LabVIEW
ISOTDAQ 2019

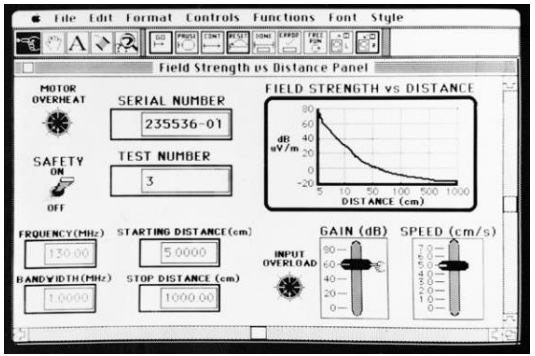
Gary Boorman
5th – April – 2019

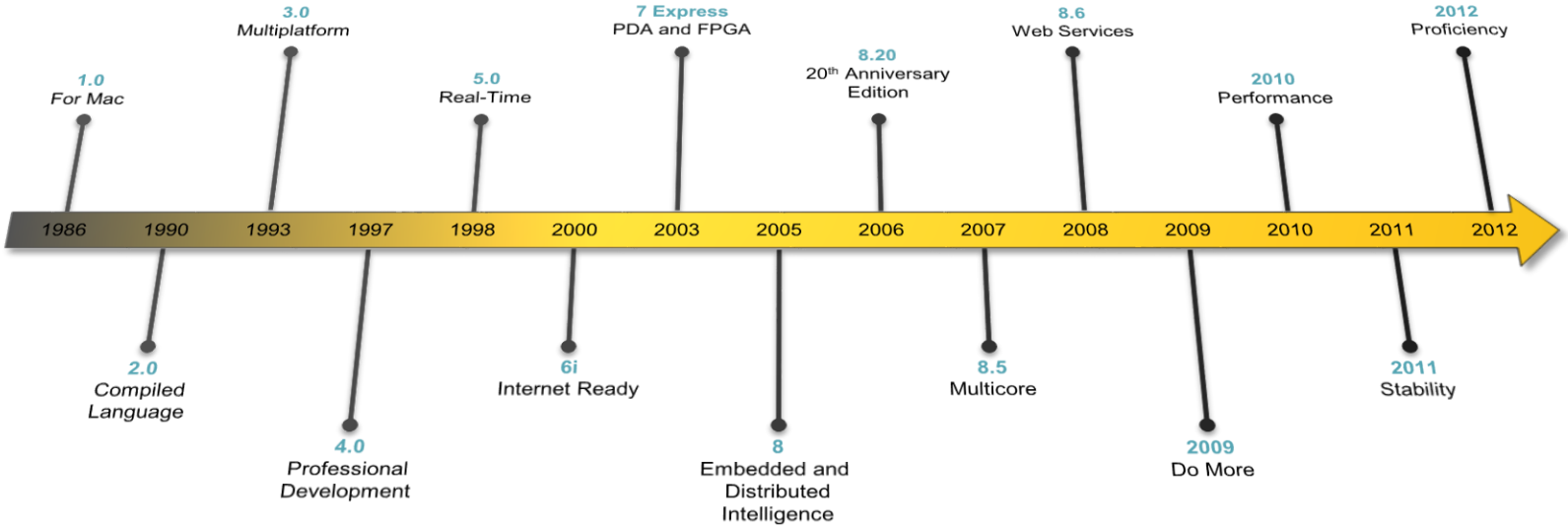
Agenda

- LabVIEW – a History
- LabVIEW for Instrumentation and Data Acquisition
- LabVIEW Development and Features
- LabVIEW at CERN
- LabVIEW – the Future

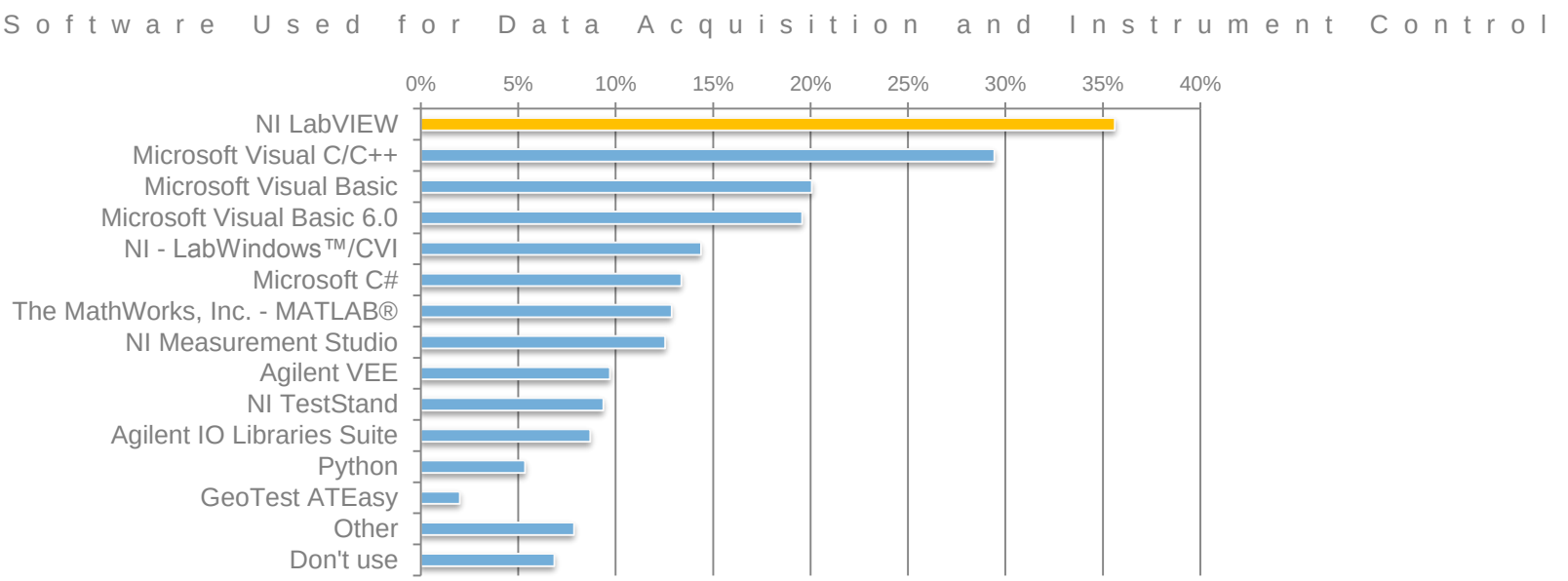
Background

National Instruments





Background


Software Used for Data Acquisition and Instrument Control
0%
5%
10%
15%
20%
25%
30%
35%
40%
NI LabVIEW
Microsoft Visual C/C++
Microsoft Visual Basic
Microsoft Visual Basic 6.0
NI - LabWindows™/CVI
Microsoft C#
The MathWorks, Inc. - MATLAB®
NI Measurement Studio
Agilent VEE
NI TestStand
Agilent IO Libraries Suite
Python
GeoTest ATEasy
Other
Don't use

「DAQ & Instrumentation」

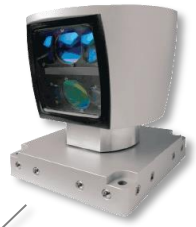
Bridging hardware and software

Measurement challenges

- Conflicting programming approaches
- Disparate drivers
- Timing, triggering, and synchronization
- Fixed soft/hardware
- Changing requirements
- …

temperature

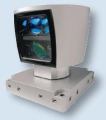
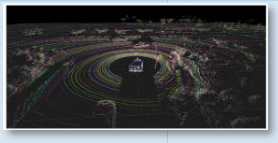
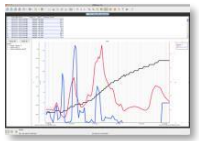
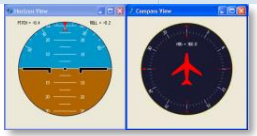
Heterogeneous systems



LiDAR

RGA

Measurement challenges

Sensor	Interface	Conditioning?	Software
		no	
		yes	
		yes	-
		no	

Heterogeneous systems


Test
Monitor
Embedded
Control
Cyber Physical
LabVIEW™
Desktops and PC-Based DAQ
PXI and Modular Instruments
NI CompactRIO
GPIB IEEE-488
ETHERNET
HI-SPEED CERTIFIED USB
Open Connectivity With Third-Party I/O

Modular Instruments

Compact DAQ

Compact RIO

PXI

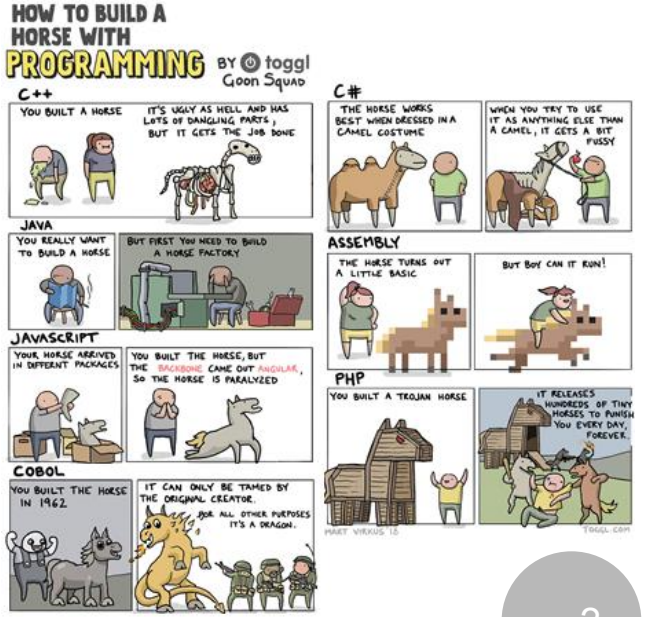
PXI/PXIe modules

chassis

「Integration」

Bridging hardware and software

Multilanguage integration



...?

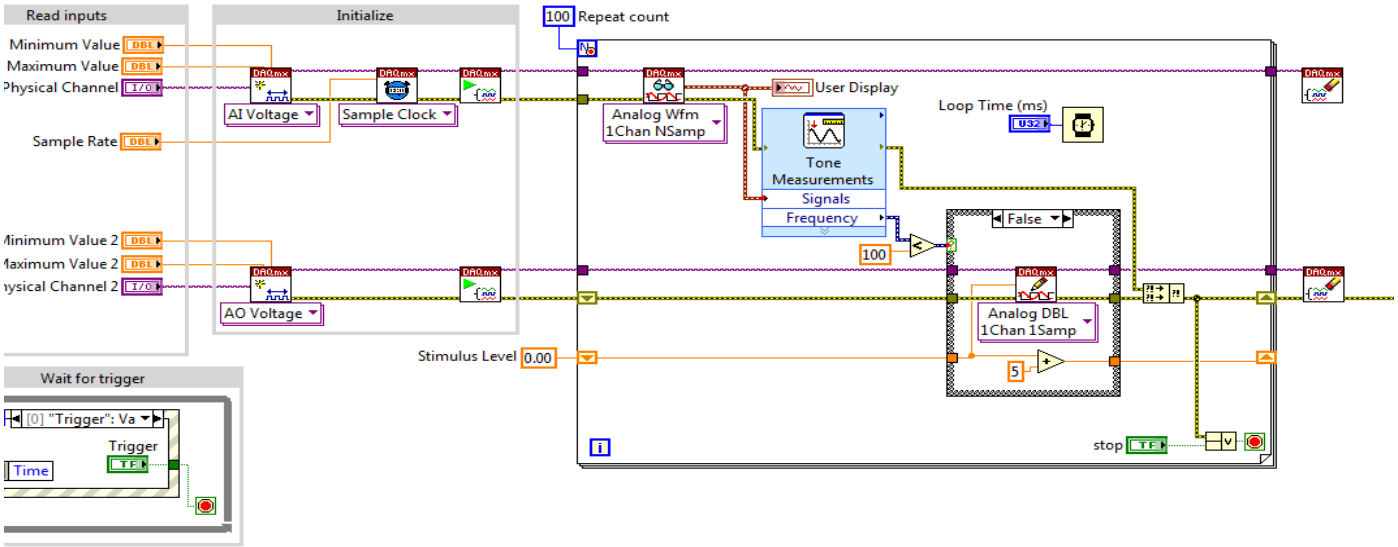
Introduction to LabVIEW

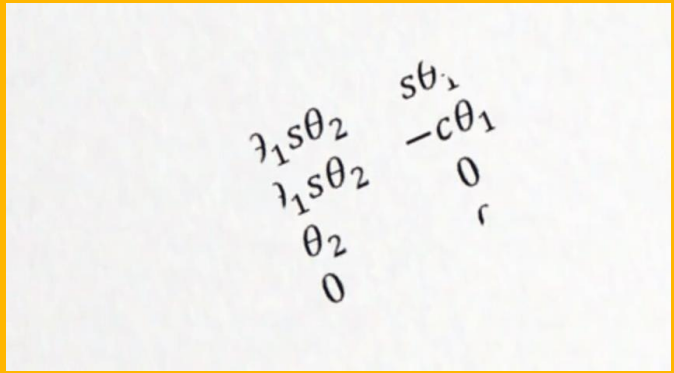
Virtual instrumentation

Laboratory
Virtual
Instrument
Engineering
Workbench

Application development

- Program as you think

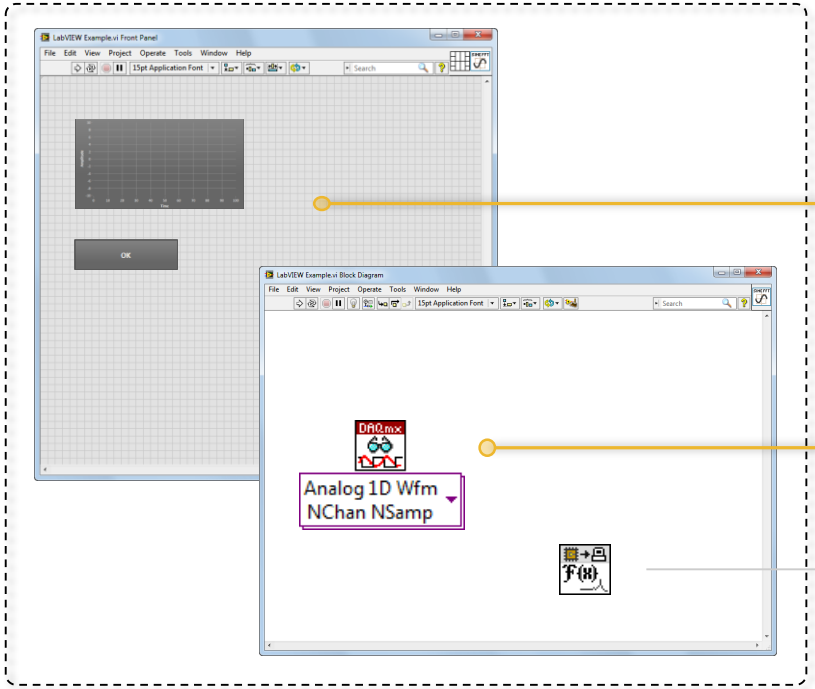




「Abstraction」

Expressing concepts and ideas without focus on syntax

Application development

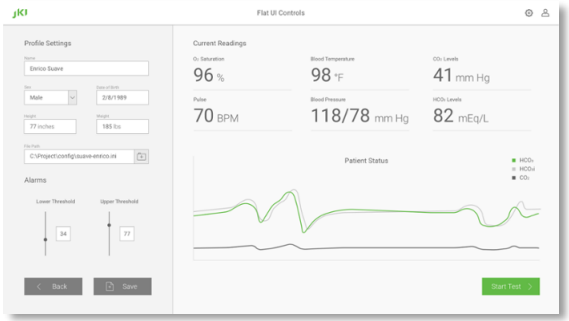


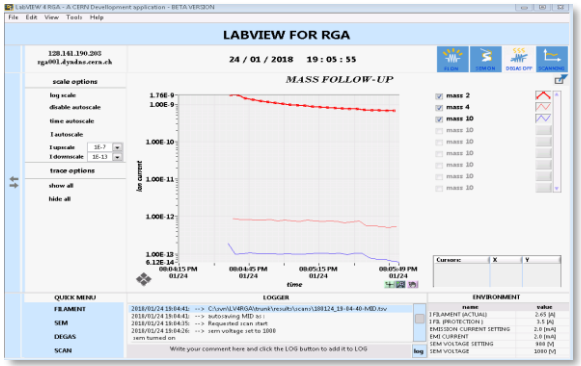
LabVIEW Front Panel
The user interface of a VI

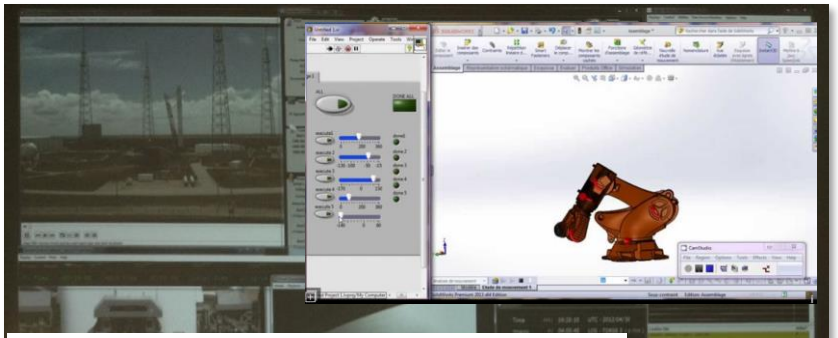
LabVIEW Block Diagram
The source code of a VI

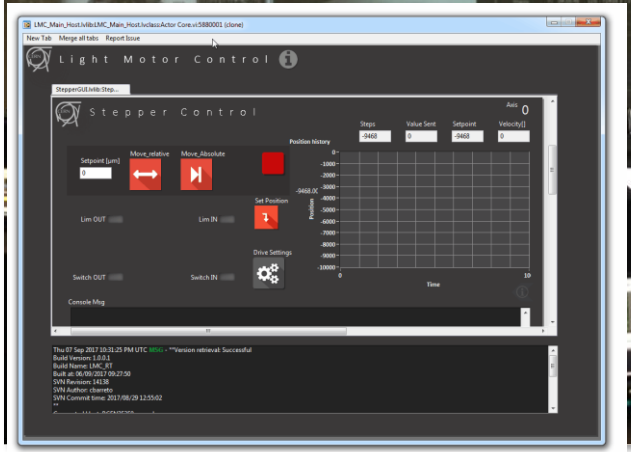
Functions:
Virtual
Instruments

Graphical interface





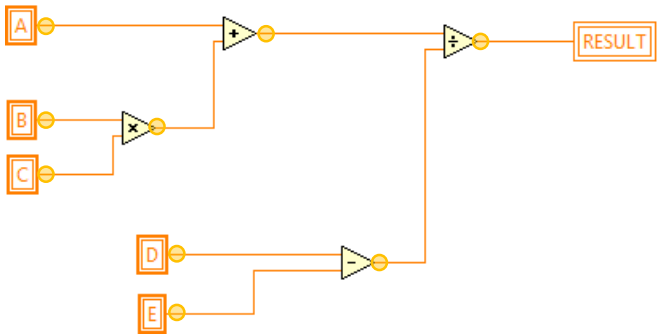




Dataflow

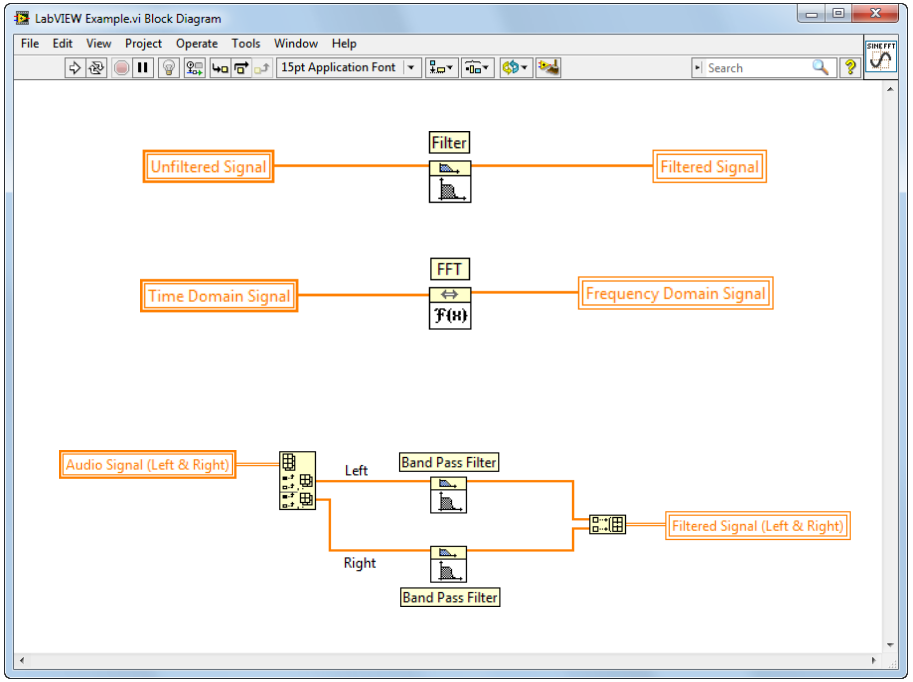
- Data driven execution

Intrinsic **Parallelism**



Dataflow

- Data driven execution



Intrinsic Parallelism

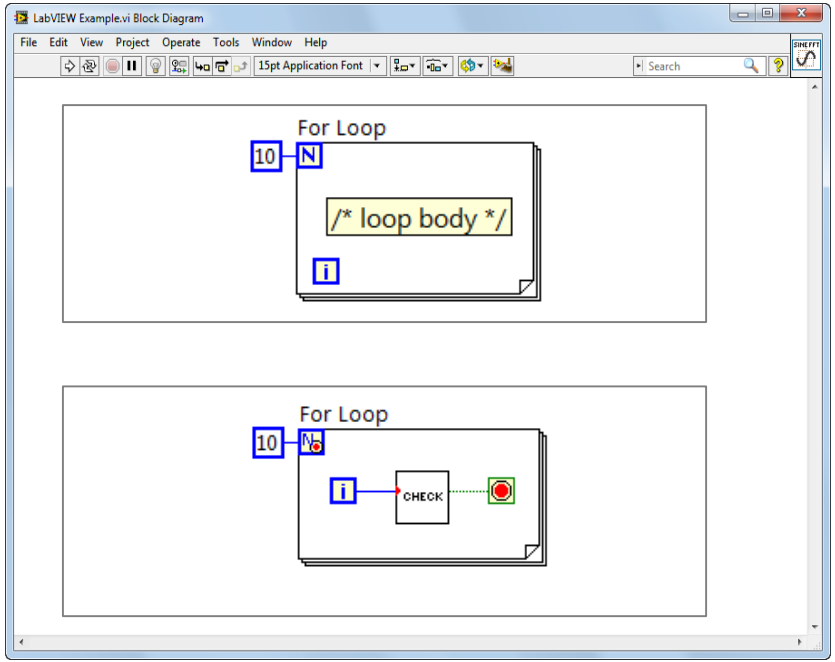
「Parallelism」

Intrinsic inclination

Comparison with text

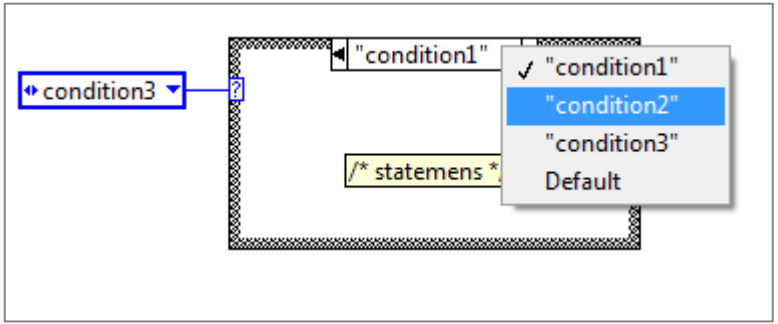
```
for (i = 0; i < 10; i++)
{
    /* loop body */
}
```

```
for (i = 0; i < 10; i++)
{
  if(check(i)) break;
}
```

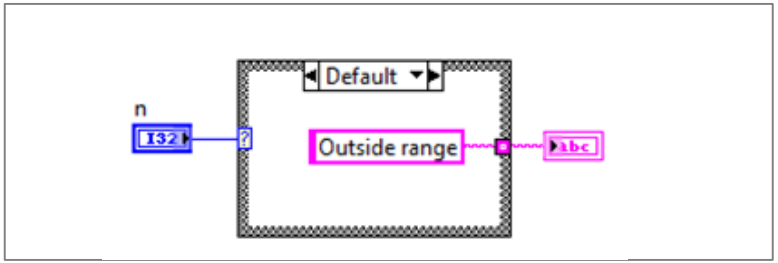


Comparison with text

```
if condition1 then
  -- statements;
elseif condition2 then
  -- more statements
elseif condition3 then
  -- more statements;
else
  -- other statements;
end if
```

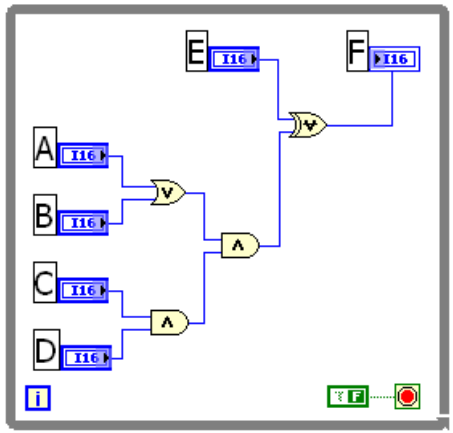


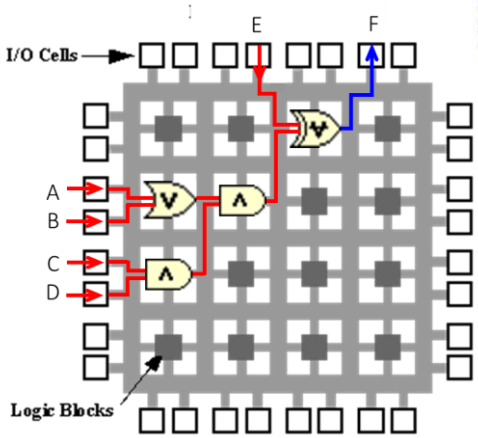

```
switch (n) {
  case 5:
    printf("Small number.");
    break;
  case 100:
    printf("Large number.");
    break;
default:
    printf("Outside range");
    break;
}
```



LabVIEW to the pin

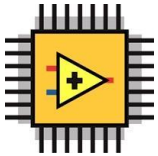
- LabVIEW FPGA

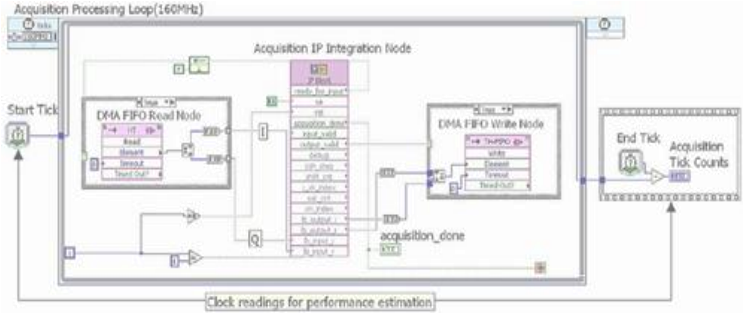




LabVIEW to the pin

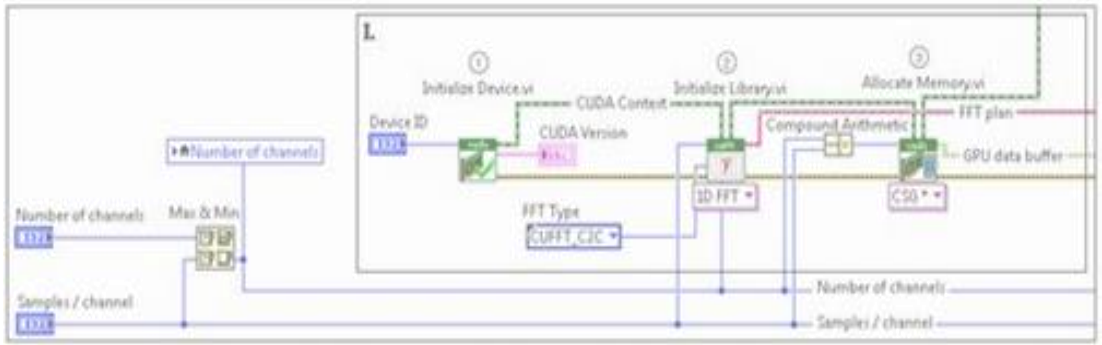
- Xilinx FPGA
  - IP integration
  - Vivado Export





- NVIDIA CUDA GPU

NVIDIA
CUDA



「LabVIEW at CERN」

LabVIEW at CERN

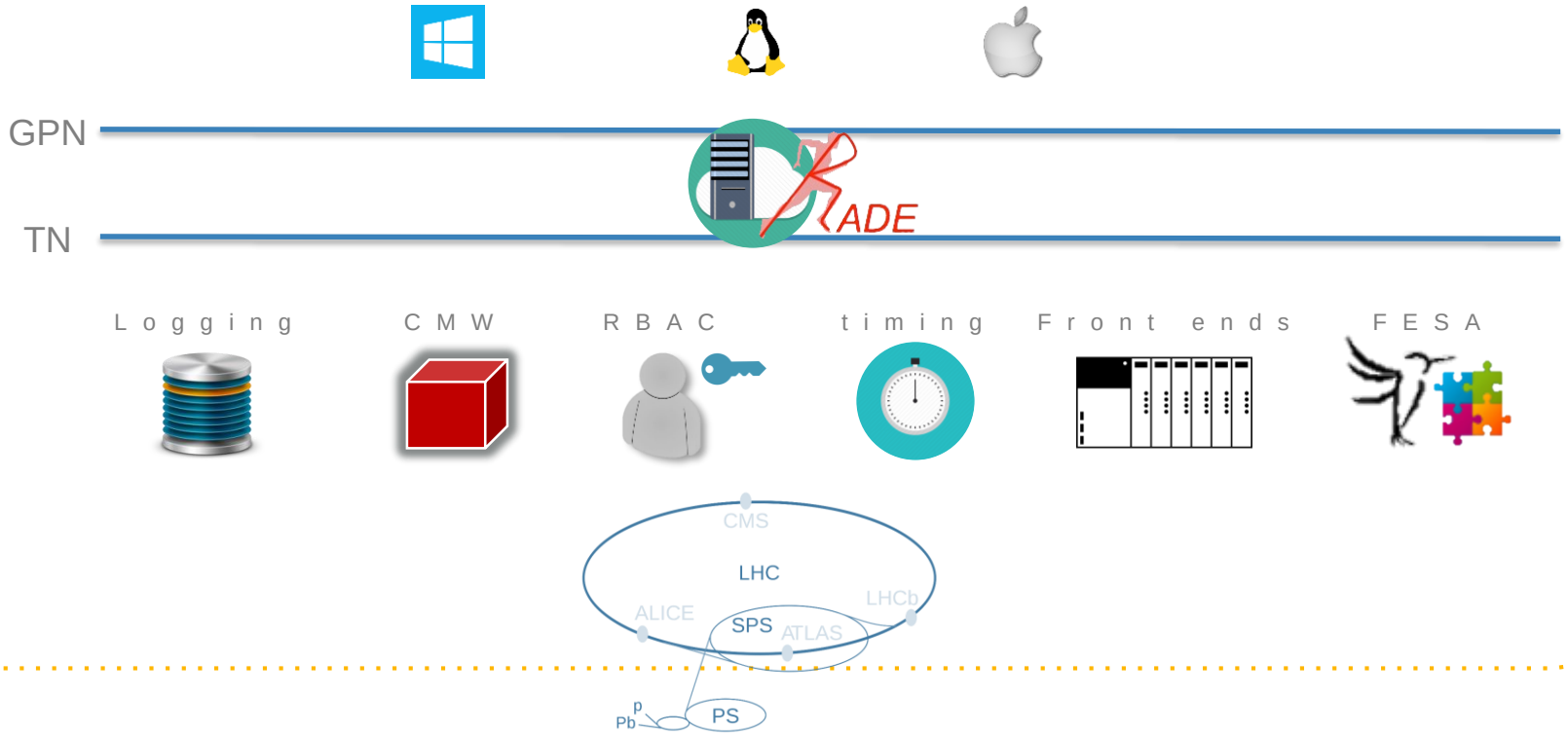
550 LabVIEW Users

30+ Project clients

CERN LabVIEW Support

LabVIEW™ Center of Excellence

The access challenge



Custom hardware

P X I

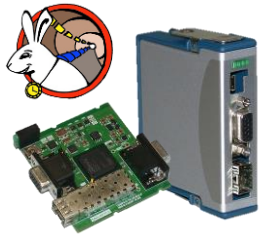
CTRP-PMC
(CERN)

PMC carrier
(Kontron)

Fine delay-FMC
(CERN)

FMC carrier
(INCAA)

c R I O



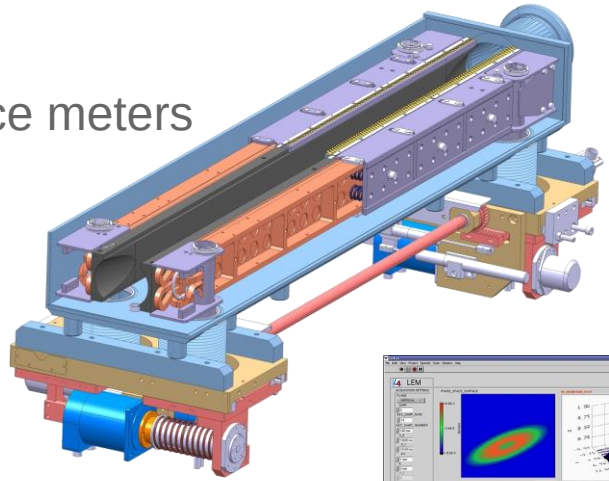
White rabbit timing

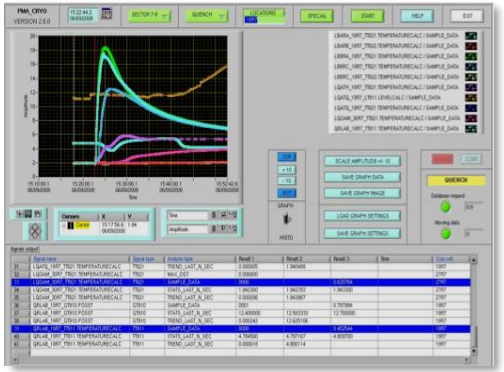
Low latency machine learning

(Cogito Instruments)

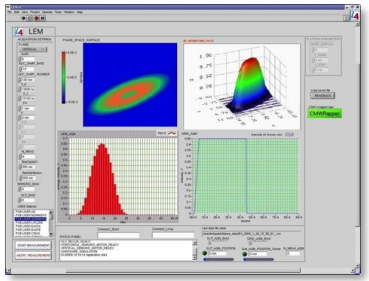
Example applications

- LHC collimators
- LINAC4 emittance meters
- Kicker Magnets
- AWAKE
- CLIC
- MedAustron
- …





Post-Mortem analysis

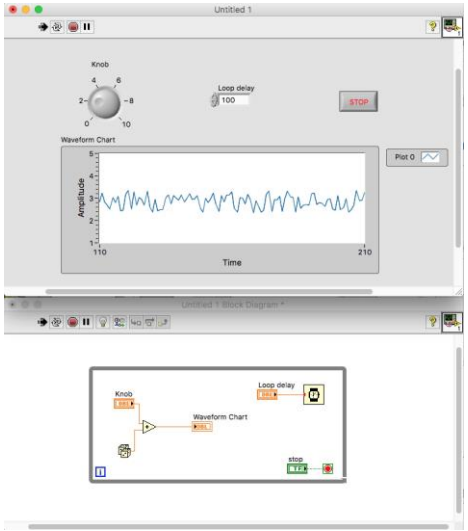


Linac4

「LabVIEW the Future」

LabVIEW NextGen

CurrentGen



NextGen (NXG)

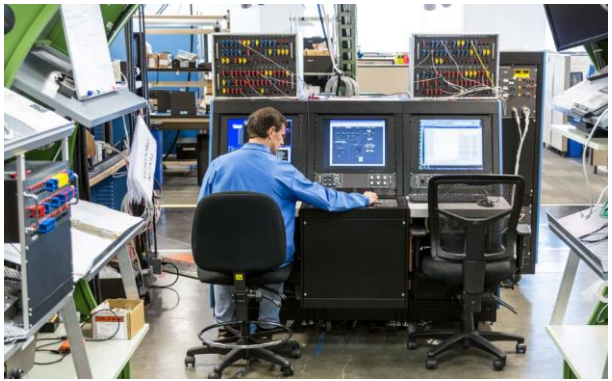
LabVIEW NXG Web Module

- Compile LabVIEW and run within web-page (Javascript)
- View compiled code on any device

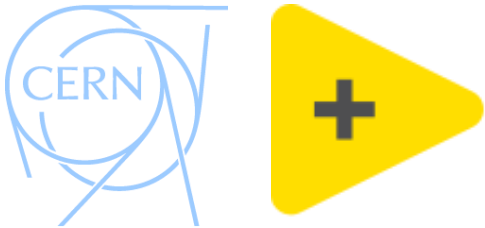
- Try *www.webvi.io*
- Create web UI in NXG, interface with LabVIEW CurrentGen application

Support for emerging technology

- Extensive HW and SW support of RF
  - Vector Signal Transceiver (VST) with accessible FPGA
  - 5G research and metrology
- Autonomous vehicles
- Industrial Internet of Things (IIoT)



Thank you



Contact me: gary.boorman@cern.ch

Credits

- National Instruments

- CERN EN-SMM group

「Spare Slides」

For that unforeseen moment …

Hello!

I'm Poppy

Modular Instruments

Compaq DAQ

PXI

PCI EXPRESS modules

chassis