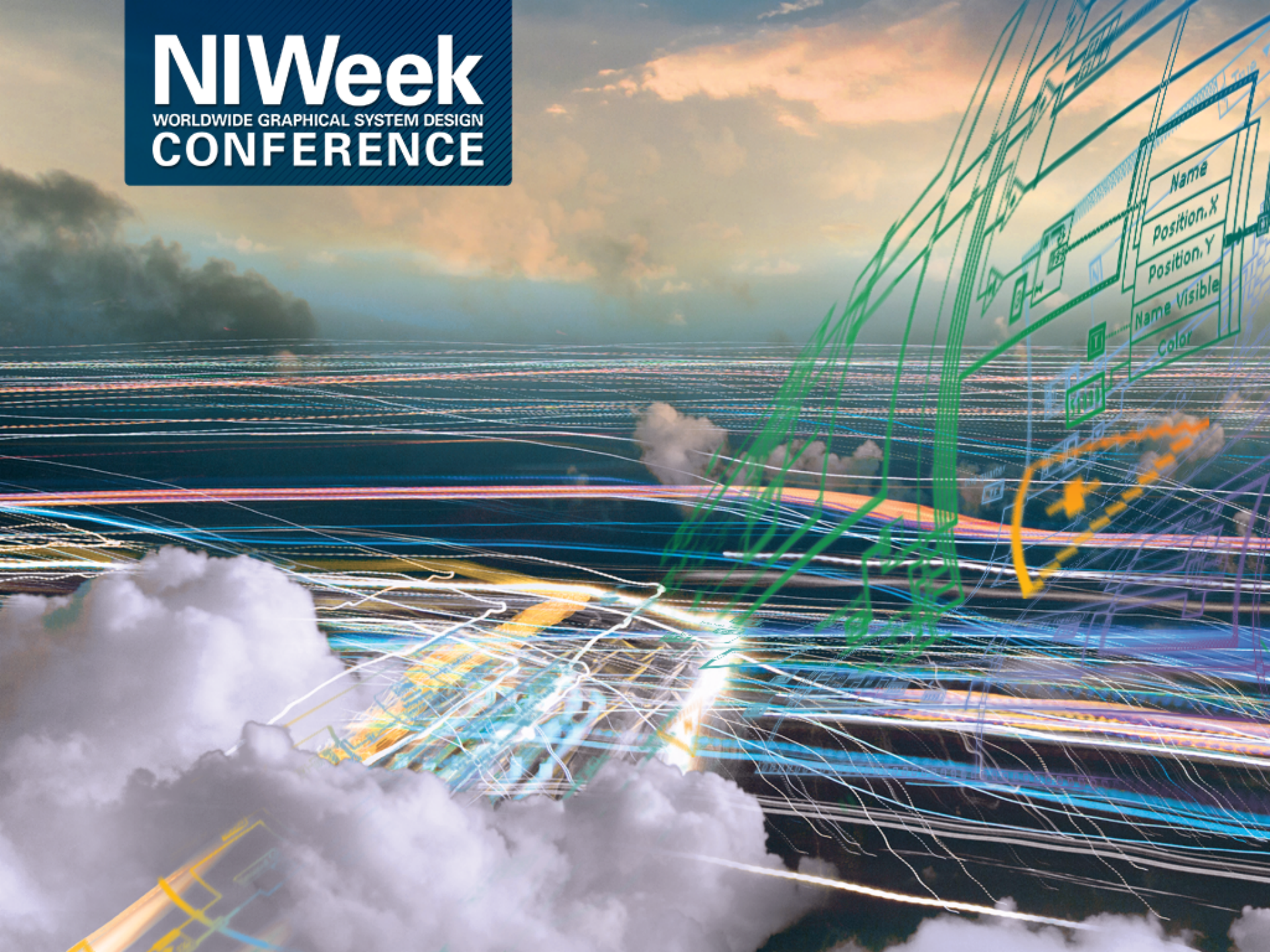


NIWeek

WORLDWIDE GRAPHICAL SYSTEM DESIGN
CONFERENCE





Bergmans Mechatronics LLC

Real-Time Web Research • Control Solutions • Instrumentation

John Bergmans

President

Bergmans Mechatronics LLC

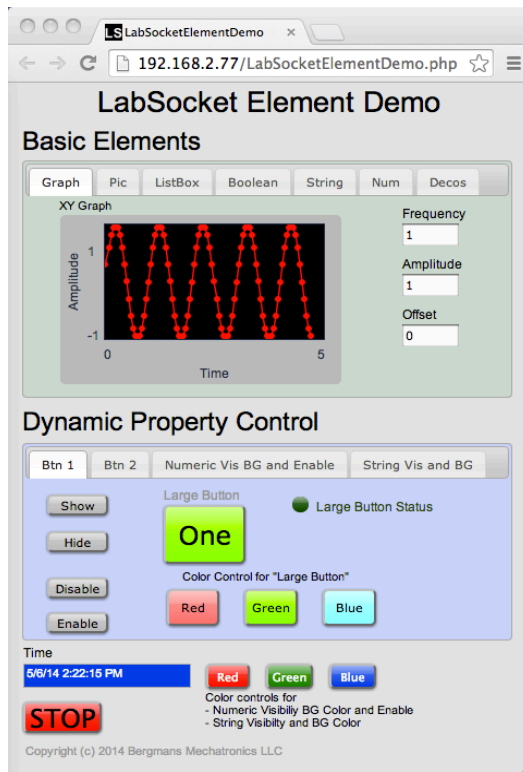
e: jbergmans@bergmans.com

p: 714-474-8956

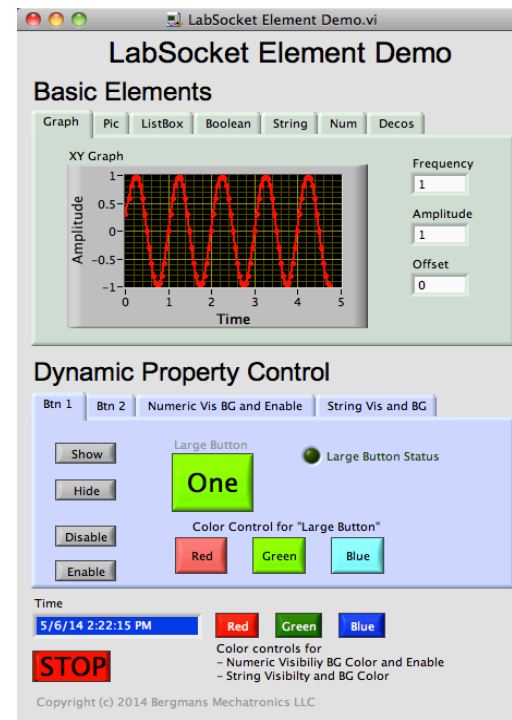
t: [@jbergmans](#) and [@LabSocket](#)



Extending LabVIEW to the Web Using the LabSocket System



Browser



Front Panel

Approaches to Remote LabVIEW Access



- Native Client App
- LabVIEW Remote Panels
- LabVIEW Web Services
- LabVIEW Web UI Builder
- Data Dashboard for LabVIEW
- Third-Party Alternatives

LabSocket-Basic Demo



Browser Representation

LabVIEW Front Panel

MultiColumn ListBox Support



LabSocket Demo - MultiColumn ListBox

labsocket.com/LabSocketDemo-MultiColumnListBox.php

LabSocket
MultiColumn ListBox
Time: 8/22/13 9:30:04 AM

START STOP

Scrollbars No Scrollbars

Column Headers Visible

Table 1	Col 1	Col 2	Col 3	Col 4
Row 1	Table 1	Col 2 - ABC	Col 3 - abc	Col 4 - i
Row 2	8/22/13 9:30:04 AM	Col 2 - DEF	Col 3 - def	Col 4 - ii
Row 3	Col 1 - cC	Col 2 - GHI	Col 3 - ghi	Col 4 - iii
Row 4	Col 1 - dD	Col 2 - JKL	Col 3 - jkl	Col 4 - iv
Row 5	Col 1 - eE	Col 2 - MNO	Col 3 - mno	Col 4 - v
Row 6	Col 1 - fF	Col 2 - PQR	Col 3 - pqr	Col 4 - vi
Row 7	Col 1 - gG	Col 2 - STU	Col 3 - stu	Col 4 - vii
Row 8	Col 1 - hH	Col 2 - VWX	Col 3 - vwx	Col 4 - viii
Row 9	Col 1 - iI	Col 2 - YZ	Col 3 - yz	Col 4 - ix
Row 10	Col 1 - jJ	Col 2 - AAB...	Col 3 - aabcc	Col 4 - x
Row 11	Col 1 - kK	Col 2 - DDEE...	Col 3 - ddeeff	Col 4 - xi
Row 12	Col 1 - lL	Col 2 - GGH...	Col 3 - gghhii	Col 4 - xii
Row 13	Col 1 - mM	Col 2 - JJKLL...	Col 3 - jkkll	Col 4 - xiii
Row 14	Col 1 - nN	Col 2 - MMN...	Col 3 - mmmnoo	Col 4 - xiv

Column Headers NOT Visible

Table 2	Col 2 - ABC	Col 3 - abc	Col 4 - i	
Row 1	Table 2	Col 2 - DEF	Col 3 - def	Col 4 - ii
Row 2	8/22/13 9:30:04 AM	Col 2 - GHI	Col 3 - ghi	Col 4 - iii
Row 3	Col 1 - cC	Col 2 - JKL	Col 3 - jkl	Col 4 - iv
Row 4	Col 1 - dD	Col 2 - MNO	Col 3 - mno	Col 4 - v
Row 5	Col 1 - eE	Col 2 - PQR	Col 3 - pqr	Col 4 - vi
Row 6	Col 1 - fF	Col 2 - STU	Col 3 - stu	Col 4 - vii
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Row 11	Col 1 - kK	Col 2 - GGH...	Col 3 - gghhii	Col 4 - xii
Row 12	Col 1 - lL	Col 2 - JJKLL...	Col 3 - jkkll	Col 4 - xiii
Row 13	Col 1 - mM	Col 2 - MMN...	Col 3 - mmmnoo	Col 4 - xiv

Table 3

Col 1	Col 2	Col 3	Col 4
Table 3	Col 2 - ABC	Col 3 - abc	Col 4 - i
8/22/13 9:30:04 AM	Col 2 - DEF	Col 3 - def	Col 4 - ii
Col 1 - cC	Col 2 - GHI	Col 3 - ghi	Col 4 - iii
Col 1 - dD	Col 2 - JKL	Col 3 - jkl	Col 4 - iv
Col 1 - eE	Col 2 - MNO	Col 3 - mno	Col 4 - v
Col 1 - fF	Col 2 - PQR	Col 3 - pqr	Col 4 - vi
Col 1 - gG	Col 2 - STU	Col 3 - stu	Col 4 - vii
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Col 1 - iI	Col 2 - YZ	Col 3 - yz	Col 4 - ix
Col 1 - jJ	Col 2 - AAB...	Col 3 - aabcc	Col 4 - x
Col 1 - kK	Col 2 - DDEE...	Col 3 - ddeeff	Col 4 - xi
Col 1 - lL	Col 2 - GGH...	Col 3 - gghhii	Col 4 - xii
Col 1 - mM	Col 2 - JJKLL...	Col 3 - jkkll	Col 4 - xiii

Table 4

Table 4	Col 2 - ABC	Col 3 - abc	Col 4 - i
8/22/13 9:30:04 AM	Col 2 - DEF	Col 3 - def	Col 4 - ii
Col 1 - cC	Col 2 - GHI	Col 3 - ghi	Col 4 - iii
Col 1 - dD	Col 2 - JKL	Col 3 - jkl	Col 4 - iv
Col 1 - eE	Col 2 - MNO	Col 3 - mno	Col 4 - v
Col 1 - fF	Col 2 - PQR	Col 3 - pqr	Col 4 - vi
Col 1 - gG	Col 2 - STU	Col 3 - stu	Col 4 - vii
Col 1 - hH	Col 2 - VWX	Col 3 - vwx	Col 4 - viii
Col 1 - iI	Col 2 - YZ	Col 3 - yz	Col 4 - ix
Col 1 - jJ	Col 2 - AAB...	Col 3 - aabcc	Col 4 - x
Col 1 - kK	Col 2 - DDEE...	Col 3 - ddeeff	Col 4 - xi
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Col 1 - nN	Col 2 - MMN...	Col 3 - mmmnoo	Col 4 - xiv

Row Headers Visible

Row Headers NOT Visible

Tab Control

Browser Representation

LabSocket Demo - MultiColumn ListBox

labsocket.com/LabSocketDemo-MultiColumnListBox.php

LabSocket
MultiColumn ListBox
Time: 8/22/13 9:30:05 AM

START STOP

Scrollbars No Scrollbars

Column Headers Visible

Table 1	Col 1	Col 2	Col 3	Col 4
Row 1	Table 1	Col 2 - ABC	Col 3 - abc	Col 4 - i
Row 2	8/22/13 9:30:05 AM	Col 2 - DEF	Col 3 - def	Col 4 - ii
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Column Headers NOT Visible

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Col 1 - lL	Col 2 - GGH...	Col 3 - gghhii	Col 4 - xii
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Table 4

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8/22/13 9:30:05 AM	Col 2 - DEF	Col 3 - def	Col 4 - ii
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Col 1 - dD	Col 2 - JKL	Col 3 - jkl	Col 4 - iv
Col 1 - eE	Col 2 - MNO	Col 3 - mno	Col 4 - v
Col 1 - fF	Col 2 - PQR	Col 3 - pqr	Col 4 - vi
Col 1 - gG	Col 2 - STU	Col 3 - stu	Col 4 - vii
Col 1 - hH	Col 2 - VWX	Col 3 - vwx	Col 4 - viii
Col 1 - iI	Col 2 - YZ	Col 3 - yz	Col 4 - ix
Col 1 - jJ	Col 2 - AAB...	Col 3 - aabcc	Col 4 - x
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Col 1 - mM	Col 2 - JJKLL...	Col 3 - jkkll	Col 4 - xiii
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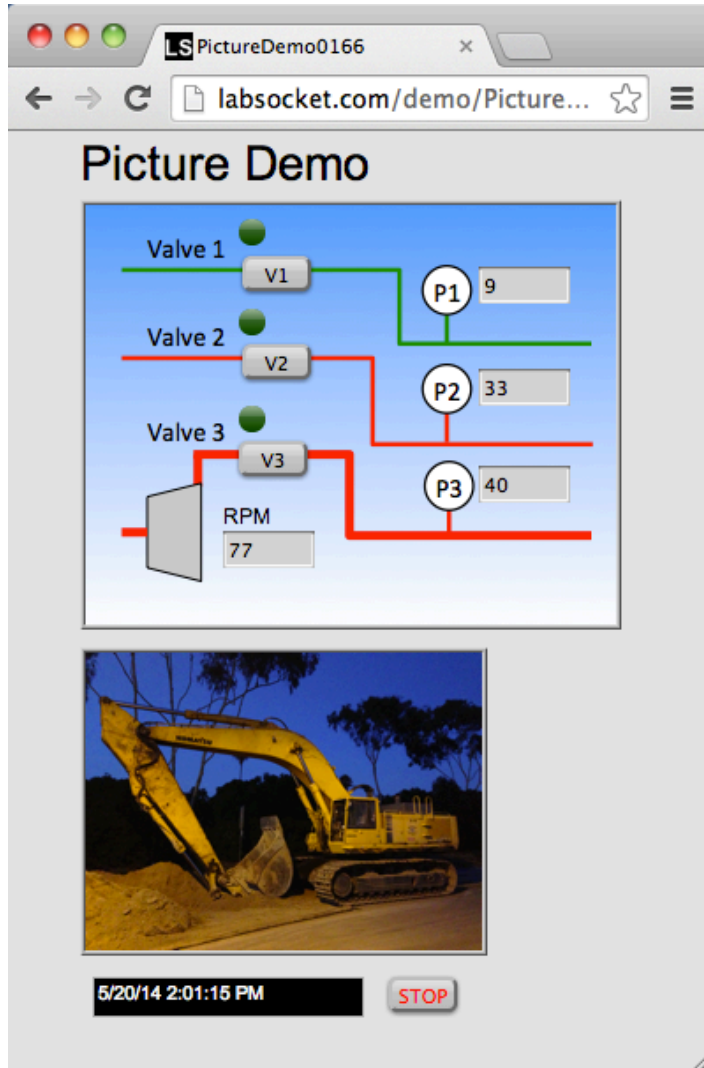
Row Headers Visible

Row Headers NOT Visible

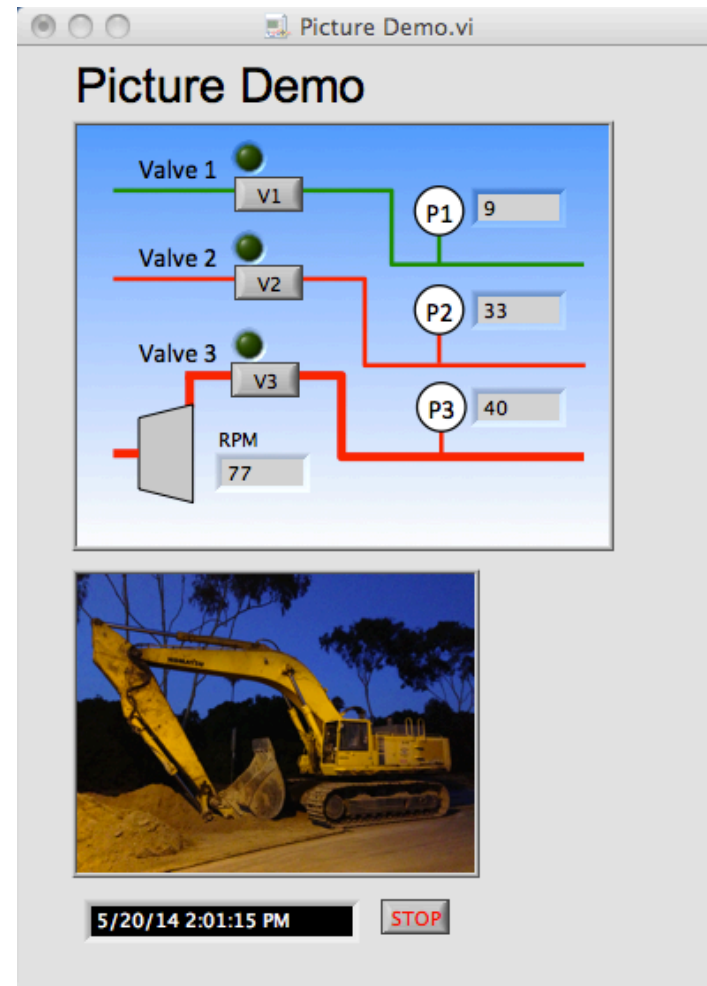
Tab Control

LabVIEW Front Panel

Picture Support



Browser
Representation

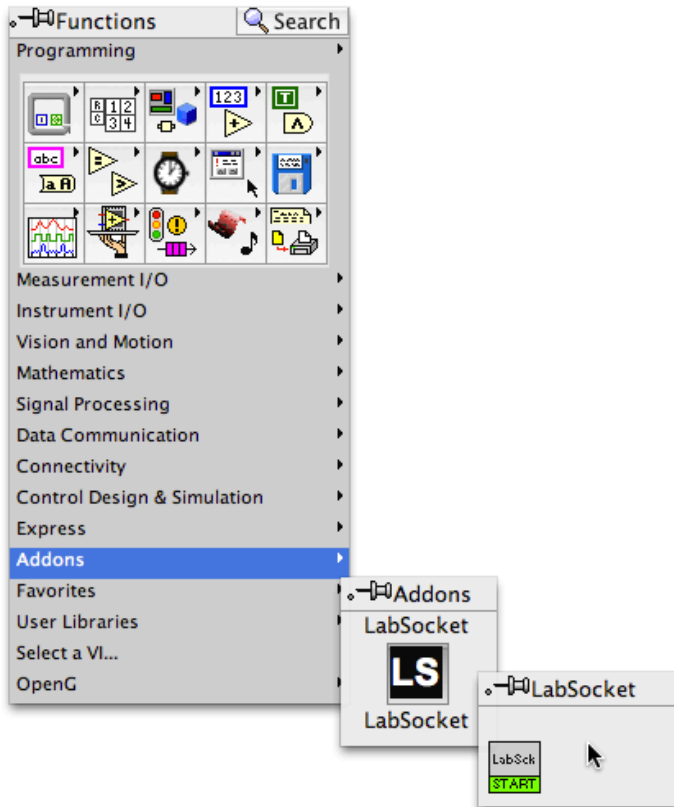


LabVIEW Front
Panel

Using LabSocket-Basic



Tools Palette



Context Help

The screenshot shows the 'Context Help' window for 'LabSocket Start.vi'. It displays a block diagram of the 'LabSock' component with the following inputs and outputs:

- Server Credentials (LabVIEW...)
- IP Address
- Application Type (standalone)
- Authentication Required (F)
- error in (no error)
- Auto-Open URL in Browser (F)
- URL
- error out

Server Credentials Username and Password for access to LabSocket server. (Default: LabVIEW / LabVIEW).

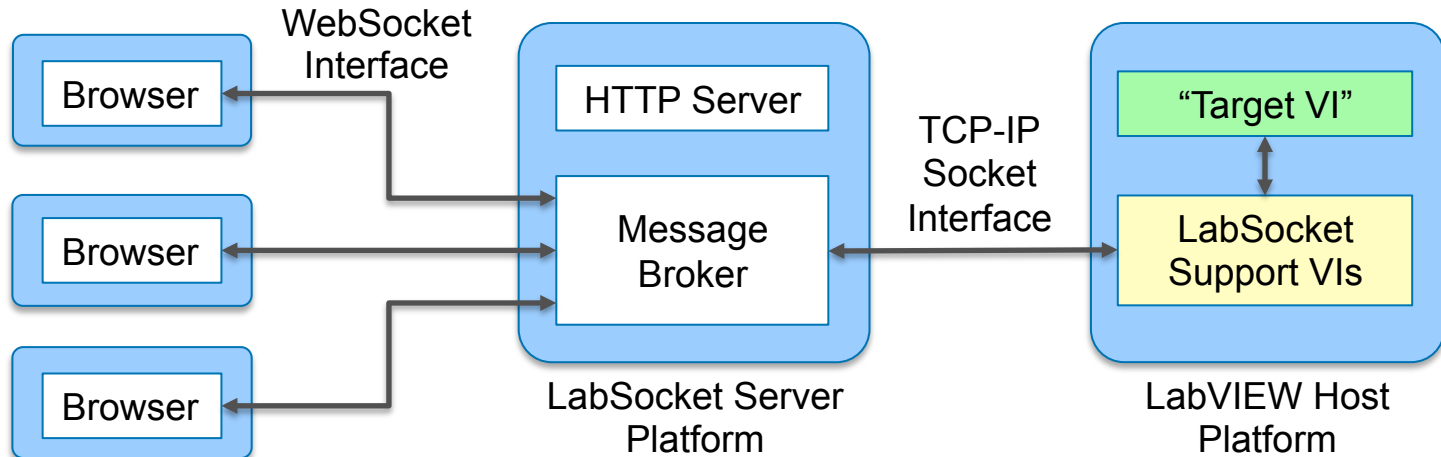
IP Address IP address of the LabSocket server.
"LabSocket_Server" – IP Address of LabSocket Server relative to LabVIEW Host platform
"External" – IP Address of LabSocket Server relative to browser. Leave blank if same as "LabSocket_Server".

Application Type Integration level of front panel in browser.
– standalone – standalone web page (default)
– moodle_integration – integrated within iframe in Moodle course web page

Authentication Required Authentication requirements for remote browser access
– T – authentication required
– F – authentication not required (default)

Auto-Open URL in Browser
– T – Web page automatically opened in browser
– F (default) – User must manually point browser to URL of application

LabSocket-Basic Architecture



LabSocket Support VIs

Startup

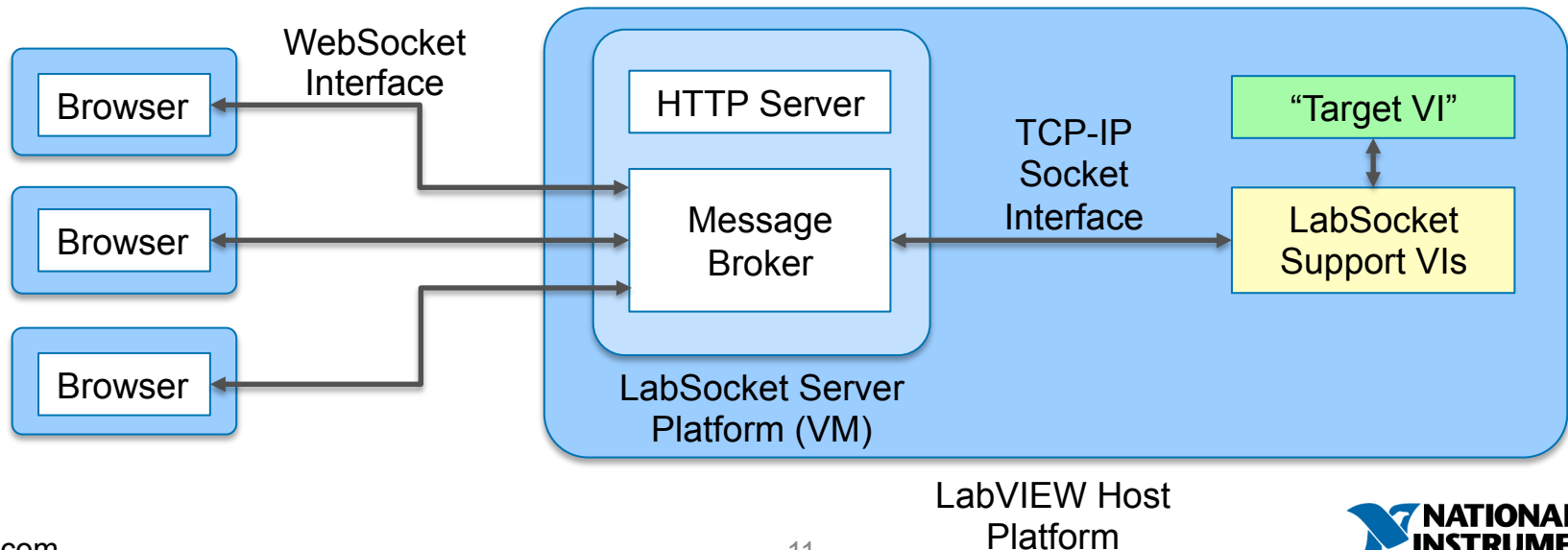
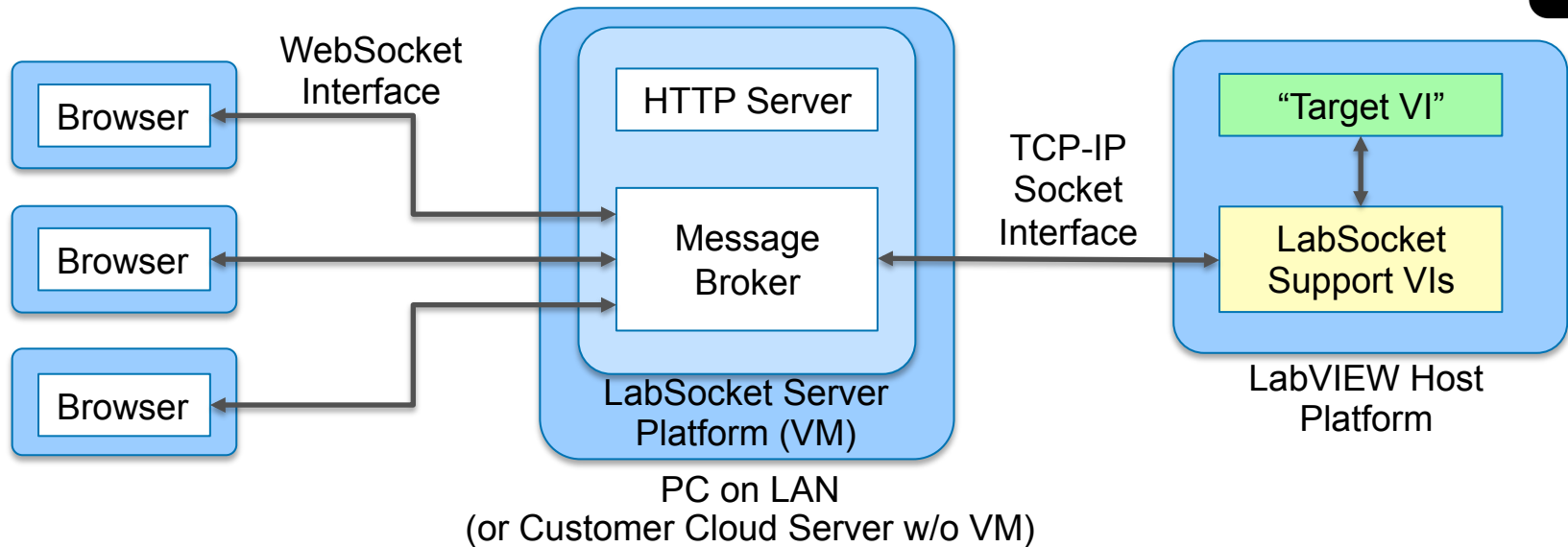
- LabVIEW Front Panel screenscrape, send HTML and JavaScript code to HTTP server

Continuous Operation

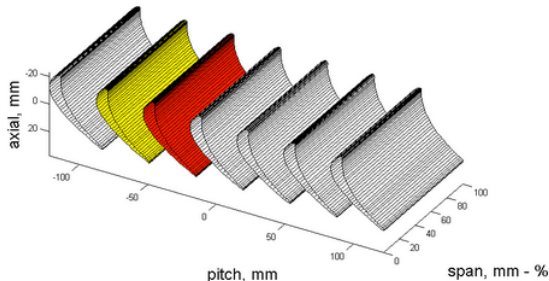
- Transmit updates of LabVIEW front panel to browser
- Update LabVIEW front panel when user generates events in browser

HTML5 WebSockets enable automatic replication of LabVIEW front panel in a browser **without plug-ins**

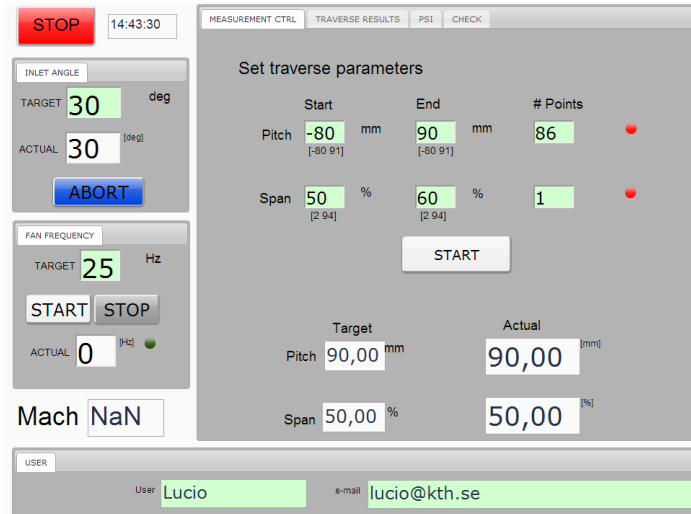
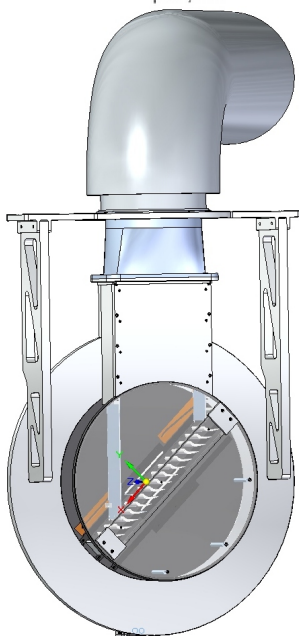
Typical Physical Configurations



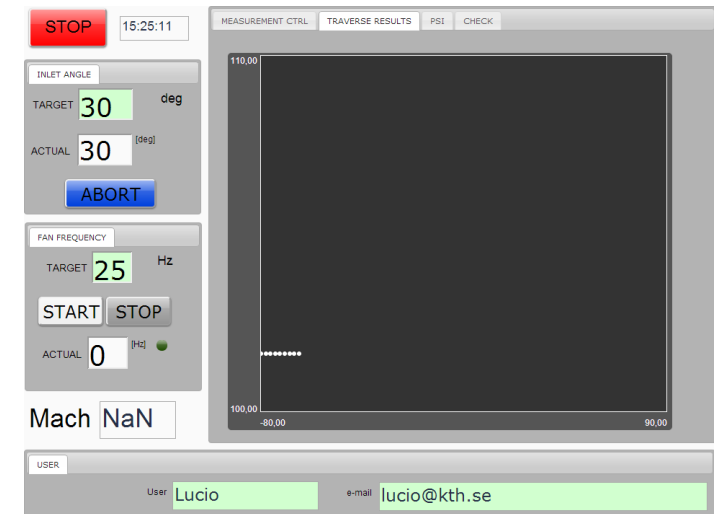
Remote Cascade Lab - KTH Royal Institute of Technology (Sweden)^{1,2}



- LabSocket-Basic enabled remote operation of experiments on turbine blades in wind tunnel
- Remote control aided by use of separate web cam
- 70 students operated rig remotely with LabSocket system (60 in groups of 3-6 and 10 individually)



GUI Main View



Live Probe Traverse Results

1 Monaco, L., Vogt, D.M., Bergmans, J.L., Fransson, T.H., *A Remotely Operated Aeroelastically Unstable LPT Cascade for Turbomachinery Aeromechanics Education and Training – Remote Flutter Lab*, Presented at ASME Turbo Expo 2014, Düsseldorf, Germany, June 16-20, 2014

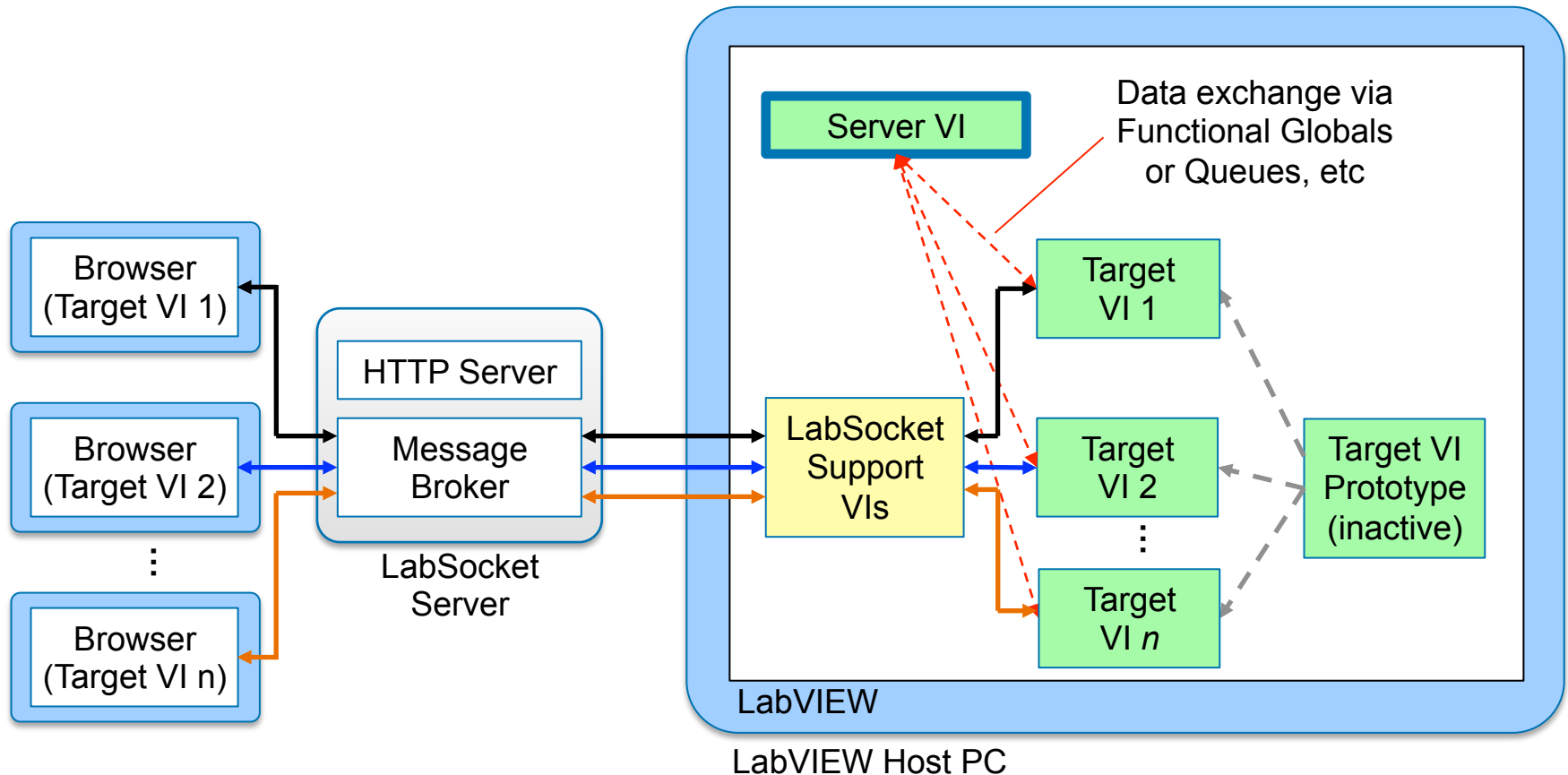
2 Monaco, L., "Remote Laboratories in the Training of Turbomachinery Engineering Students", Licentiate Thesis 2013, KTH Royal Institute of Technology, Stockholm, Sweden, Trita KRV Report 13/11, Dec 2013.

See also: http://www.energy.kth.se/proj/projects/Remote_labs/RL/RL_website/RCL/RCL.html
ni.com

LabSocket-MultiClient



- Each browser connects to instance of Target VI
- LabSocket Support VIs automatically start and stop Target VI instances
- Useful for applications requiring unique client session
- **LabVIEW is now a dynamic web application authoring tool**

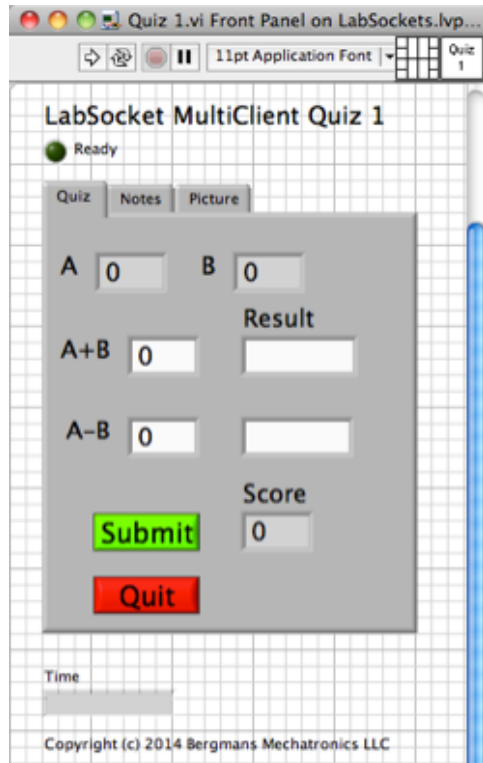


LabSocket-MultiClient

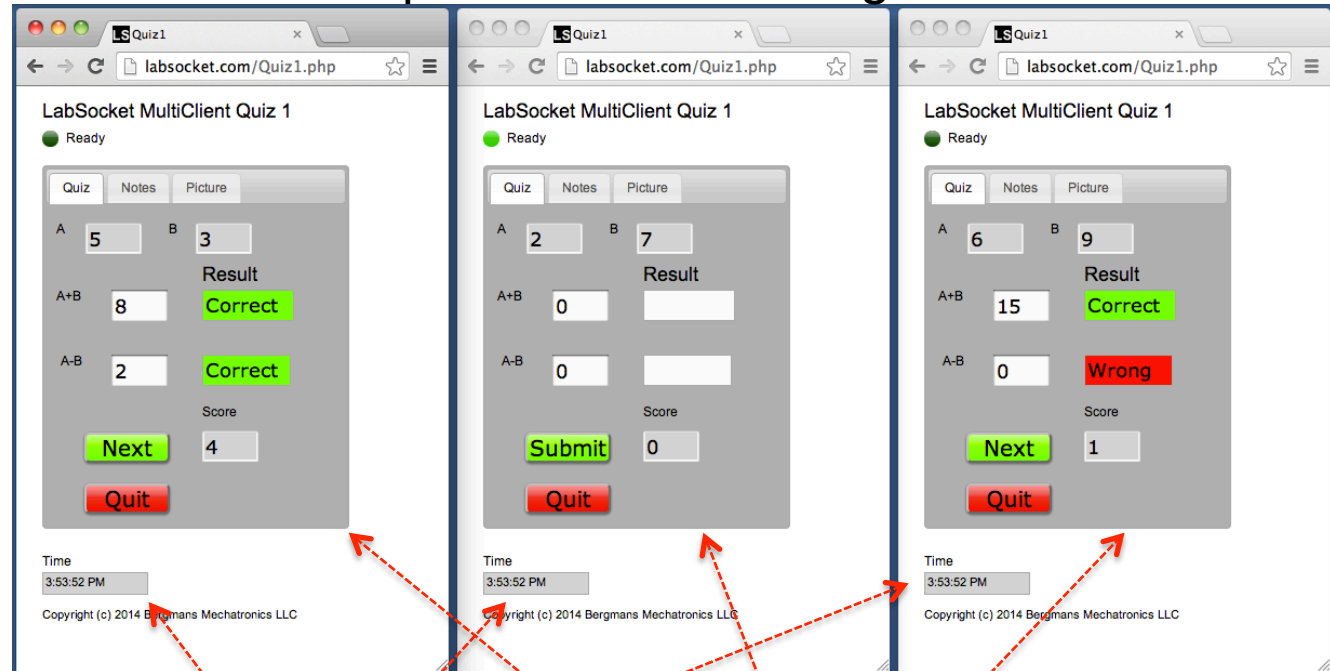
Simple Math Quiz



Target VI



Three browsers, each connected to unique instances of Target VI

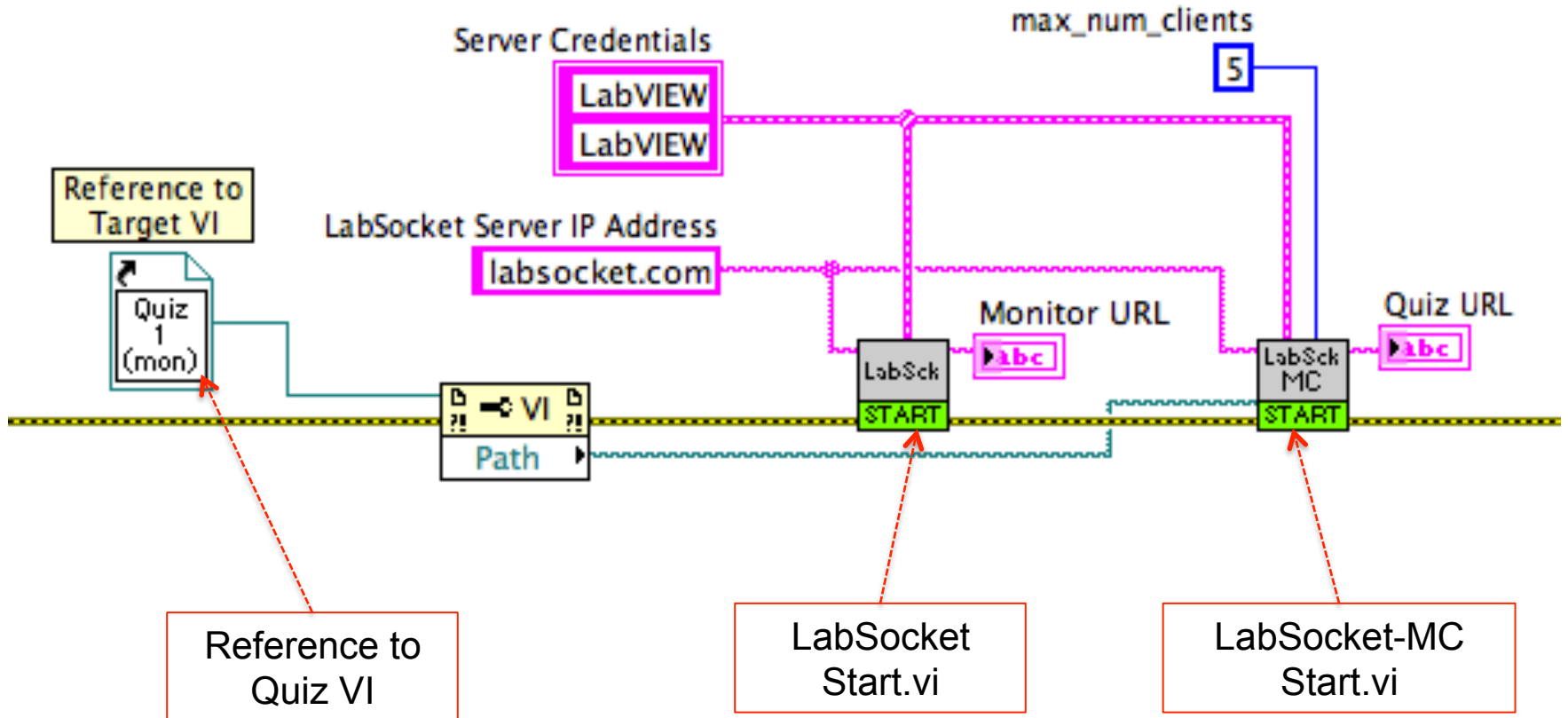


Same
Timestamp

Unique
Quiz States

Combining LabSocket-Basic and -MultiClient

Server VI Block Diagram



Combining LabSocket-Basic and -MultiClient Server VI Monitoring in the Browser



Three browsers, each connected to
unique instances of Target VI

Server VI in Browser

LabSocket MultiClient Quiz 1

Ready

Quiz Notes Picture

A 7 B 8

A+B 15 Result Correct

A-B -1 Correct

Score

Next 2

Quit

Time 12:11:50 PM Client ID 484

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Quiz Server

Instructions: Use this VI to test launch and operation of multiple instances of a Target VI. See block diagram for more information.

Monitor URL
http://labsocket.com/QuizServerwithMonitoring.php

Quiz URL
http://labsocket.com/Quiz1withMonitoring.php

STOP

Date and Time
3/26/14 12:11:50 PM

Log

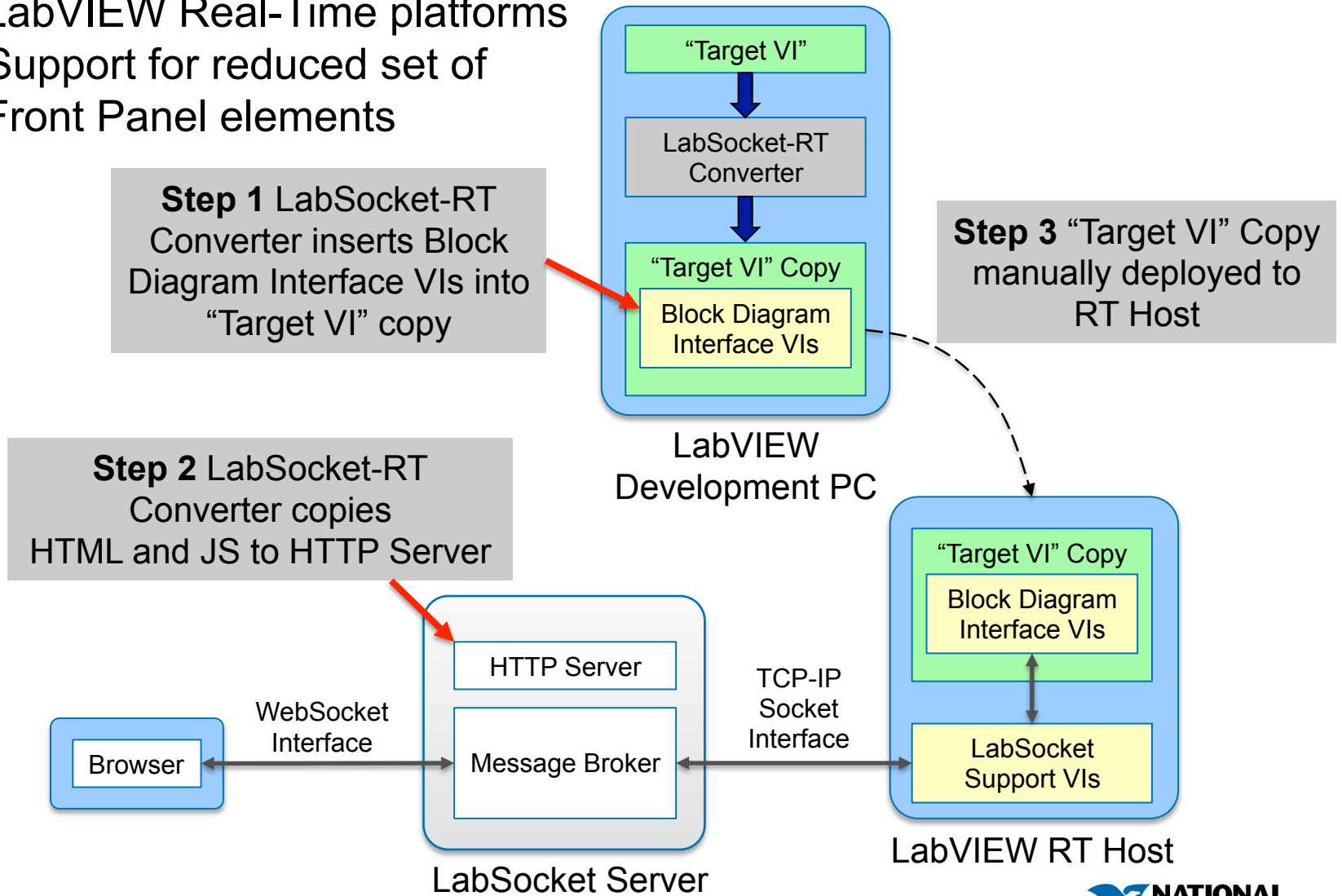
3/26/14 12:09:58 PM	Client ID 481: Connected
3/26/14 12:10:32 PM	Client ID 483: Connected
3/26/14 12:10:39 PM	Client ID 484: Connected
3/26/14 12:10:49 PM	Client ID 484: Current Score: 0
3/26/14 12:11:26 PM	Client ID 484: Current Score: 0
3/26/14 12:11:44 PM	Client ID 484: Current Score: 2

Update from browser "Client ID 484"
transmitted to Server VI via LabVIEW queue

LabSocket-RT

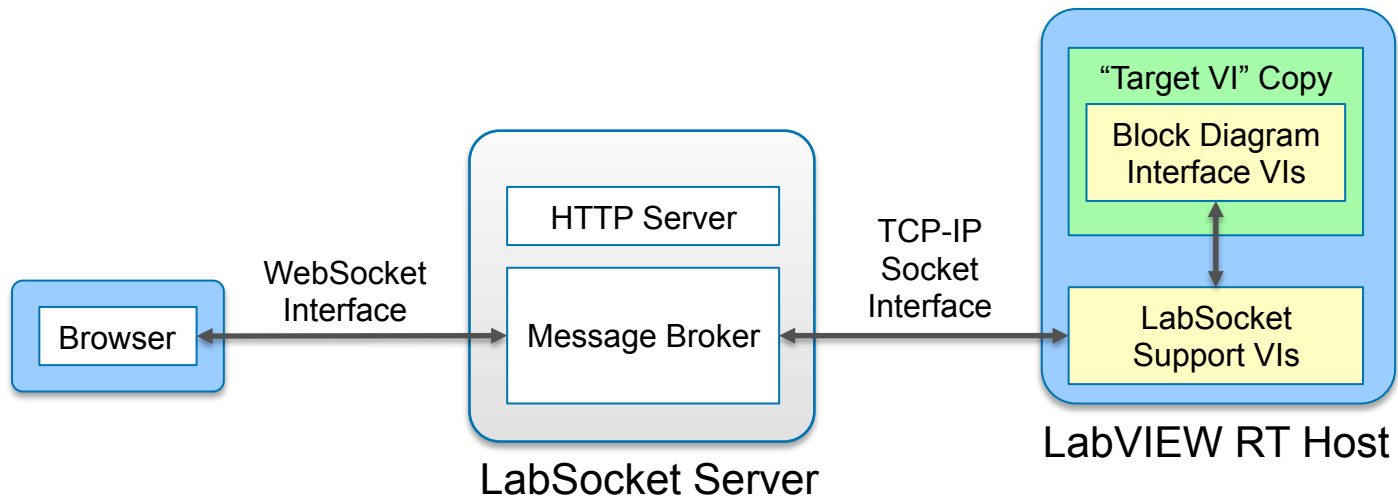


- Easy access to applications on LabVIEW Real-Time platforms
- Support for reduced set of Front Panel elements



LabSocket-RT

Steady State Operation

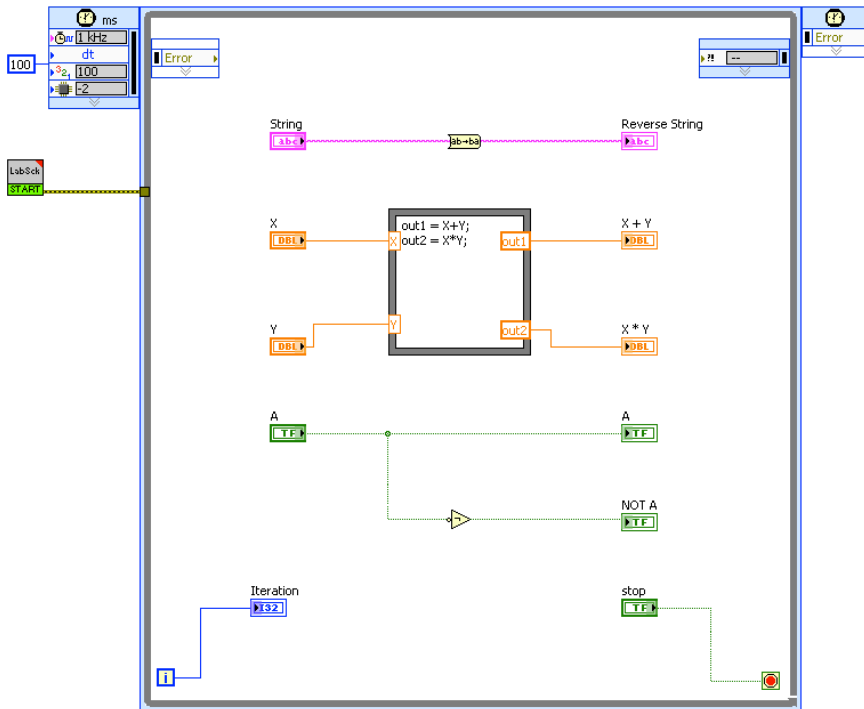


LabSocket-RT Converter

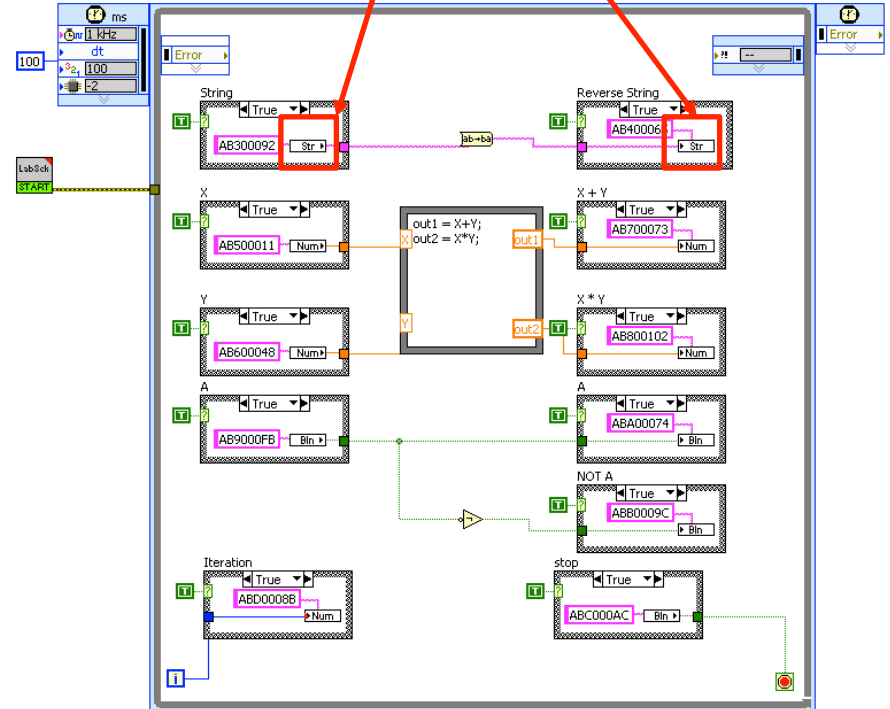
Automatically replaces front panel elements in block diagram with “Block Diagram Interface VIs”



Block Diagram Interface VIs

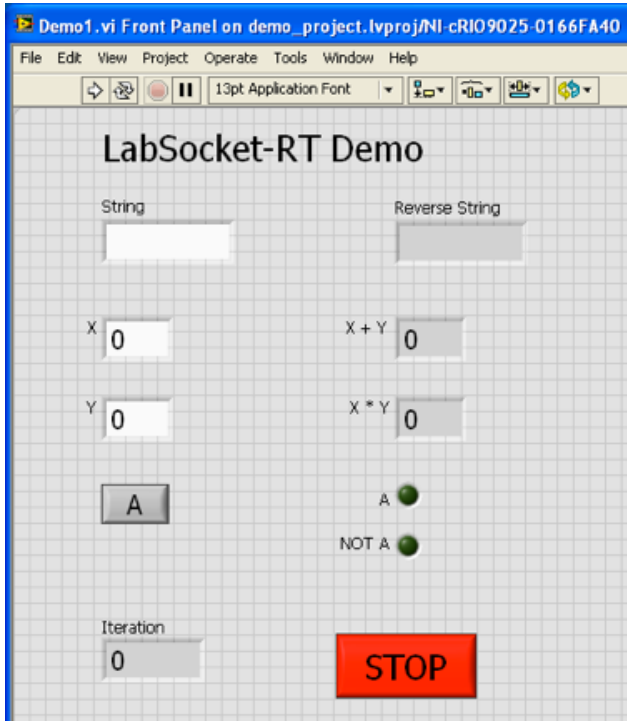


Demo1.vi

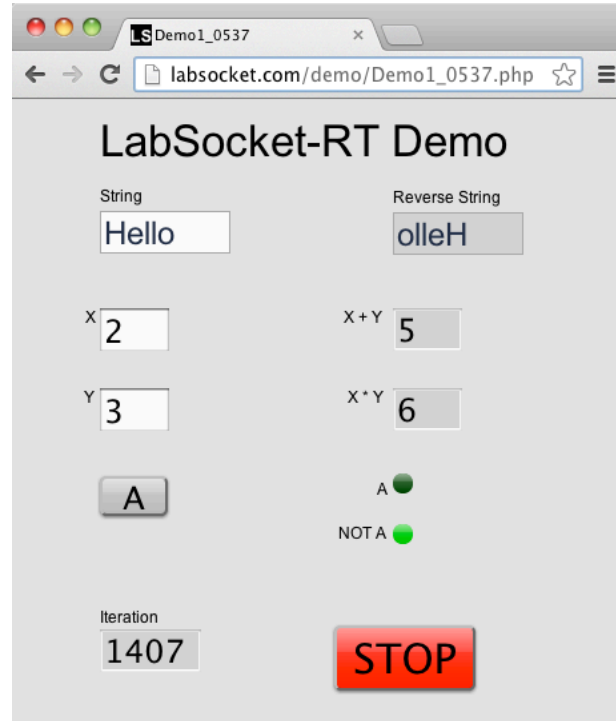


Demo1_RT.vi

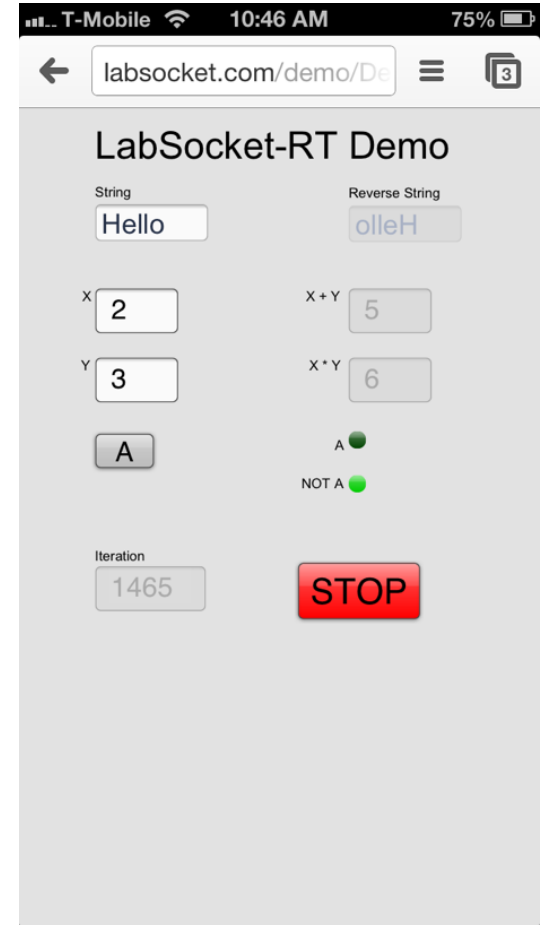
LabSocket-RT Screenshots



Demo1.vi Front Panel (Idle)



Chrome Browser on Mac

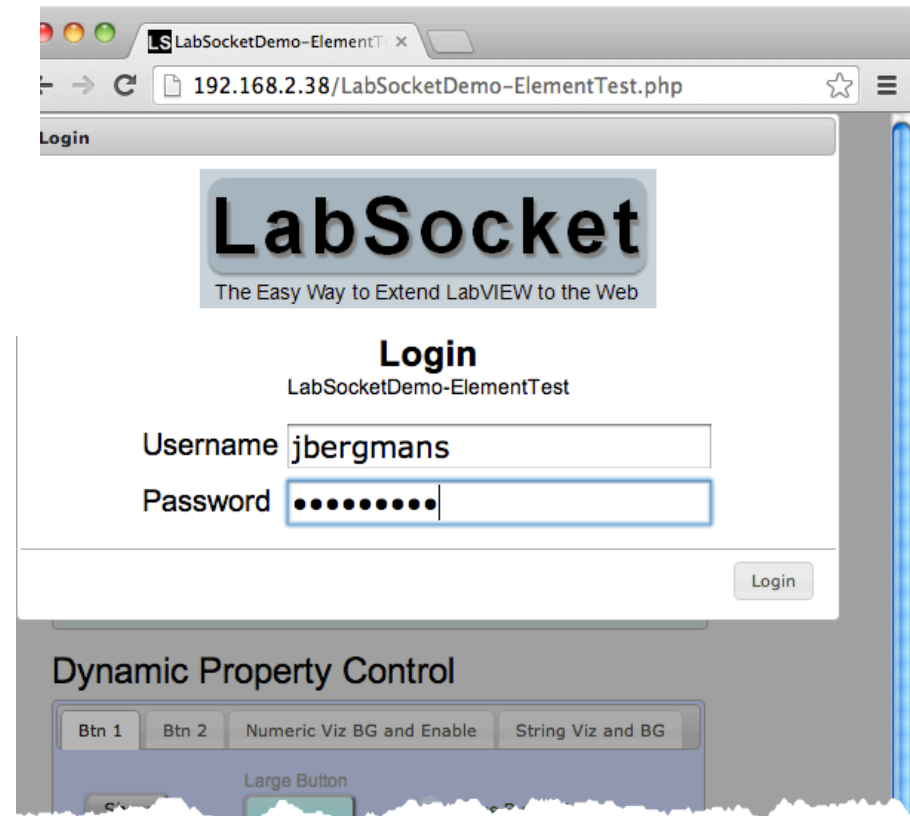
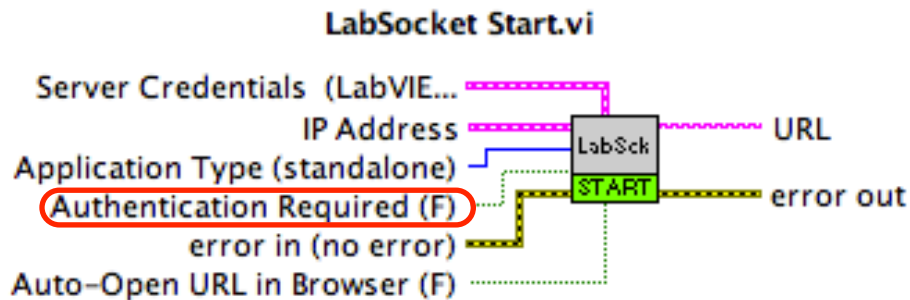


Chrome Browser on iPhone



User Authentication

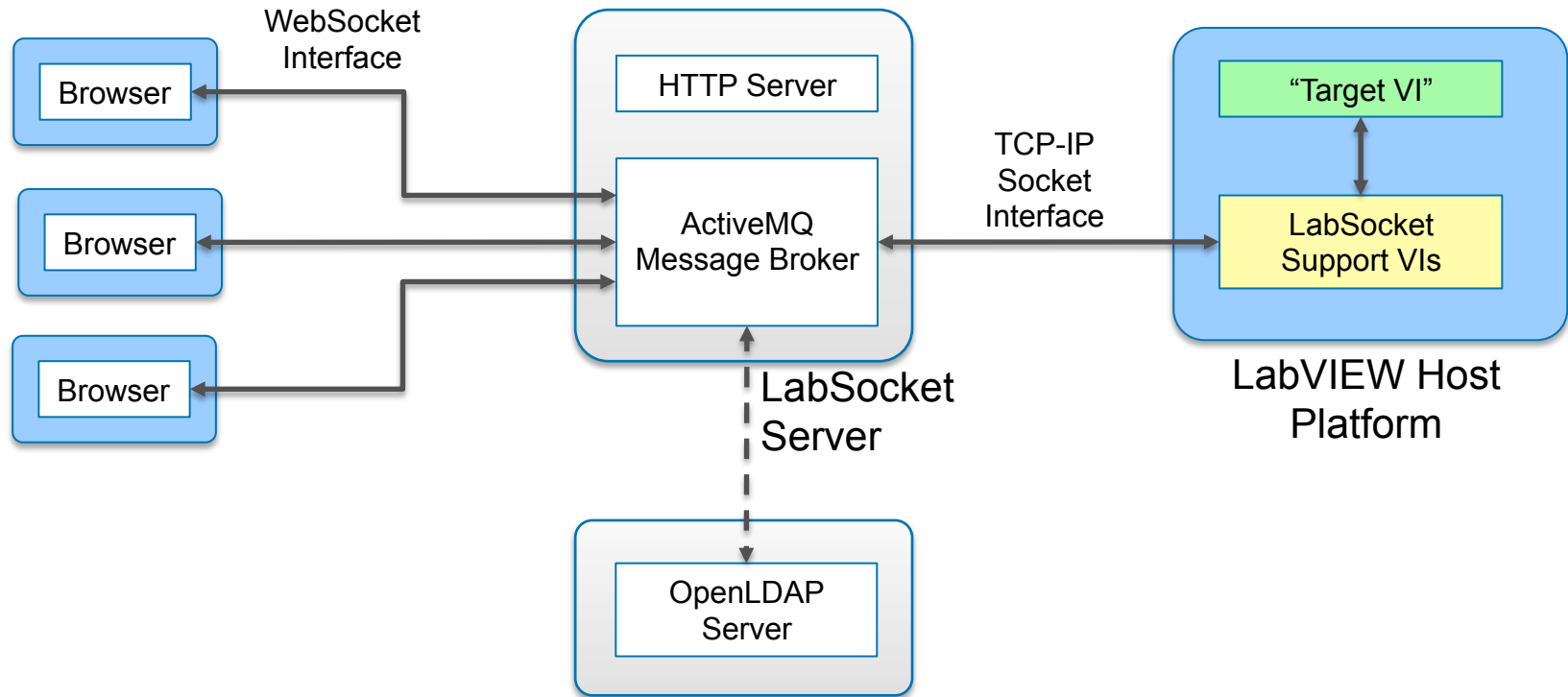
- *Authentication=T* enables user authentication
- WebSocket interface between browser and ActiveMQ only established if valid credentials supplied
- Credentials can be hard-coded into ActiveMQ configuration file or stored in LDAP server





LDAP User Authentication Integration

- LDAP (Lightweight Directory Access Protocol) enables on-the-fly LabSocket user management using industry-standard database system
- OpenLDAP server can be included in LabSocket Server VM or customers can configure ActiveMQ for use with own LDAP server



LDAP User Authentication Integration



- phpLDAPadmin permits browser-based LDAP server management
- Easy to add / remove users to / from list of authorized users

The screenshot shows the phpLDAPadmin web interface in a browser window. The address bar shows the URL: `192.168.2.37/phpldapadmin/cmd.php?cmd=template_engine&server_id=1&dn=uid%3Djbergmans%2Cou%3DUser%2Cou%3DActiveM...`. The page title is "phpLDAPadmin (1.2.2) - ui".

The main content area is titled "uid=jbergmans". Below the title, it shows the server information: "Server: LabSocket LDAP Server", "Distinguished Name: uid=jbergmans,ou=User,ou=ActiveMQ,dc=labsocketserver,dc=com", and "Template: Default".

On the left side, there is a tree view of the LDAP directory structure. The tree shows the following hierarchy:

- dc=labsocketserver,dc=com (2)
 - ou=ActiveMQ (3)
 - ou=Destination (3)
 - ou=Group (2)
 - ou=User (5)
 - uid=admin
 - uid=jbergmans
 - uid=jdoe
 - uid=LabSocketPHP
 - uid=LabVIEWTarget
 - ★ Create new entry here
 - ★ Create new entry here
 - ou=Services (1)
 - ★ Create new entry here

On the right side, there are several actions and hints:

- Refresh
- Switch Template
- Copy or move this entry
- Rename
- ★ Create a child entry
- Hint: To delete an attribute, empty the text field and click save.
- Hint: To view the schema for an attribute, click the attribute name.
- An attribute (Password) was modified and is highlighted below.

Below the hints, there are two input fields:

- cn** (required): (add value)
- objectClass** (required):



Closing Notes

- LabSocket-Basic now available on LabVIEW Tools Network
- LabSocket-MultiClient and -RT available now from BML, coming soon to LVTN
- LabVIEW / LabSocket-MultiClient is a dynamic web authoring system
- LabSocket framework customizable for other use-cases
- Other configurations feasible – eg. “LabSocket-MultiTarget”
- What other applications can be enabled by WebSockets and ubiquitous mobile/desktop browsers?

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