



LabVIEW ISOTDAQ 2018

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15th - Feb - 2018



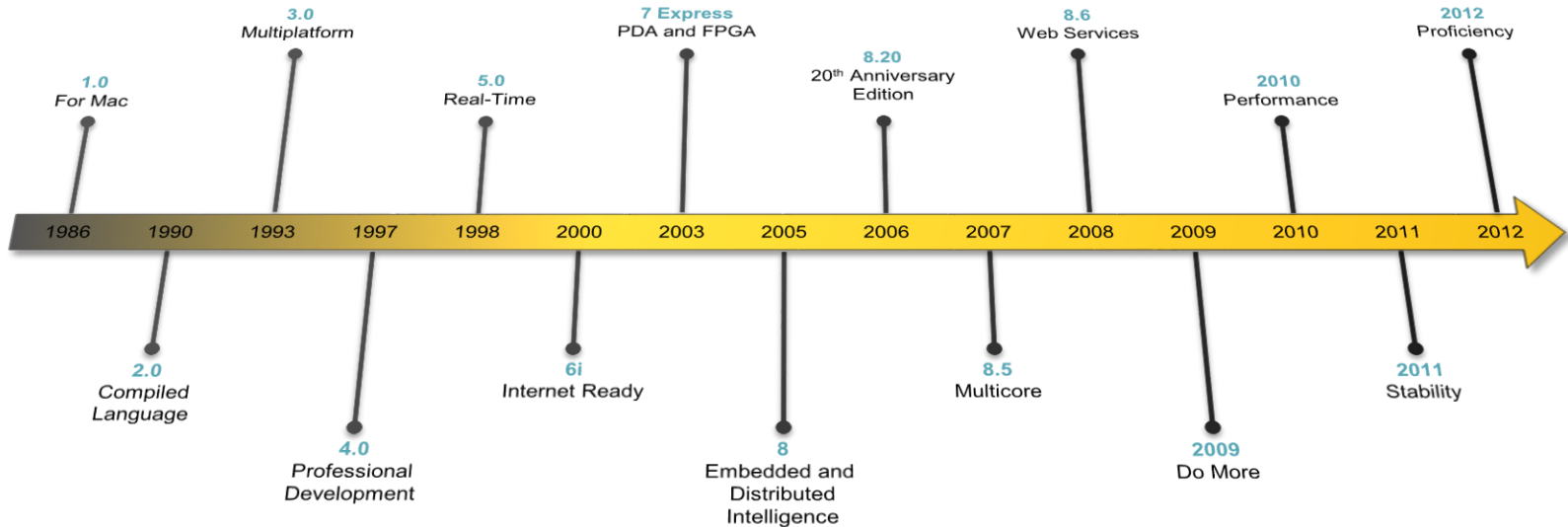
Summary

- National Instrument and LabVIEW
- LabVIEW in Instrumentation and DAQ
- Introduction to LabVIEW development
- LabVIEW at CERN



Background

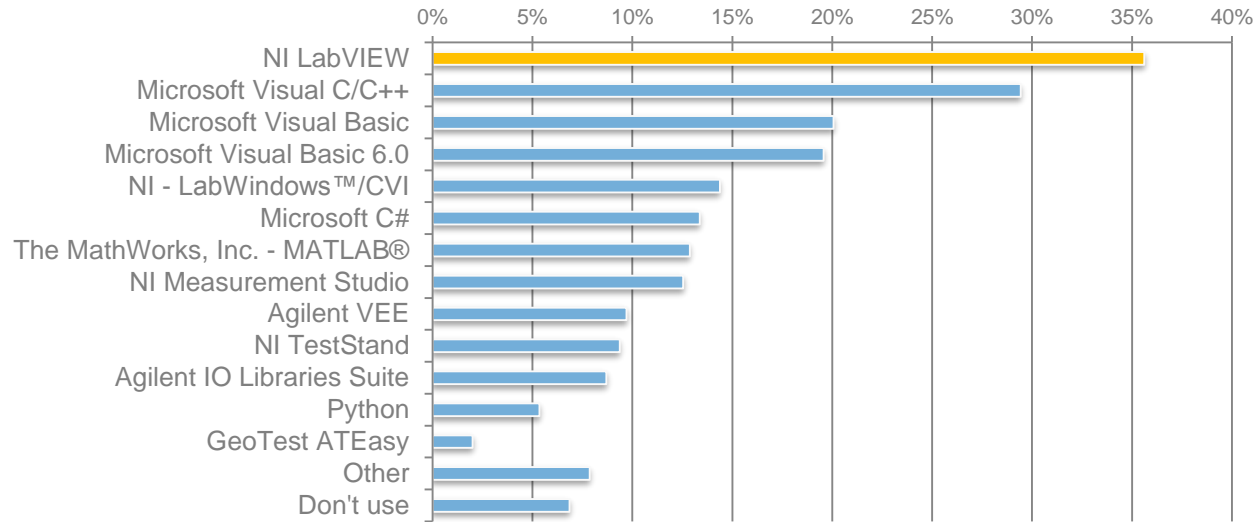
- National Instruments 





Background

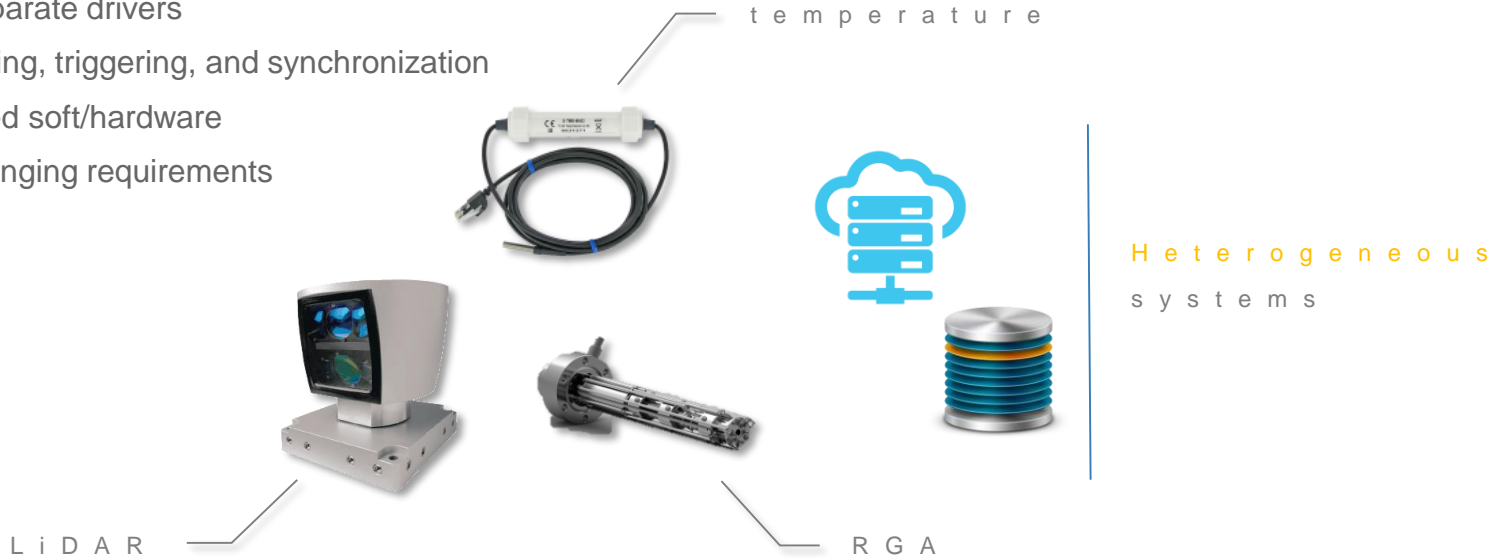
Software Used for Data Acquisition and Instrument Control





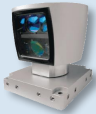

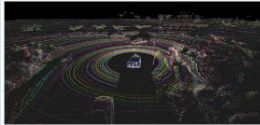


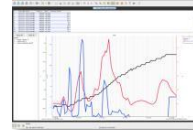





Measurement challenges

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





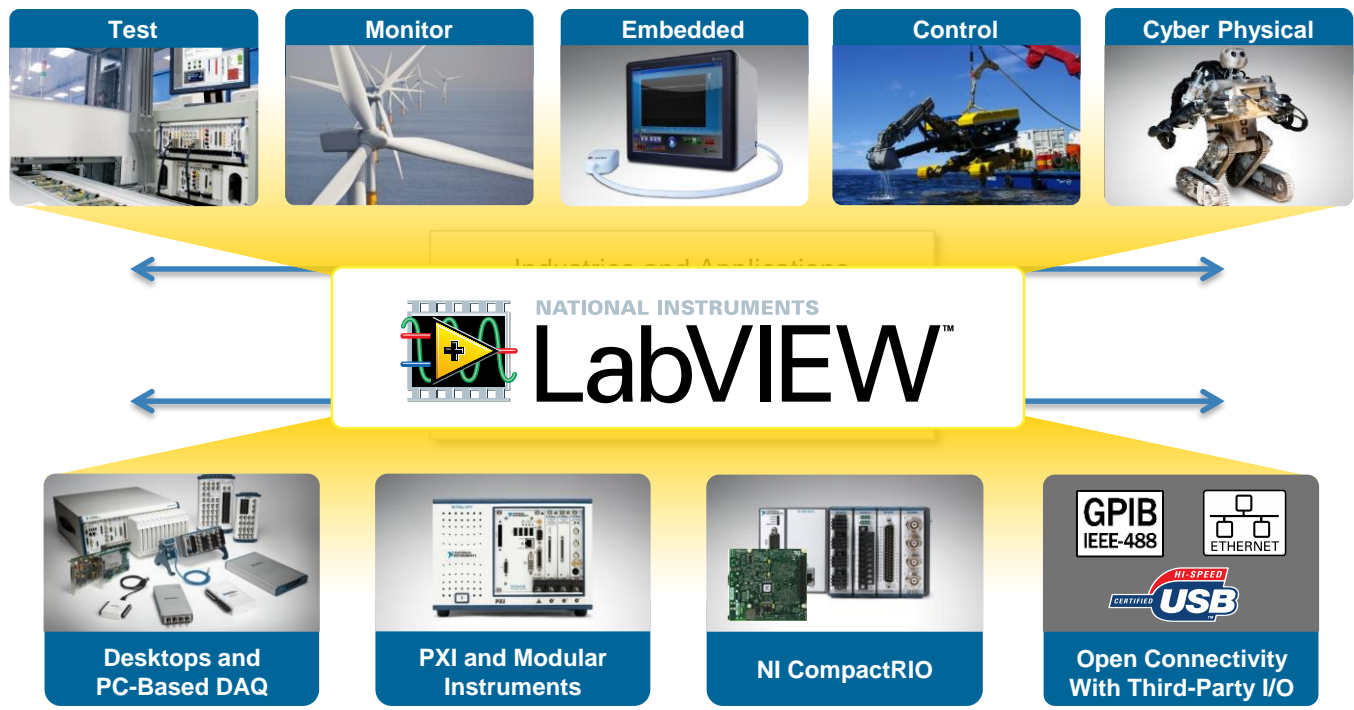
Measurement challenges

Sensor	Interface	Conditioning?	Software
		n o	
		y e s	
		y e s	-
		n o	

Heterogeneous systems



Introduction to LabVIEW





「Integration」

Bridging hardware and software



Multilanguage integration

HOW STANDARDS PROLIFERATE:
(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC.)

<p>SITUATION: THERE ARE 14 COMPETING STANDARDS.</p>	<p>14?! RIDICULOUS! WE NEED TO DEVELOP ONE UNIVERSAL STANDARD THAT COVERS EVERYONE'S USE CASES.</p> <p>YEAH!</p> 	<p>SOON:</p> <p>SITUATION: THERE ARE 15 COMPETING STANDARDS.</p>
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HOW TO BUILD A HORSE WITH PROGRAMMING

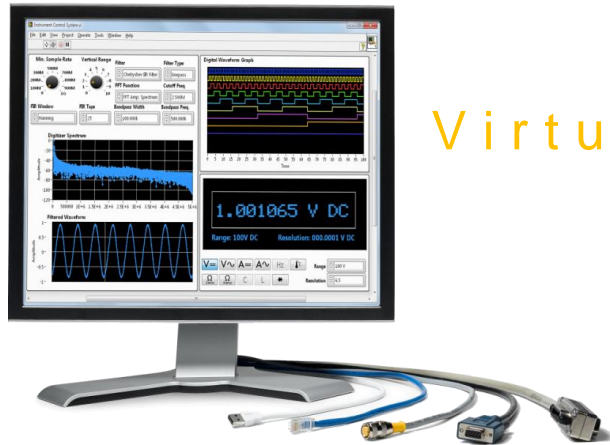
BY togg
Goon Squad

<p>C++</p> <p>YOU BUILT A HORSE</p> <p>IT'S UGLY AS HELL AND HAS LOTS OF DANGLING PARTS, BUT IT GETS THE JOB DONE</p> 	<p>C#</p> <p>THE HORSE WORKS BEST WHEN DRESSED IN A CAMEL COSTUME</p> <p>WHEN YOU TRY TO USE IT AS ANYTHING ELSE THAN A CAMEL, IT GETS A BIT FUSSY</p> 
<p>JAVA</p> <p>YOU REALLY WANT TO BUILD A HORSE</p> <p>BUT FIRST YOU NEED TO BUILD A HORSE FACTORY</p> 	<p>ASSEMBLY</p> <p>THE HORSE TURNS OUT A LITTLE BASIC</p> <p>BUT BOY CAN IT RUN!</p> 
<p>JAVASCRIPT</p> <p>YOUR HORSE ARRIVED IN DIFFERENT PACKAGES</p> <p>YOU BUILT THE HORSE, BUT THE SHIPMENTS CAME OUT ANGLAK, SO THE HORSE IS PARALYZED</p> 	<p>PHP</p> <p>YOU BUILT A TROJAN HORSE</p> <p>IT RELEASES HUNDREDS OF TINY HORSES TO PUNISH YOU EVERY DAY, FOREVER.</p> 
<p>COBOL</p> <p>YOU BUILT THE HORSE IN 1962</p> <p>IT CAN ONLY BE TAMED BY THE ORIGINAL CREATOR</p> <p>FOR ALL OTHER PURPOSES IT'S A DRAGON</p> 	<p>MARK VIKRUS 15</p> <p>TOMAL.COM</p> 





Introduction to LabVIEW



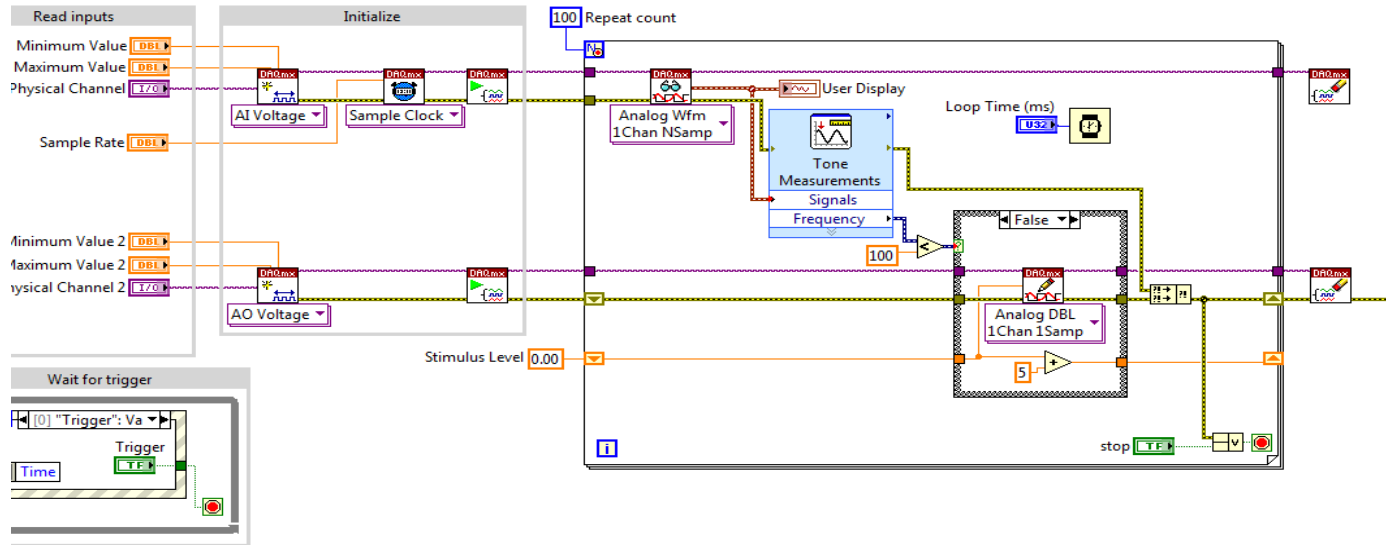
Virtual instrumentation

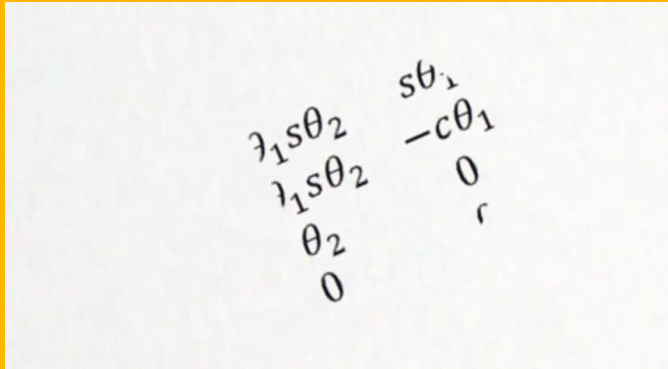
Laboratory
Virtual
Instrument
Engineering
Workbench



Application development

- Program as you think





Handwritten mathematical expressions on a white background:

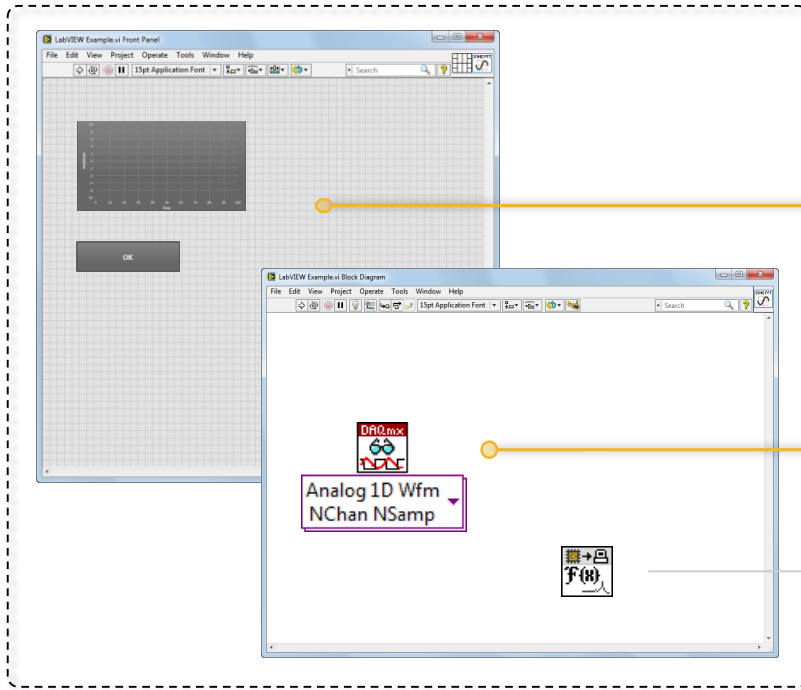
$$\begin{array}{l} \lambda_1 s \theta_2 \\ \lambda_1 s \theta_2 \\ \theta_2 \\ 0 \end{array} \quad \begin{array}{l} s \theta_1 \\ -c \theta_1 \\ 0 \\ r \end{array}$$

「Abstraction」

Expressing concepts and ideas without focus on syntaxe



Application development



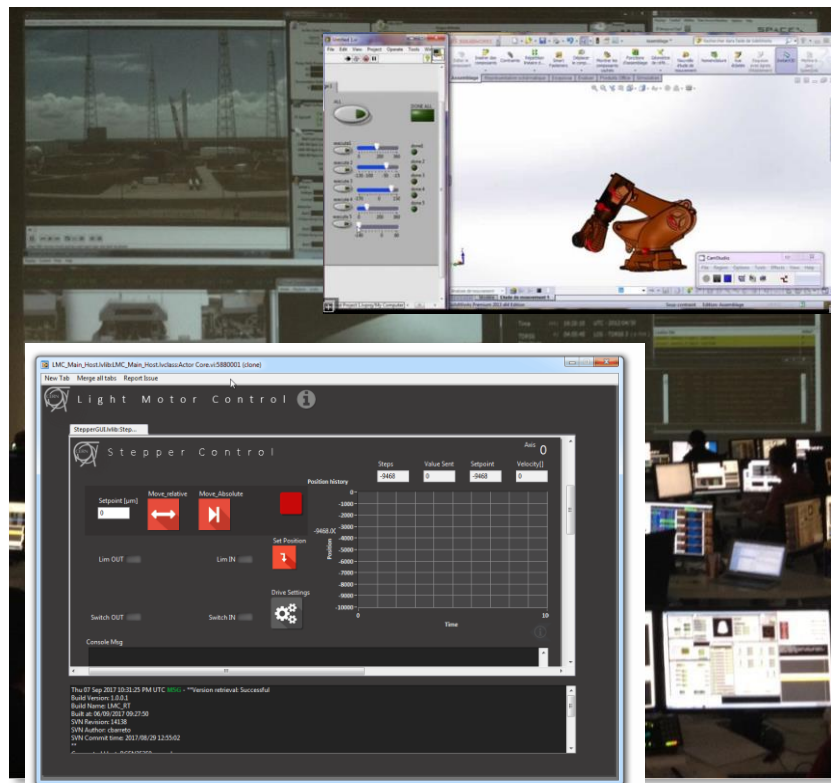
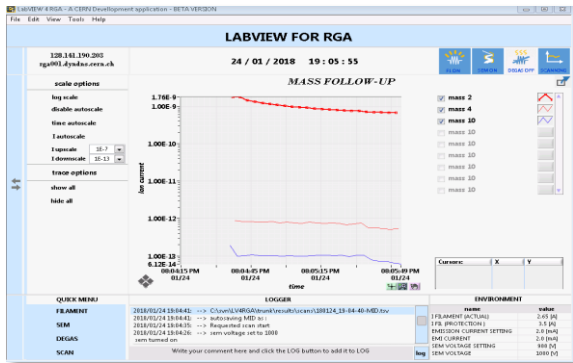
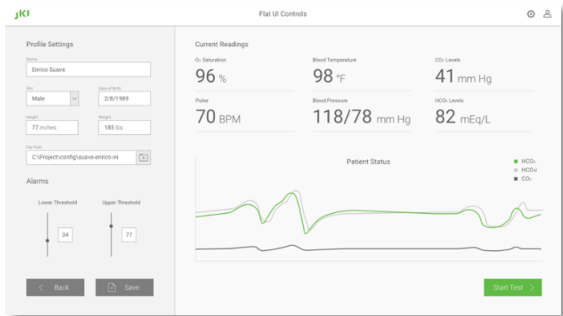
LabVIEW Front Panel
The user interface of a VI

LabVIEW Block Diagram
The source code of a VI

Functions:
Virtual
Instruments



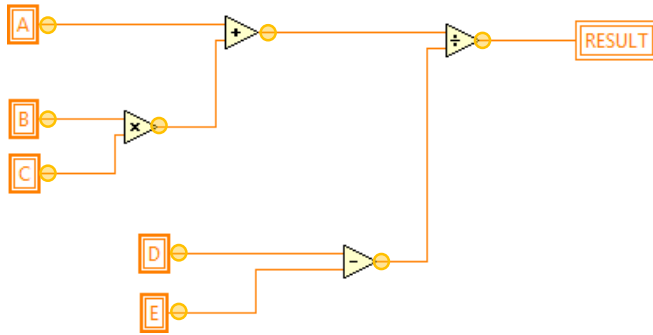
Graphical interface





Dataflow

- Data driven execution

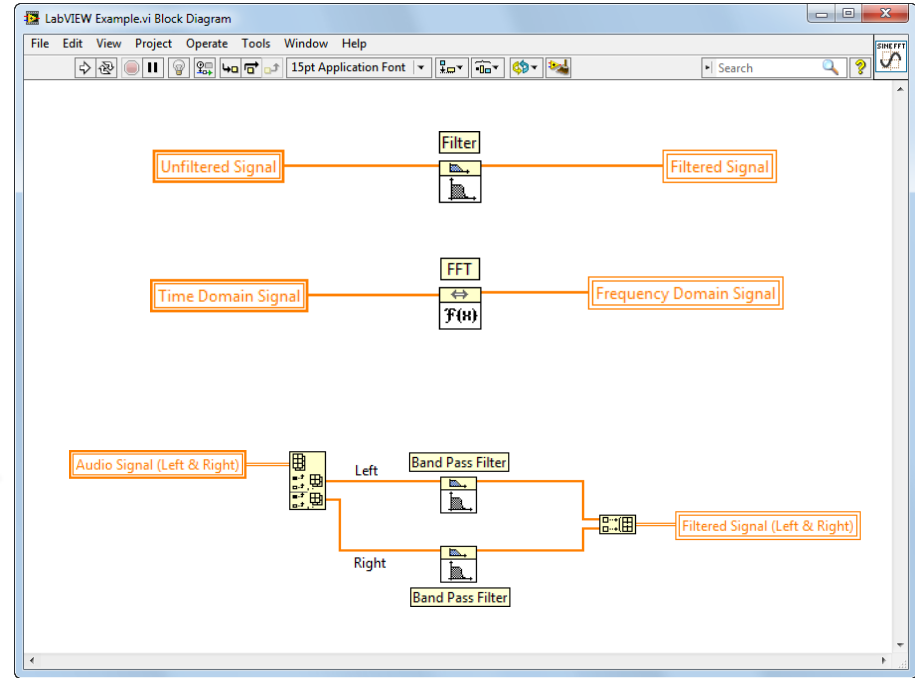


Intrinsic Parallelism

Dataflow

- Data driven execution

Intrinsic Parallelism



「Parallelism」

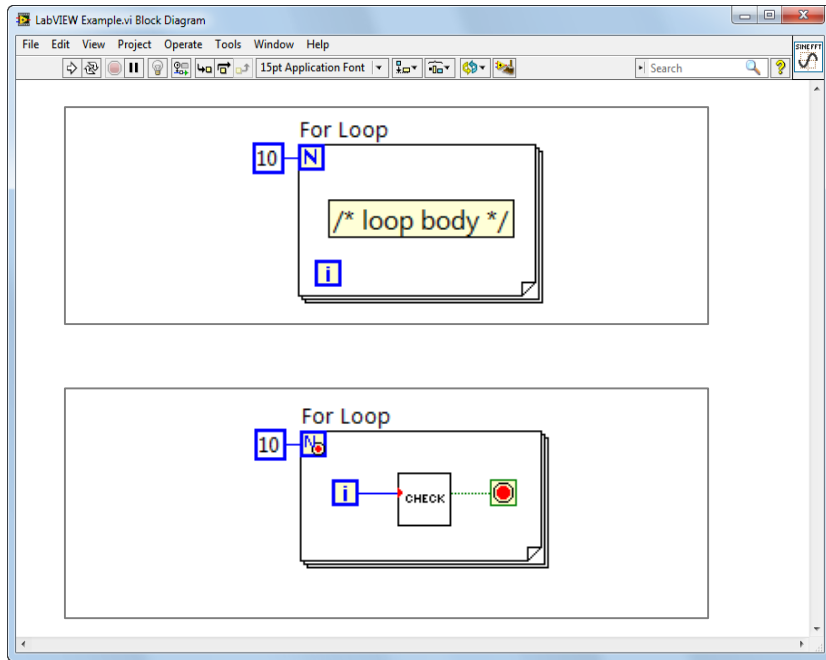
Intrinsic inclination

Comparison with text



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

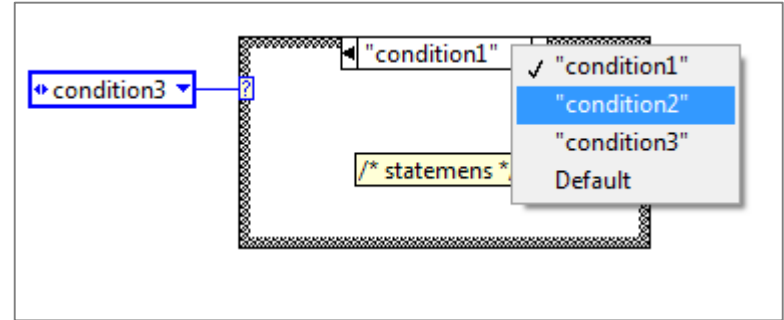
```
for (i = 0; i < 10; i++)  
{  
    if(check(i)) break;  
}
```



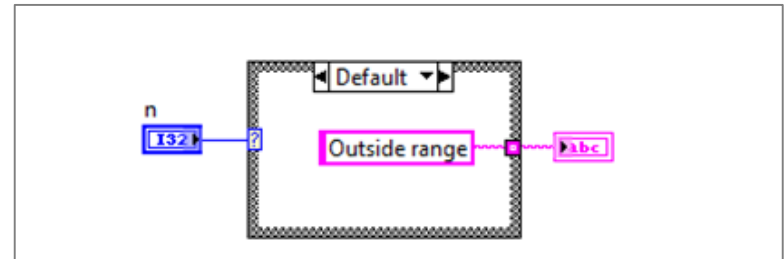


Comparison with text

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

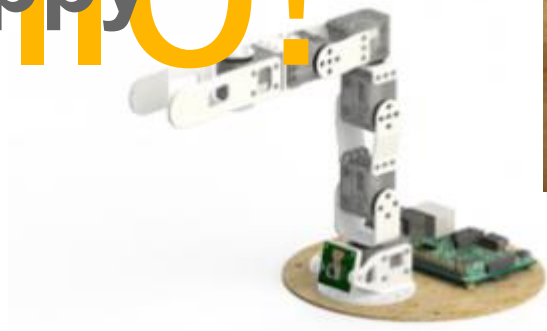


```
switch (n) {
  case 5:
    printf("Small number.");
    break;
  case 100:
    printf("Large number.");
    break;
  default:
    printf("Outside range");
    break;
}
```





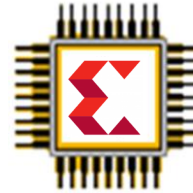
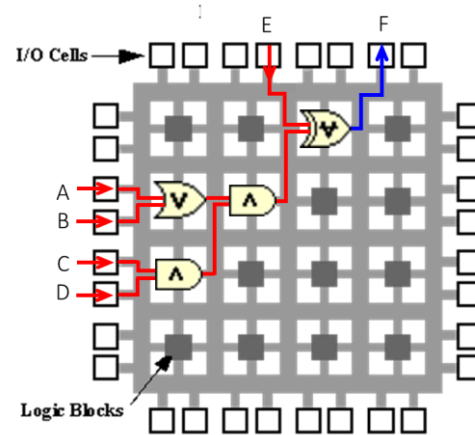
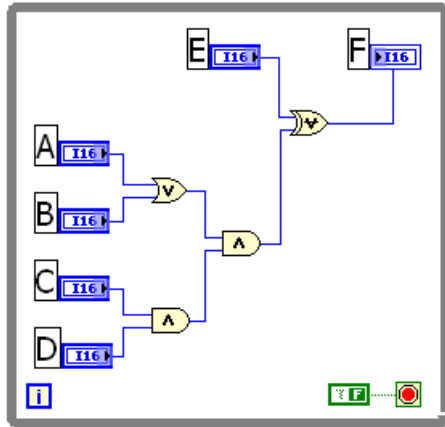
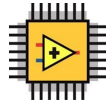
I'm Poppy!





LabVIEW to the pin

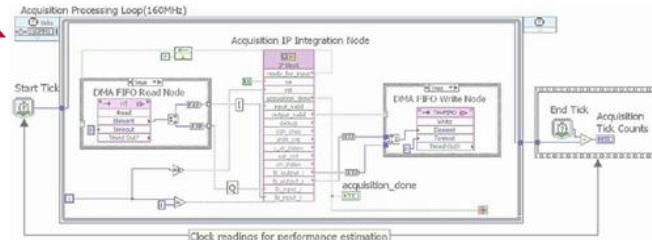
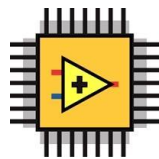
- LabVIEW FPGA





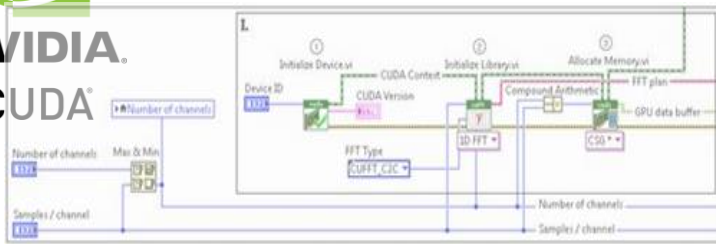
LabVIEW to the pin

- Xilinx FPGA
 - IP integration
 - Vivado Export
- NVIDIA CUDA GPU



nvidia.

CUDA





LabVIEW at CERN

550 LabVIEW Users



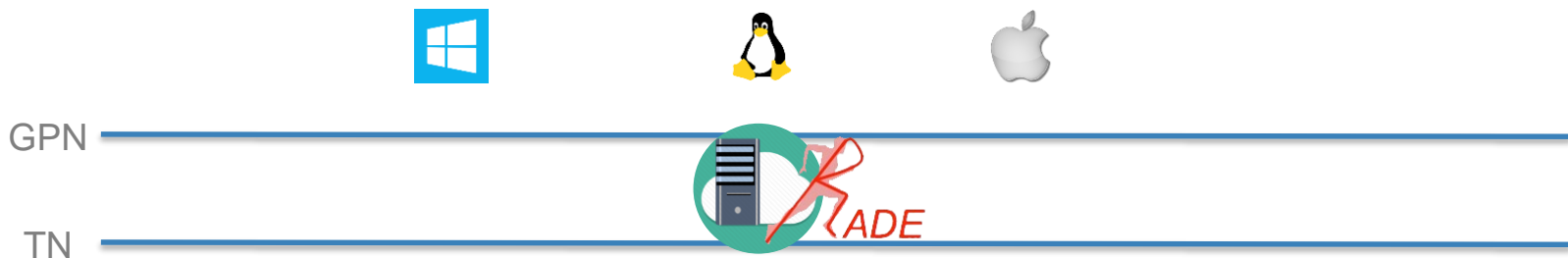
30 Project clients



CERN LabVIEW
Support



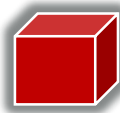
The access challenge



Logging



CMW



RBAC



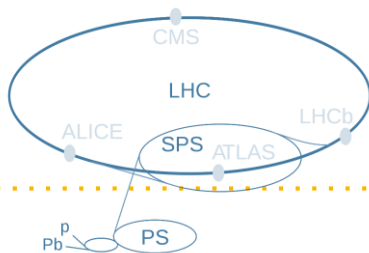
timing



Front ends



FES A





Custom hardware

P X I



CTRIP-PMC
(CERN)



PMC carrier
(Kontron)



Fine delay-FMC
(CERN)



FMC carrier
(INCAA)

c R I O



● White rabbit timing

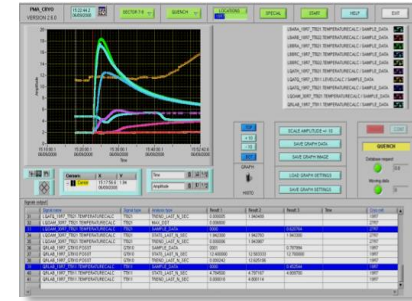
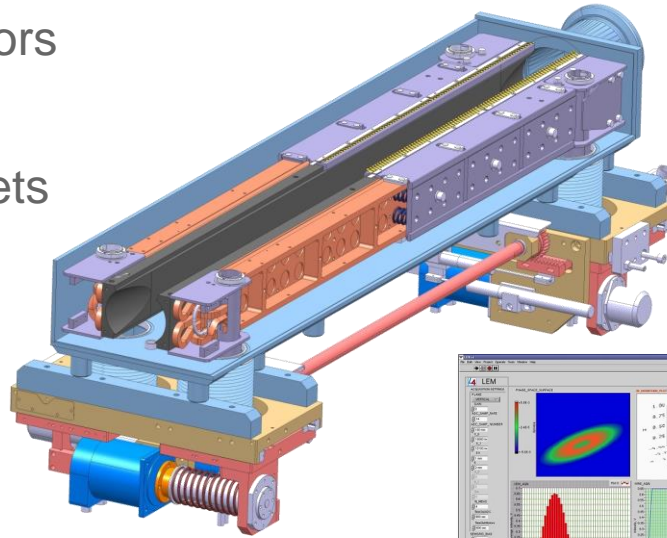


● Low latency machine learning
(Cogito Instruments)

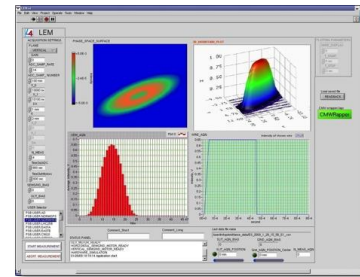


Example applications

- LHC collimators
- TOTEM
- Kicker Magnets
- AWAKE
- CLIC
- MedAustron
- ...



Post-Mortem analysis



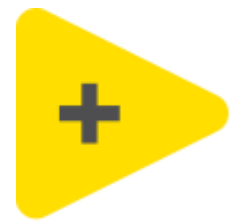
Linac 4

MedAustron ^N





Thank you



Reach me @ crisovao.andre.barreto@cern.ch



Credits

- National Instruments



- CERN EN-SMM group





「Modular」

Agile and scalable systems



Modular Instruments



Compaq DAQ

P X I

chassis

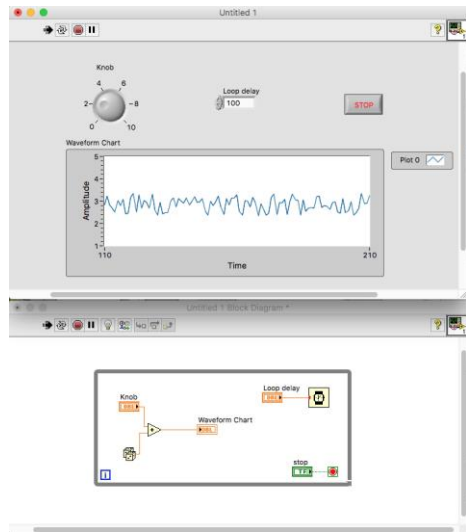
PCI EXPRESS modules





LabVIEW Tech preview

- Current Gen



- Next Gen

