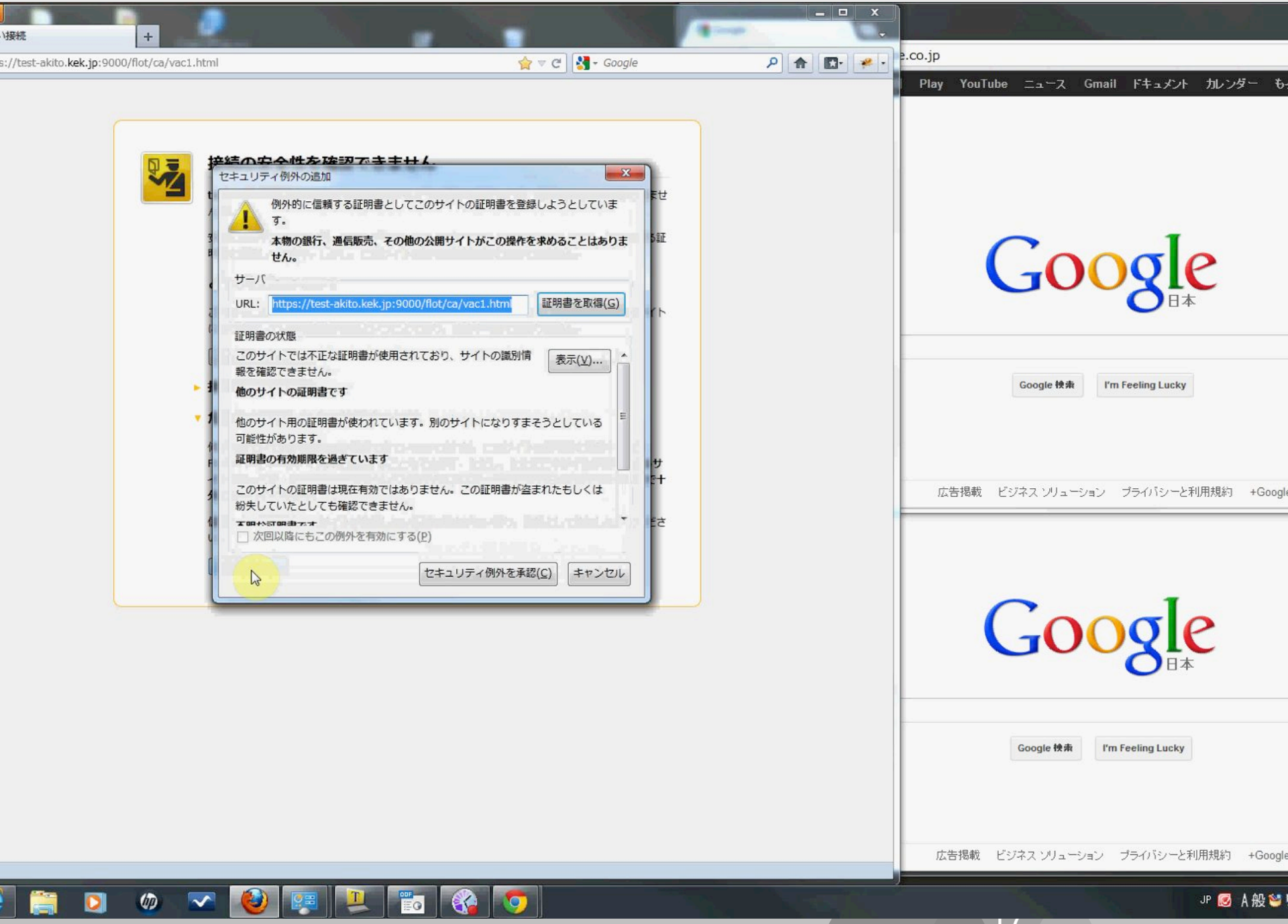
- jsgauge
- flot (jQuery-base library, MIT license)



Making good looking chart from scratch is costly work.
Other paid JavaScript libraries are also available.

GUI development for OPI ≒ Web(HTML) development

The level of difficulty become lower.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I'm Feeling Lucky
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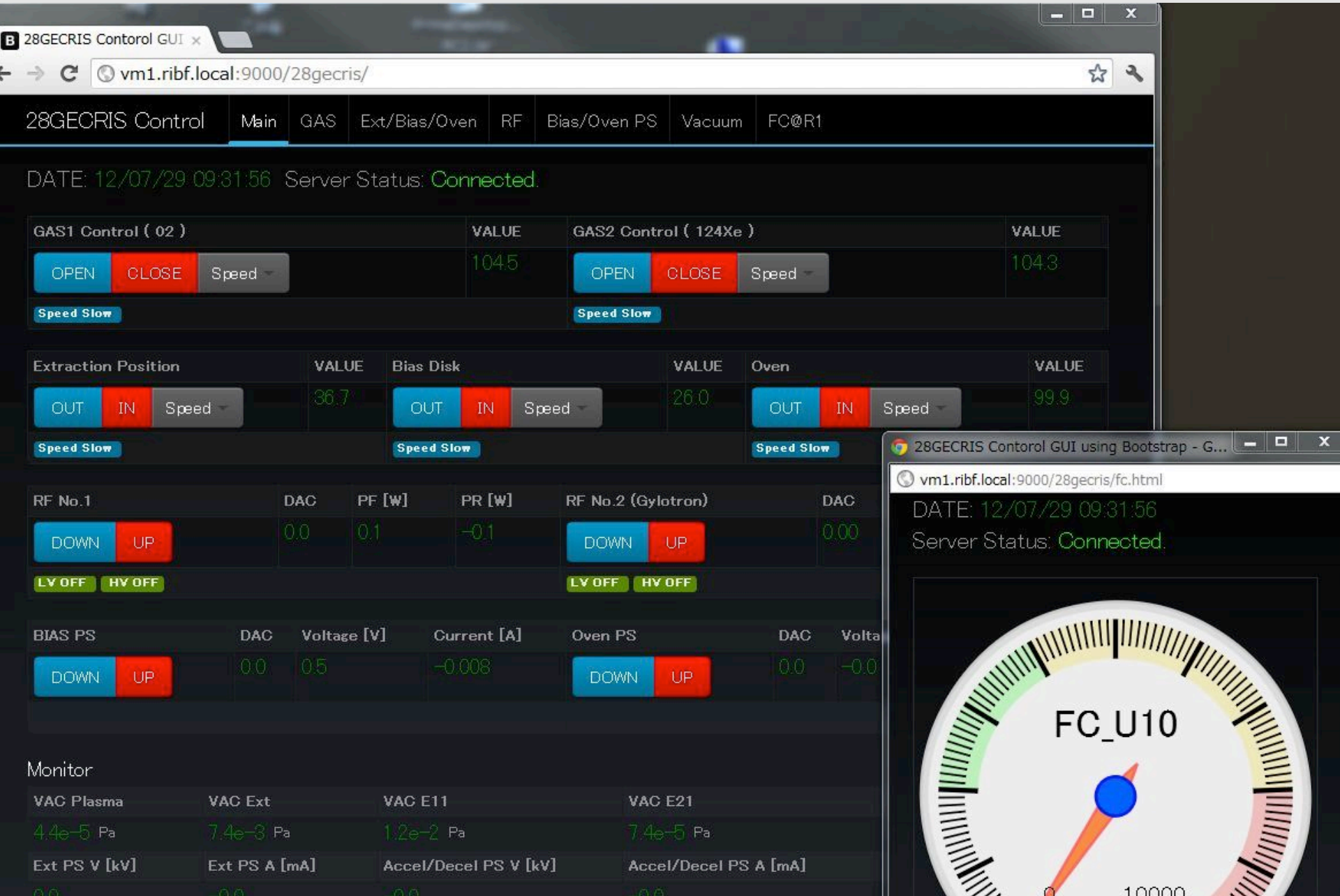
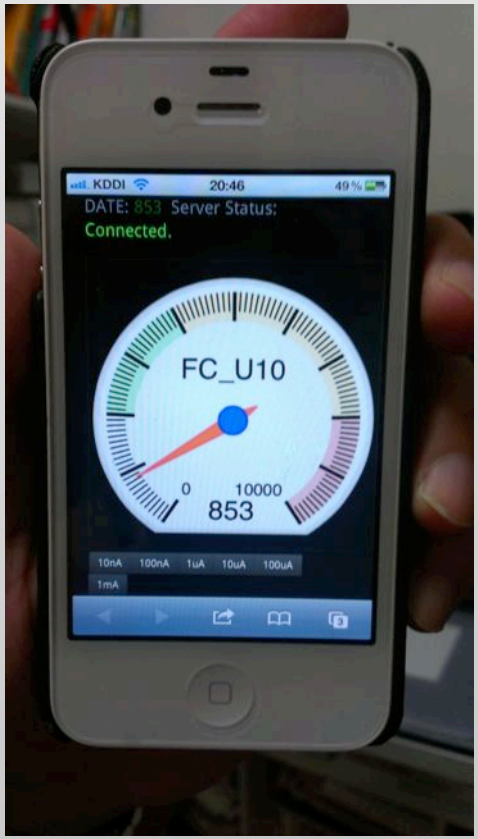
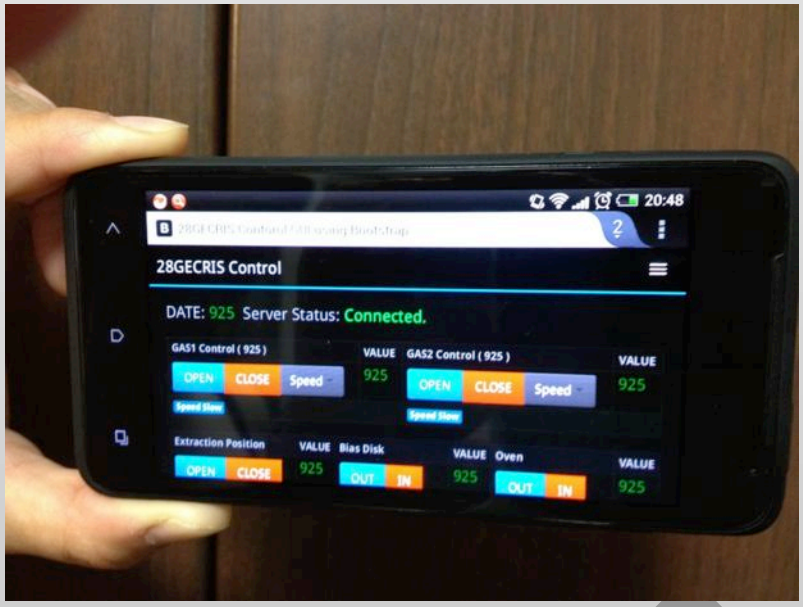
Example of RIBF SC-ECR Ion Source Control



Implementation of client-side (Mobile)



Safari on iPhone4S



Google Chrome on Android4.0

The Level of difficulty become lower than Objective-C & cocoa Touch

・Safari has a function to get the touch event for iPhone/iPod Touch.

Multi-touch application is also available.

WWW

- World Wide Web was born in CERN

  Tim Berners-Lee developed WWW for
  sharing and updating information among researchers.

- Since then, we can control accelerators
  by using WWW with new WebSocket now

Don't you feel
dramatic story ?

Flickr upload bot on 16:24, 1 May 2010 (UTC) by Ranveig (talk).

Summary

- We developed the OPI for EPICS using WebSocket.
- In order to develop the OPI, we developed
  - NodeCA as an add-on to the interface for the CA protocol.
  - WebSocket server for CA call from client-side JavaScript.
- We could control and monitor one part of the accelerator parameters as well as the traditional EPICS-based application.
- The developed Web-based OPI runs not only on the main PC-based browsers, but also Android and iPhone4S browsers.

Thank you