EPICS Channel Access using WebSocket

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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 sends the HTTP request.
2. Web application is run in the server.
3. HTTP response is returned.

CGI
Web Application

GET /sample1/Hello.cgi?message=ABCD
POST/sample1/Hello

HTTP Request

HTTP Response

Server-Side

Client-Side
Web-based System Using EPICS (1)

CAML  Channel Access Markup Language  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.

CA plug-in
WebCA plug-in developed by Cosylab
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
New protocol for bi-directional communication

Disadvantage of Ajax
- Must make the socket connection many times.
  - Response speed is very important for OPI.
- There is no callback function.
- We cannot know the server status from browsers.

Success because of OK callback
WebSocket (2)

Disadvantage of WebSocket

All browsers are not available.

- Mozilla Firefox ◎
- Google Chrome ◎
- Opera ◎
- Internet Explorer 9 ×

Microsoft planned WebSocket-compliance in IE10
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

WebSocket Server for EPICS CA

- Socket.IO
- Node.js
- Google V8 Engine
- NodeCA
- EPICS base

The software developed by this research

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

caget Example(server-side)

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

Devices

EPICS IOC

EPICS

CA Protocol

WebSocket Server

OPI
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'
});

/* receive */
socket.on('ca', function(data){  
  var value = data.ai;
});
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
Example of RIBF SC-ECR Ion Source Control
Implementation of client-side (Mobile)

Safari on iPhone4S

Google Chrome on Android4.0

- Safari has a function to get the touch event for iPhone/iPod Touch.
- Multi-touch application is also available.

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