# DEVELOPING INSTRUMENT DRIVERS with LabVIEW

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#### **Overview**

- I. Why use Instrument Drivers?
- II. Finding LabVIEW Instrument Drivers
- III. Instrument Interfaces
- IV. Instrument Driver Architecture
- v. NI Instrument Driver Guidelines
- VI. Calling Shared Libraries
- VII. Example:
  - I. Tektronix AFG 3252
  - II. Tektronix DPO7104



#### I. Why use Instrument Drivers?

- Simplify Development
- Automate Testing
- Abstract Developer from Device Syntax
- Code Reuse
  - write once, use many times



#### **Simplify Development with Instrument Drivers**



#### **II. Finding Instrument Drivers**

- Manufacturer's website
  - Not all provide drivers
  - Some offer only API (e.g. DLLs)
- NI Instrument Driver Network
  - Learn about drivers
  - Get help with developing drivers
  - Submit your driver to the network
- Request Instrument Driver



#### **NI Instrument Driver Network**

• Via web browser <u>www.ni.com/idnet</u>

				및 C Improve your ni.com ex	art   Help Se	earch n or Create a	a user profile.
MyNI Contact NI	Products & Services	Solutions	Support	NI Developer Zone	Academic	Events	Company
NI Developer Zone	I Instrument Driv	ver Network	(			Unit	ted States
	d Submit a Driver	»   📥 Reque	est a Driver	»   🔎 Browse Drivers	»		
Narrow Results By	Instrument	Driver N	etwork				
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#### • Find drivers from within LabVIEW

🔁 Getting St	arted		
<u>File O</u> perate	Tools Help		
SCIENCIES NAT	Measurement & Automation Explorer		
1 €	Instrumentation	•	Find Instrument Drivers
	MathScript Window		<u>C</u> reate Instrument Driver Project Advanced Development ►
Files	<u>M</u> erge VIs… Security		Visit Instrument Driver Network



#### **Search by Manufacturer**





#### **Select Drivers to Install**

Driver	Driver Technoloav	NI Certified	Rating	3.9 ★★★★★ 39 ratings	^
🙀 ag3000 Instrument Driver	PnP	Yes	5.00	-	
Reprint For LabVIEW 7.0				Driver ADE(s):	
Carl Driver for LabVIEW 8.0				- LabVIEW	
ag33xxx Instrument Driver	PnP	Yes	3.87	Min Version - 7.0	
Driver for LabVIEW 7.0				Dequired Current Coffman	
Driver for LabVIEW 8.0				NT_VISA	
ag33xxx Instrument Driver	PnP Proj	Yes	4.08	Min Version - 3.0	
C 🚓 Driver for LabVIEW 8.0					
🙀 ag34405a Instrument Driver	PnP	Yes	NR	Driver Revision:	
Reprint Strate Contract Contra				1.5.1	
Context For LabVIEW 7.1					
g ag3458 Instrument Driver	PnP Proj	Yes	NR	Manufacturer:	
🗌 🎧 Driver for LabVIEW 8.0				Aglient Technologies	
🙀 ag4339b Instrument Driver	PnP	Yes	NR	nemett Pathara	
Real Driver for LabVIEW 8.0					
Content of CabVIEW 7.0				Model(s) Supported:	
🙀 ag5313xa Instrument Driver	PnP Proj	Yes	NR	33120A	
C 🚓 Driver for LabVIEW 8.0				33220A	
g ag546xx Instrument Driver	PnP	Yes	3.87	33250A	
Real Driver for LabVIEW 8.0				Interface(s):	
Contraction Contra				IEEE 488.2 (GPIB)	~
g ag546xx Instrument Driver	PnP Proj	Yes	3.67	V K 1	
na na sa ta					_



### **Install Drivers**

🔁 Inst	trument Driver Installation	$\mathbf{X}$
Insta C:\Pr Serie	llation successful. The driver is located in the directory listed below. ogram Files\National Instruments\LabVIEW 8.5\instr.lib\Agilent 33XXX s	
	Close	



#### **Use Installed Drivers**

🔛 Untitled 2 Block Diagram	
<u>File E</u> dit <u>V</u> iew Project <u>O</u> perate <u>T</u> ools <u>W</u> indow <u>H</u> elp	
🖒 🐼 🔘 💵 😵 🖳 🏎 🖻 🔐 13pt Application Fe	ont 🚽
Functions      Search    Orm    View      Programming    Measurement I/O      Measurement I/O    Instrument Drivers      AG 33XXX FGen      Instrument Drivers    Instrument Drivers      AG 33XXX FGen    Instrument Drivers      Instrument Drivers    Instrument Drivers      AG 33XXX FGen    Instrument Drivers      Instrument Drivers    Instrument Drivers    Instrument Drivers      Instrument Drivers    Instrument Drivers    Instrument Drivers      Instrument Drivers    Instrument Drivers    Instrument Drivers      Instrument Drivers    Instrument Drivers    Instrument Drivers      Instrument Drivers    Instrument Drivers    Instrument Drivers      Instrument Drivers    Instrument Drivers    Instrument Drivers      Instrument Drivers    Instrument Drivers    Instrument Drivers      Instrument Drivers    Instrument Drivers    Instrument Drivers      Instrument Drivers	
Configure Action/Status Utility	



# **III. INSTRUMENT INTERFACES**



#### **Hardware Instrument Interfaces**

- Serial (e.g. RS232)
- GPIB IEEE 488
- USB 1.1/2.0
- FireWire IEEE 1394
- Ethernet (e.g. IEEE 802.3)
- Internal Computer Buses
  - ISA/PCI/PCIe/PXI/PXIe
- Industrial Networks
  - DeviceNET, PROFIBUS, etc.















## **Software Instrument Interfaces**



#### **Programming With SCPI**

- Standard Commands for Programmable Instruments
- Set of required commands (\*IDN?, \*RST, \*TST?, ...)
- Hierarchical command structure
- Example: "set:vert\_div:0.001"



#### **Virtual Instrument Software Architecture**

- Platform and Interface independent
- Is the backbone of the IVI
- SCPI command set used









## Instrument I/O Assistant – (demo)

- Interactive window uses VISA to help user communicate with SCPI commands
- Automatic and Manual parsing of received output
- Build I/O Steps, Test, and Verify
- Instr. I/O Assistant generates LabVIEW code.





#### **Interchangeable Virtual Instrument (IVI)**



Courtesy of Interchangeable Virtual Instruments Foundation, Inc.



#### **IV. Instrument Architecture**





#### **Instrument Driver VIs**







Data























#### **Instrument Driver Inputs & Outputs**



- Instrument Descriptor
- VISA Sessions
  - A connection or link to a specific instrument
  - Created after instrument is initialized
  - Used throughout VI whenever you communicate with that specific instrument
- Error cluster



## **Putting It All Together**



- Initialize instrument
- Perform operation(s)
- Close instrument
- Check error status



## **Controlling Multiple Instruments**

- Similar to controlling one instrument
- Get details and make a flowchart
- Keep VISA sessions separate
- Use error clusters to define execution order



#### **V. Driver Guidelines**

- 1. Familiarize yourself with instrument
- 2. Driver Architecture and API Design
- 3. VIs: Names and Properties
- 4. Control/Indicators
- 5. VI Front Panels
- 6. Icon and Connector Panes



#### **Driver Guidelines** (continued)

- 7. Block Diagrams
- 8. Testing
- 9. Documentation
- 10. Example VIs
- 11. Palette Menu Files
- 12. Files and Documents to be Submitted



#### **VI. Shared Library Overview**

- A shared library is a software module containing executable code and data that can be call by applications or other shared libraries
- Functions and data in a shared library are loaded and linked at run time
- Shared libraries can be written in a variety of languages



# Shared Library Overview (continued)

- Shared libraries expose functions and data through a standardized interface
- Most types of shared library definition are similar to function definitions in the C programming language
- Shared libraries are often called by different names depending upon the platform where they are used
  - Windows = DLLs
  - MacOS = Frameworks
  - Unix = Shared Libraries



## **Calling Shared Libraries**

- Two methods for calling a Shared Library from LabVIEW
  - Configure functions manually using the Call Library Function node
  - Allow LabVIEW to generate code by using the Import Shared Library wizard



## **Call Library Function Node**

n **fil** an

Library nan	ne or path	Thread
		Run in UI thread
		Reentrant
funcName	3	Calling convention
funcName	3	Calling convention Stdcall (WINAPI) C
funcName	3	Calling convention Stdcall (WINAPI) C
Function protot	type	Calling convention Stdcall (WINAPI) C



### **Shared Libraries Summary**

- Call Library Function node to offer easy access to your shared libraries.
- To call a function in a shared library, you need to know the following:
  - The data type returned by the function
  - The calling convention used
  - The parameters to be sent to the function, their types and the order in which they must be passed
  - The location of the library on your computer
  - Whether the function can be called safely by multiple threads simultaneously
- The Shared Library Import Wizard allows you to automatically generate shared library calls if you have a header file for the library



#### VII. Sample Drivers – (demo)

#### • Tektronix AFG 3252

 Dual Channel Arbitrary/Function Generator



- Tektronix DPO7104
  - Digital Phosphor Oscilloscope





#### References

- National Instruments Instrument Driver network <u>http://www.ni.com/idnet</u>
- NI LabVIEW Instrument Driver Guidelines
  http://www.ni.com/devzone/idnet/library/instrument\_driver\_guidelines.htm
- LabVIEW Instrument Guidelines and Information: LabVIEW -> Tools -> Instrumentation
- LabVIEW 8 Help > Controlling Instruments Available within LabVIEW and online at <u>http://zone.ni.com/reference/en-XX/help/371361D-01/</u>
- ALE System Integration website: <u>http://www.aleconsultants.com</u>
- Interchangeable Virtual Instruments Foundation, Inc.
  Your Guide to Getting Started with IVI Drivers <u>http://www.ivifoundation.org/downloads/IVI\_GSG\_v\_1.0.pdf</u>



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