

# LabVIEW and the LHC



## ***The Large Hadron Collider***



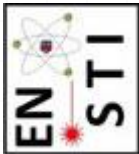
# Rapid Application Development Environment



based on LabVIEW

# Outline







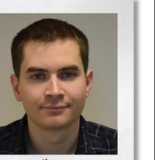
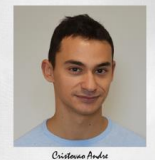
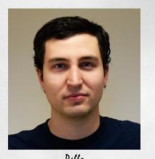
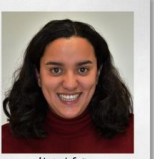




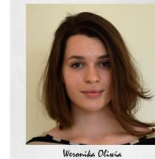


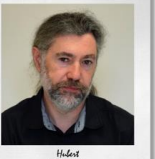


- MTA
- Why RADE?
- The challenge
- The Scope
- Coping with large applications
- RADE today
- Future

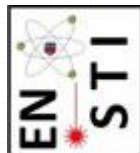


# EN-STI-ECE-MTA

Sources, Targets and Interactions

**Measurements  
Tests &  
Analysis**

 Sofia Lina ALDOSA BAZQUEZI	 Ole Eystein ANDRÉSSON	 Antoine BENOIT	 Angel BLANCO ALONSO	 Olivier CHARDONNIERE	 Alison DE DIOS FUENTE	 Kevin DEVELLE
 Christiane Andrea DIONISIO BARRETO	 Pablo FERNANDO LOPEZ	 María de Fatima GOMEZ DE LA CRUZ	 Robert KALLAI	 Miklós Nagy MHLACRNE	 Tamas Tapani HATASHO	
 Rikke HØRCK KNUDSEN	 Urszula Olwia MROZINSKA	 Jakub Wojciech RACHUŁKI	 Eric RASOASEHO DIT MICHEL	 Hubert REYMOND	 Abelien RULLART	 Joseph TAGG



labview.support@cern.ch

# Outline

- MTA
- Why RADE?
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Why was RADE developed?

# The Origin



- 10.000+ Magnets
- 1750 Circuits
- 13000+ Tests

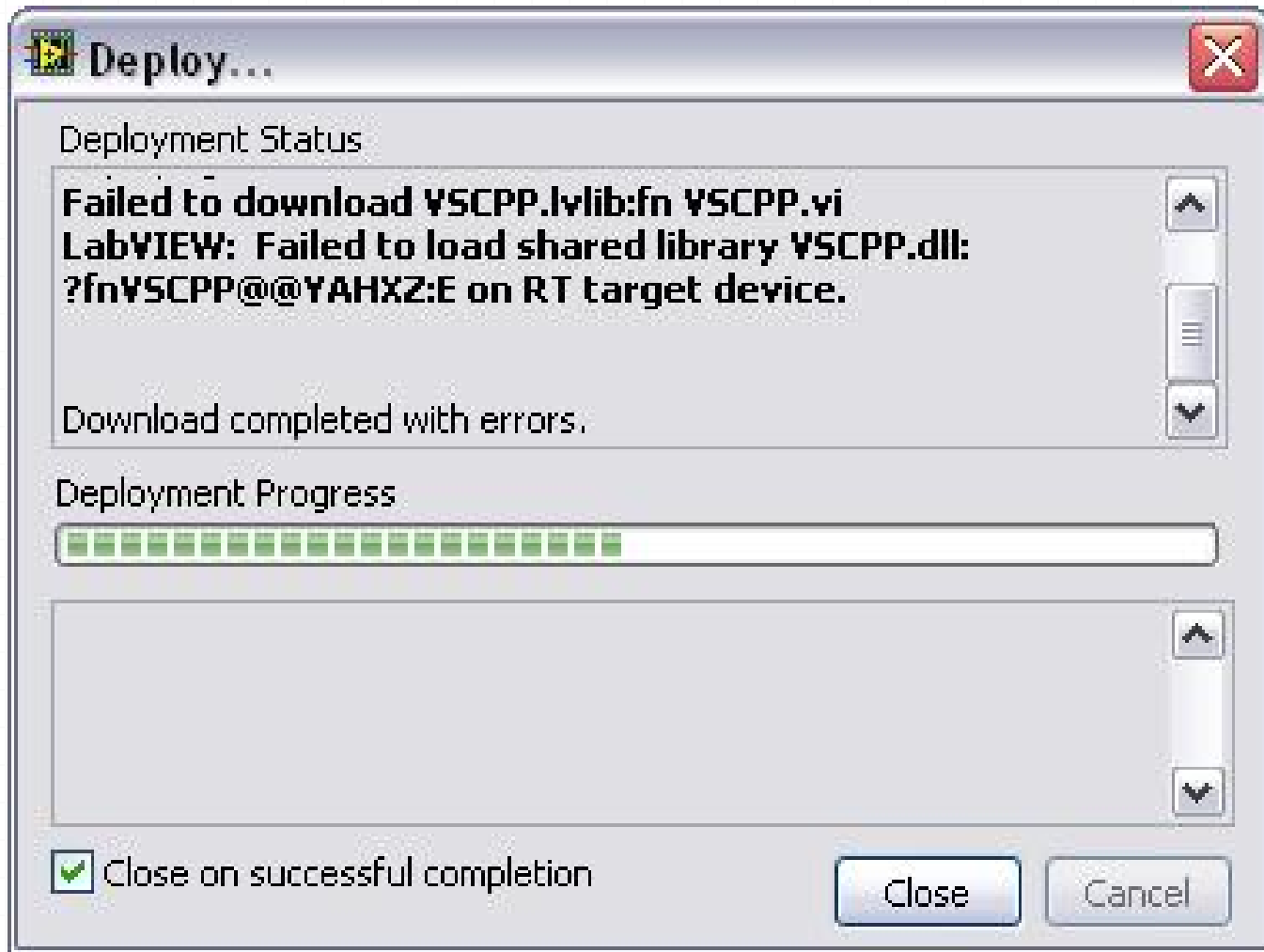


# Outline

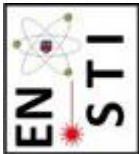
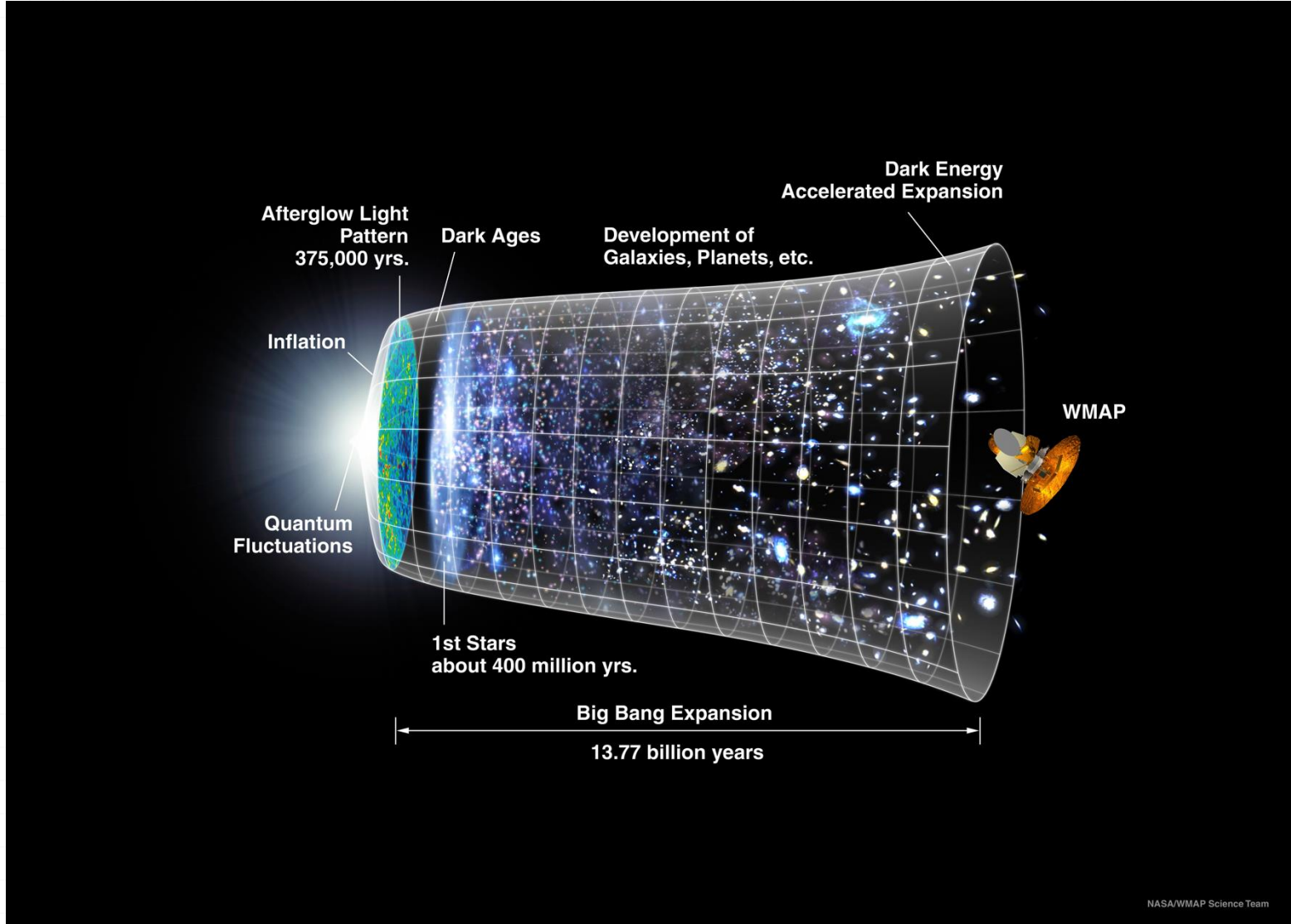
- MTA
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# The Challenge



# The Challenge



# The Challenge



Linux

Windows

Mac

GPN

TN



DB

CM  
W

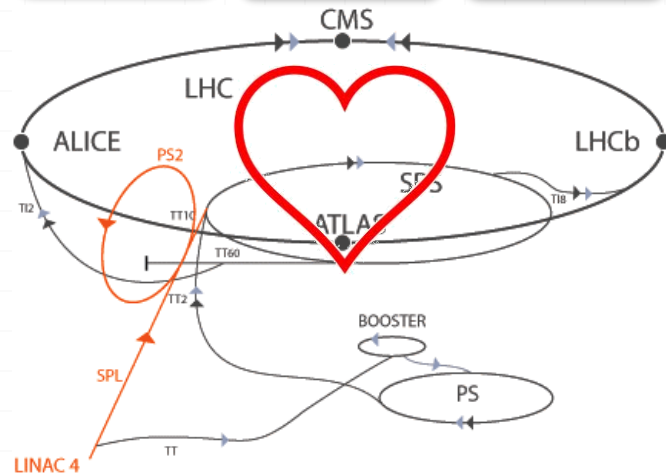
RBA  
C

Timing

Files

PLC

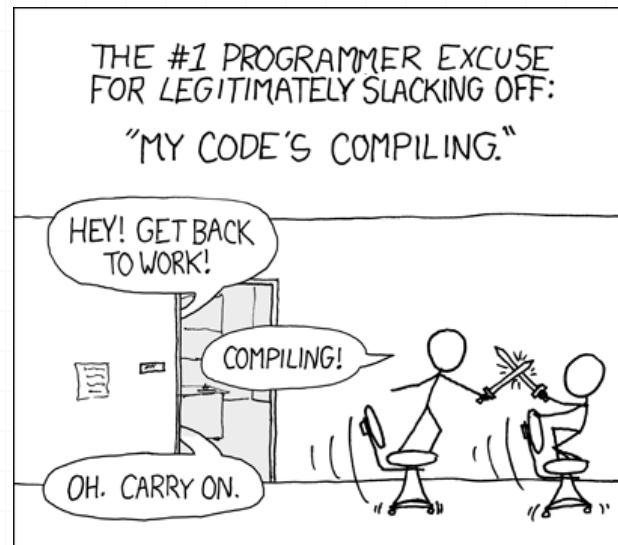
DAQ



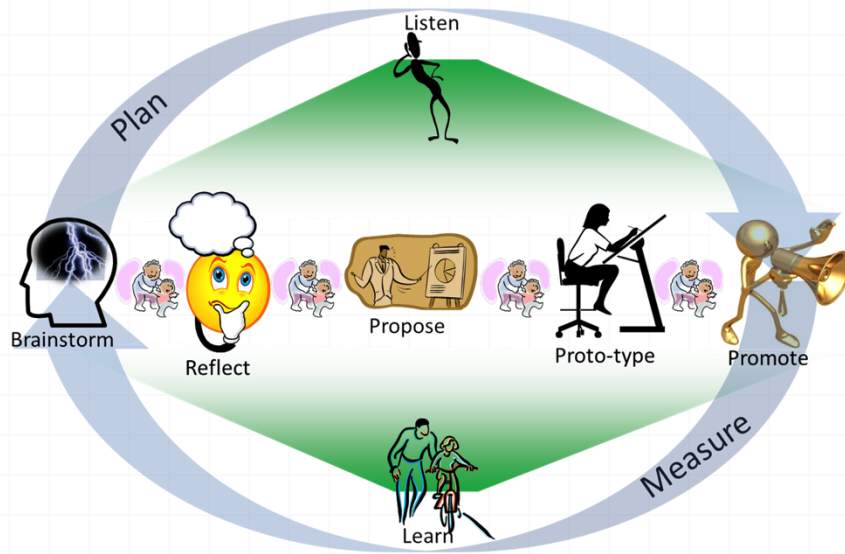
# RAD(E)

RAD(E) (rapid application development) is a concept that products can be developed faster and of higher quality through:

- Gathering requirements
- Prototyping
- Defer design improvements to the next release
- Less formality in reviews and communication
- Re-use of software components



# Development Methods

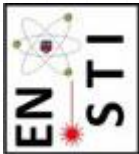


## Extreme Programming methods

- Small increments
- Minimal planning
- Cross-functional team working on all aspects
- Demonstrated to the stakeholders frequently
- Minimizing risks
- Fast changes and adaptations.

# Outline

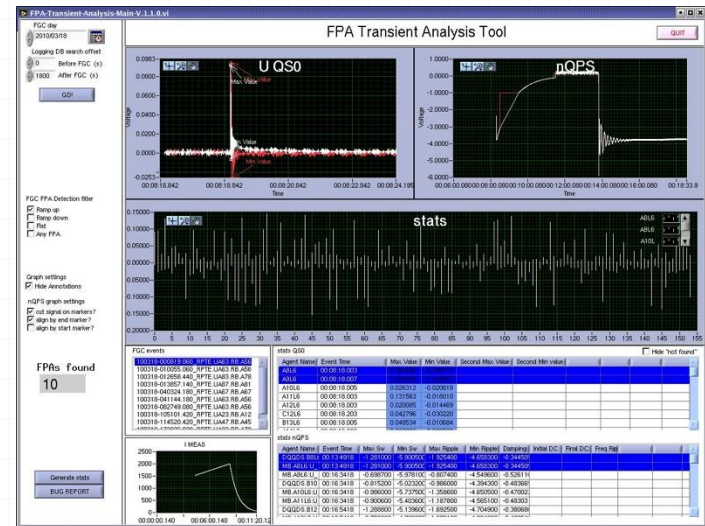
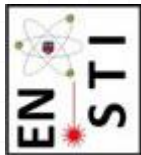
- MTA
- Why RADE?
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- The Scope
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Application characteristics:

- Short development time
- Rapidly evolving
- Light and independent

# The Scope





# Initial Requirements

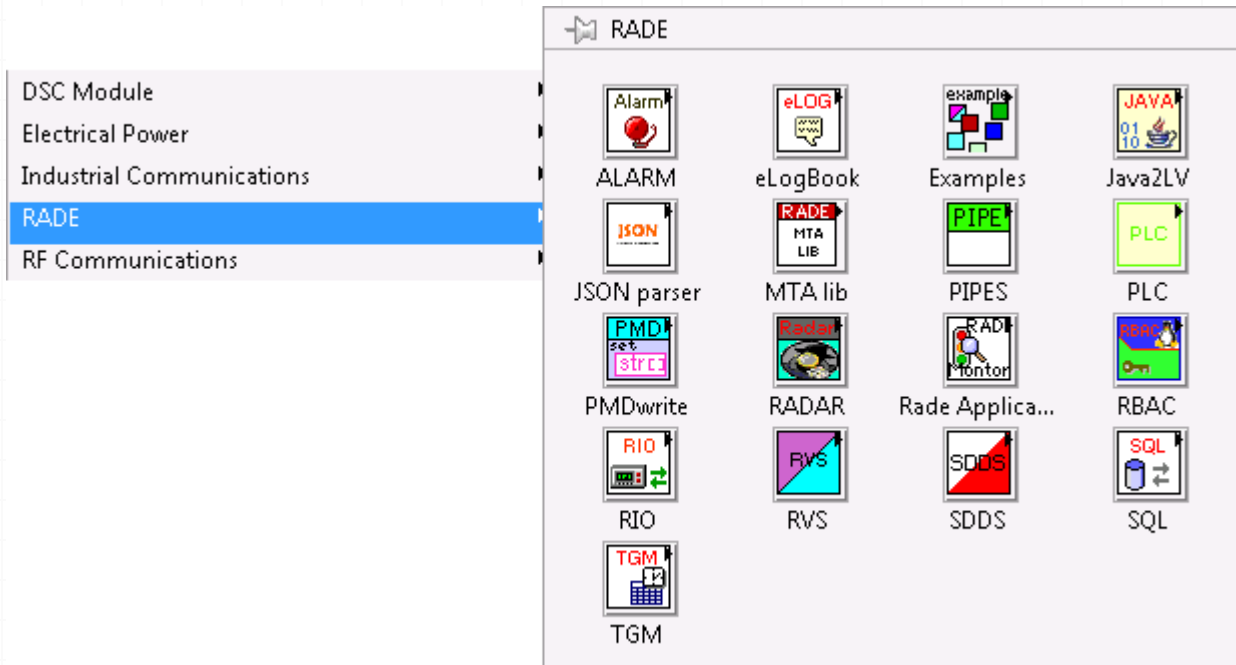
- Fast programming
- Rapid learning curve
- Drag and drop GUI development
- Wide range of analysis libraries
- Light/independent environment
- Integration with CERN infrastructures



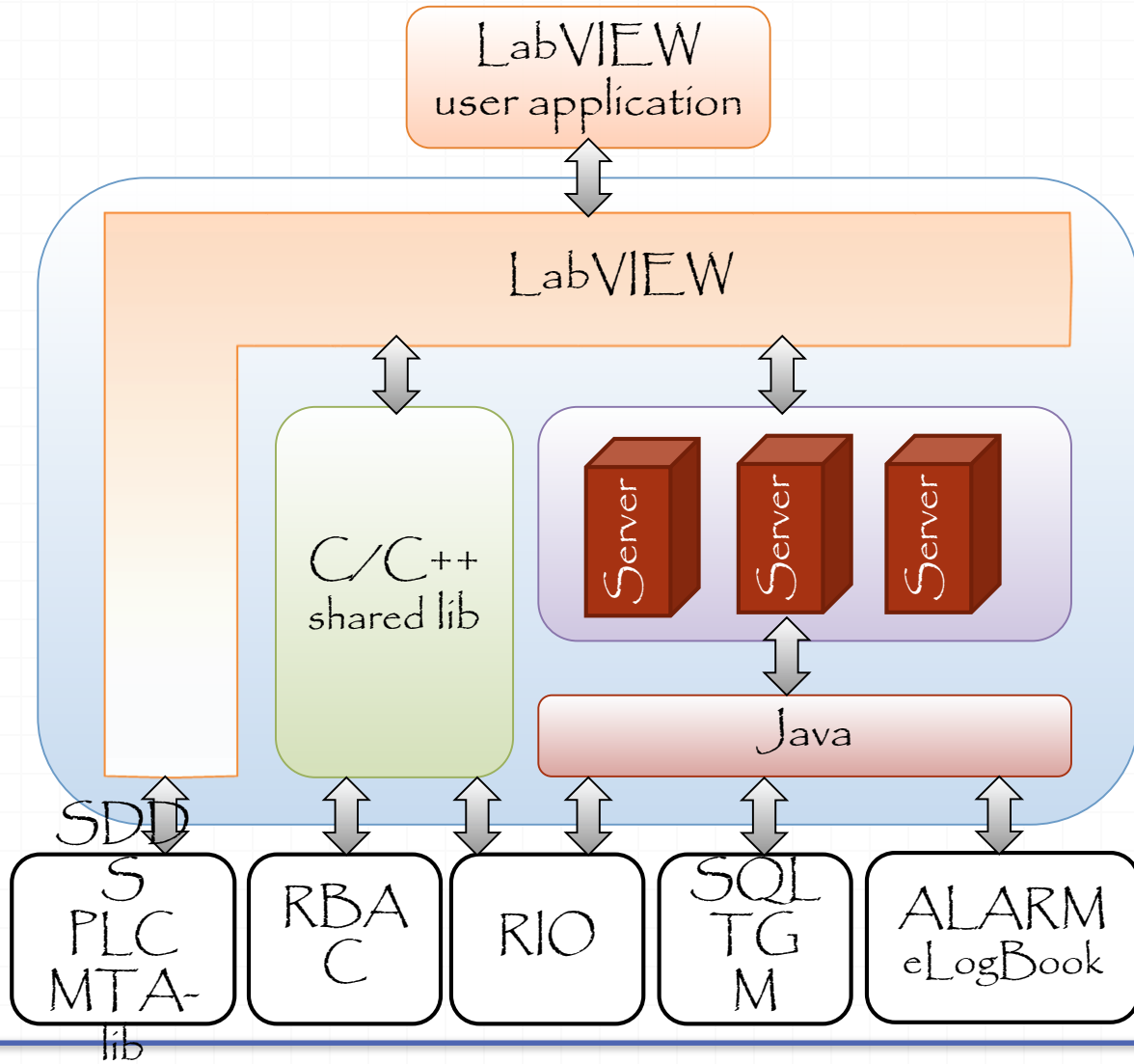
LabVIEW



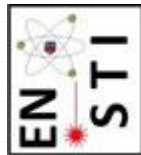
# RADE Palette



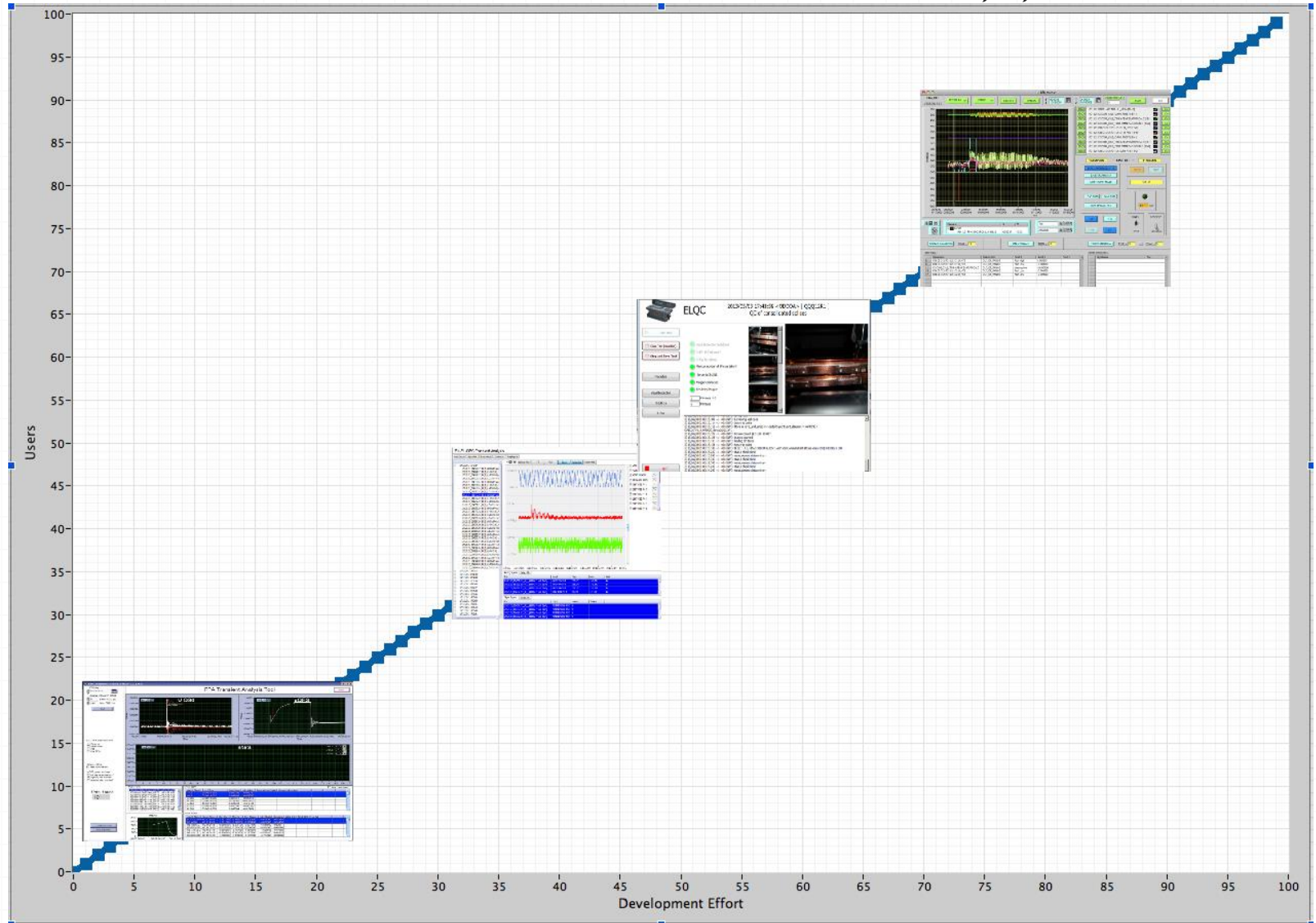
# RADE Core Technology



# Sources, Targets and Interactions



# RADE Applications

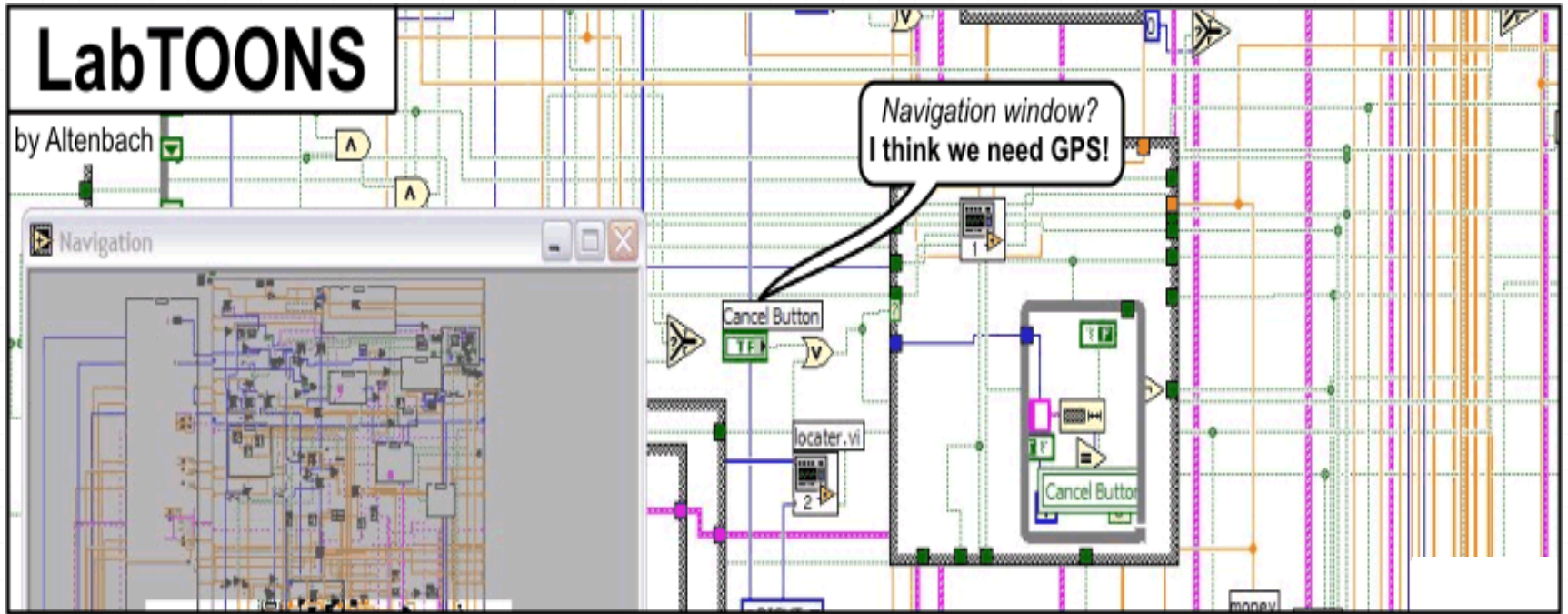


# Outline

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# Coping With Large Applications





# Large Application Requirements

Sources, Targets and Interactions

- Fast programming
- Rapid learning curve
- Drag and drop GUI development
- Wide range of analysis libraries
- Light/independent environment
- Integration with CERN infrastructures
- **Source control and distribution**
- **Instance generation**
- **Templates and documentation**
- **Automated tests and builds**

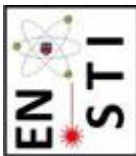
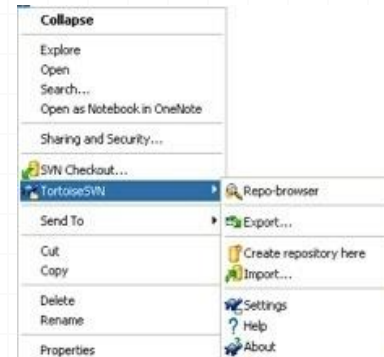
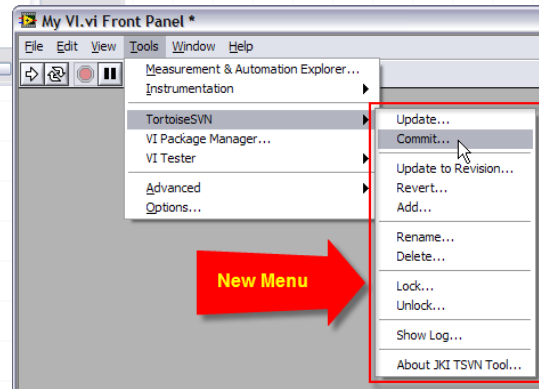
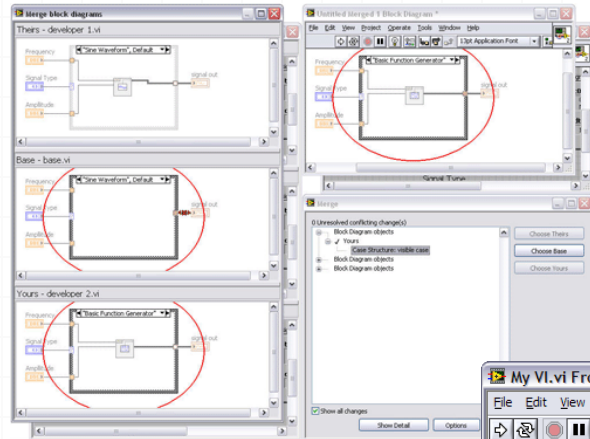


LabVIEW

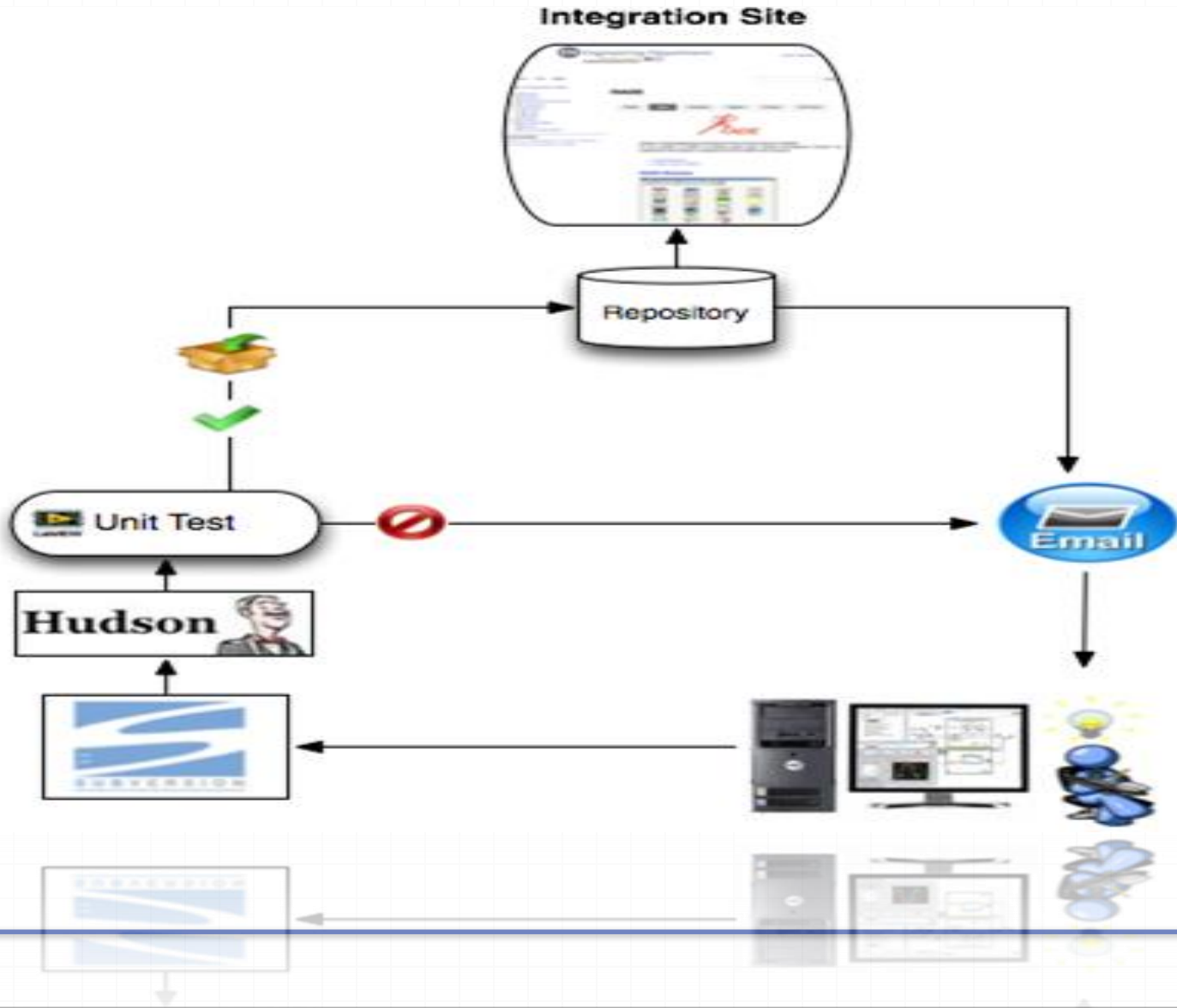




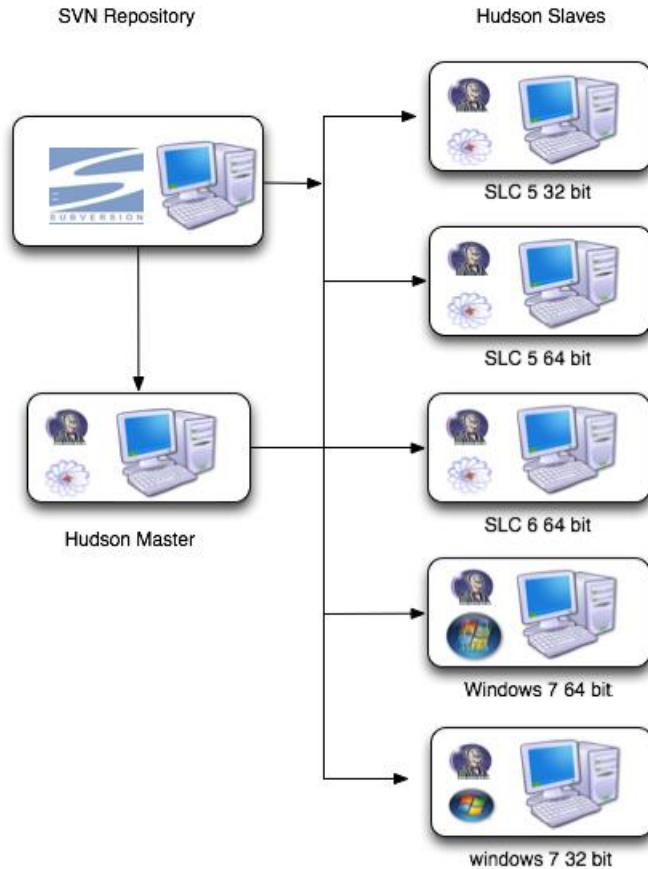
# Source Control



# Continuous Integration



# Continuous Integration



Linux Windows and Mac  
Open stack and VPN



# Continuous Integration

**Hudson** search pma | log out

Hudson ENABLE AUTO REFRESH

[New Job](#)  
[Manage Hudson](#)  
[People](#)  
[Build History](#)  
[New View](#)  
[My Views](#)

**Build Queue**

- [0-Build\\_RADE\\_Release\\_win](#)
- [0-Build\\_RADE\\_Release\\_mac](#)
- [cmww\\_win7\\_64](#)
- [Unittest-MI](#)
- [TGM-MI](#)
- [Templates-MI](#)
- [SQL-MI](#)
- [SDDS-MI](#)
- [RVS-MI](#)
- [RIO-DIMWrapper-MI](#)
- [RIO-CMWWrapper-MI](#)
- [RBAC-MI](#)
- [RADAR-MI](#)
- [PMDwrite-MI](#)
- [PLC-MI](#)
- [PIPES-MI-Template](#)
- [MTA-lib-MI](#)
- [JSON-MI](#)
- [Jars2LV-MI](#)
- [FESA-MI](#)
- [examples-MI](#)


<http://abcopm04-8080/hudson/queue/item/2860/cancelQueue>

All	Backup Hudson jobs	JavaBuilds	Linux library test	RADE builds	Windows library test	cpp builds	+
S	W	Job ↓	Last Success	Last Failure	Last Duration	Console	
		0-Build_RADE_all	6 days 20 hr (#24)	N/A	0.25 sec		
		0-Build_RADE_Release_linux	1 mo 4 days (#33)	20 days (#46)	50 min		
		0-Build_RADE_Release_mac	4 mo 5 days (#28)	20 days (#56)	12 min		
		0-Build_RADE_Release_win	1 mo 4 days (#17)	20 days (#29)	41 min		
		ALARM-MI	19 days (#489)	N/A	15 min		
		ALARM-Windows-MI	19 days (#223)	N/A	11 min		
		Backup-jobs	2 days 20 hr (#502)	20 hr (#504)	0.33 sec		
		cmww_SLC5	20 hr (#165)	N/A	2 min 3 sec		
		cmww_SLC6	19 days (#108)	N/A	8 min 38 sec		
		cmww_win7_64	N/A	1 day 20 hr (#44)	16 min		
		CO-MI	19 days (#443)	N/A	8 min 41 sec		
		CO-Windows-MI	19 days (#453)	N/A	54 sec		
		DBService-build	20 hr (#417)	N/A	16 min		
		DIPService_1_0_0-Build	20 hr (#387)	N/A	27 min		
		eLogBook-MI	19 days (#291)	N/A	16 min		
		eLogBook-Windows-MI	19 days (#225)	N/A	10 min		
		examples-MI	19 days (#421)	N/A	8 min 45 sec		
		examples-Windows-MI	19 days (#393)	N/A	59 sec		
		FESA-MI	19 days (#424)	N/A	9 min 8 sec		
		FESA-Windows-MI	19 days (#404)	N/A	2 min 5 sec		
		InCA-prev-build	20 hr (#378)	N/A	8 min 33 sec		
		InCa_1_0_1-Build	19 hr (#418)	N/A	20 min		
		JAPC_RDA_BLM_1_0_0-Build	3 days 19 hr (#450)	19 hr (#453)	10 min		
		Jars2LV-MI	19 days (#421)	N/A	8 min 41 sec		
		Java2LV-Windows-MI	19 days (#399)	N/A	59 sec		
		JSON-MI	19 days (#299)	N/A	13 min		
		LSA_1_0_0-Build	3 days 19 hr (#89)	19 hr (#92)	17 min		
		LVSservice-build	19 hr (#380)	N/A	9 min 0 sec		
		MTA-lib-MI	19 days (#419)	N/A	13 min		

[add description](#)



# Continuous Integration



Project

CURRENT PROJECT  
**EN Industrial Control...**


Manage Compute

- Overview
- Instances
- Volumes
- Images & Snapshots
- Access & Security


[Logged in as: oddoa](#)
[Settings](#)
[Help](#)
[Submit a ticket](#)
[Sign Out](#)

## Overview


### Limit Summary




**Instances**  
Used 28 of 100




**VCPUs**  
Used 67 of 100



**RAM**  
Used 134.0 GB of 250.0 GB



**Available Volumes**  
Used 0 of 0



**Available Volume Storage**  
Used 0 of 4.9TB

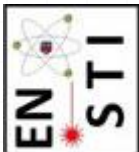
Select a period of time to query its usage:

From:  To:   The date should be in YYYY-mm-dd format.

Active Instances: 29 Active RAM: 142GB This Period's VCPU-Hours: 575.17 This Period's GB-Hours: 34510.22

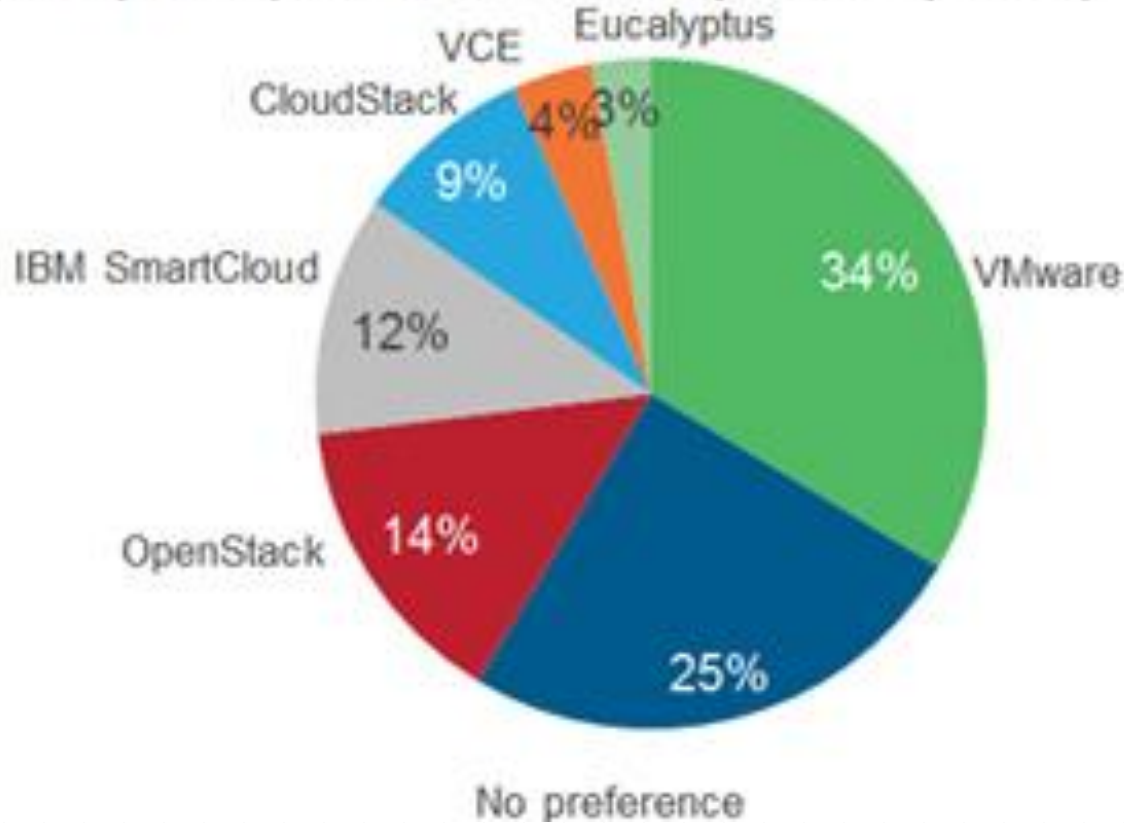
### Usage Summary

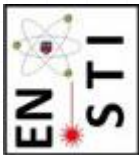
Instance Name	VCPUs	Disk	RAM	Uptime
<a href="#">cvi-analytics-srvr</a>	4	80	8GB	6 months
<a href="#">cvi-bip-fv</a>	4	80	8GB	6 months
<a href="#">cvi-icenexus</a>	2	40	4GB	5 months
<a href="#">cvw-piquet01</a>	2	40	4GB	4 months, 1 week



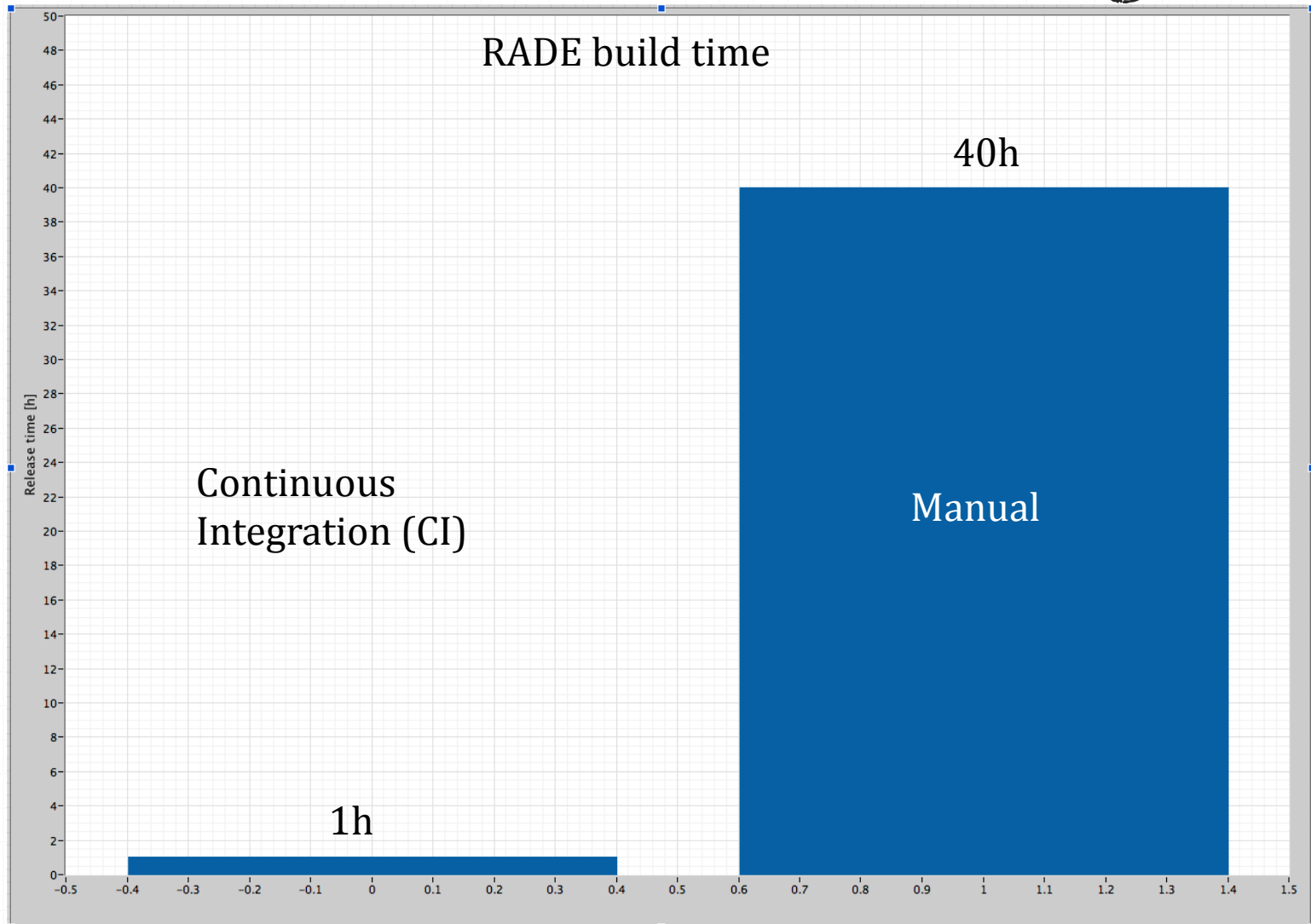
# Continuous Integration

Preference for cloud platform  
Buyer responses (cloud infrastructure implemented/planned)





# Continuous Integration





# Software repository

The screenshot displays the Nexus Repository Manager OSS interface. At the top, it says "Nexus Repository Manager OSS" and "Nexus Repository Manager OSS 2.12.0-01". The main area is titled "Repositories" and contains a table of repository configurations.

Repository	Type	Health Check	Format	Policy	Repository Status	Repository Path
<b>Public Repositories</b>	group	ANALYZE	maven2			http://rade-nexus-01:8081/nexus/content/groups/public
3rd party	hosted	ANALYZE	maven2	Release	In Service	http://rade-nexus-01:8081/nexus/content/repositories/thirdparty
Apache Snapshots	proxy	ANALYZE	maven2	Snapshot	In Service	http://rade-nexus-01:8081/nexus/content/repositories/apache-snapshots
Central	proxy	ANALYZE	maven2	Release	In Service	http://rade-nexus-01:8081/nexus/content/repositories/central
Central M1 shadow	virtual	ANALYZE	maven1	Release	In Service	http://rade-nexus-01:8081/nexus/content/shadows/central-m1
libraries	hosted	ANALYZE	maven2	Release	In Service	http://rade-nexus-01:8081/nexus/content/repositories/libraries
Releases	hosted	ANALYZE	maven2	Release	In Service	http://rade-nexus-01:8081/nexus/content/repositories/releases
Snapshots	hosted	ANALYZE	maven2	Snapshot	In Service	http://rade-nexus-01:8081/nexus/content/repositories/snapshots

Below the table, there is a "Releases" section with tabs for "Browse Index", "Browse Storage", "Configuration", "Routing", "Summary", and "Artifact Upload". The "Browse Storage" tab is active, showing a tree view of the repository structure:

- Releases
  - rade
    - Installer
    - Library
      - Mac
        - 2015
          - CO
          - MTA-lib
  - archetype-catalog.xml

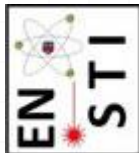
On the right side of the "Browse Storage" view, there is a detailed view for a Maven artifact:

```

Maven Artifact
Group: rade.Library.Mac.2015
Artifact: CO
Version: CO-1.1.0
Extension: tar.gz
XML: <dependency>
      <groupId>rade.Library.Mac.2015</groupId>
  
```

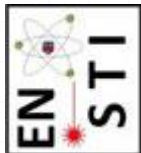
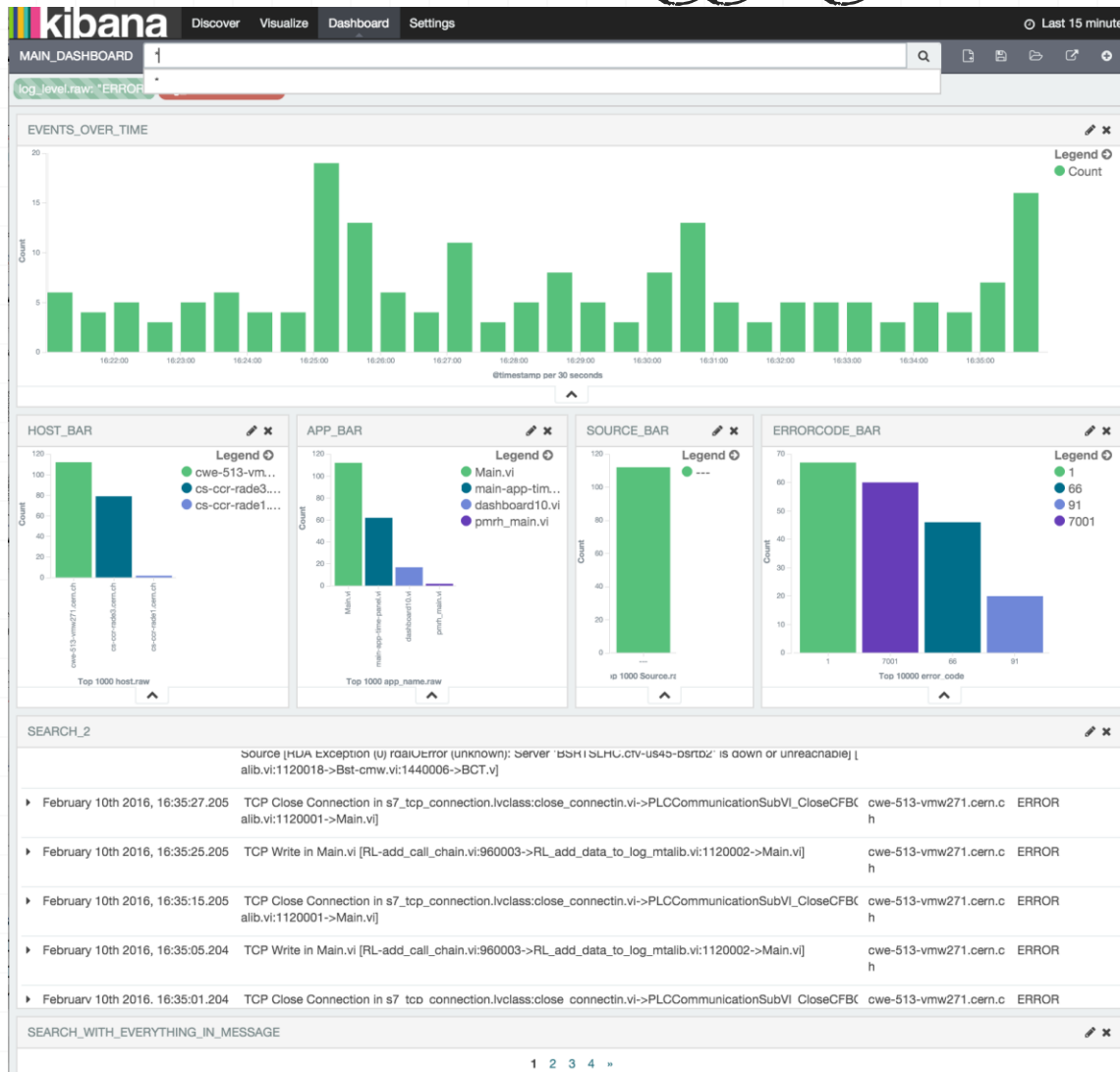


# Nexus



# Logging and diagnostics

("ELK")





# Distribution

EN Home / Frameworks / RADE / RADE-Getting-Started / RADE-install Tools ▾

## RADE-install

Added by Unknown User (atarasen), last edited by Odd Oyvind Andreassen on Feb 10, 2014 (view change)

Home Getting Started Libraries Download Support Glossary

RADE is available through CMF.

If your computer doesn't have the CMF agent installed you can get RADE from the locations linked below.

	Windows	Linux Local (64 bit)	Linux Local (32 bit)	Linux (NFS)	Mac OSX
LabVIEW 2010	<a href="#">RADE 10</a>	<a href="#">RADE 10</a>	<a href="#">RADE 10</a>	RADE is installed centrally	<a href="#">RADE 10 OSX DMG</a>
LabVIEW 2011	<a href="#">RADE 11</a>	<a href="#">RADE 11</a>	<a href="#">RADE 11</a>	RADE is installed centrally	<a href="#">RADE 11 OSX DMG</a>
LabVIEW 2012	<a href="#">RADE 12</a>	<a href="#">RADE 12</a>	<a href="#">RADE 12</a>	RADE is installed centrally	<a href="#">RADE 12 OSX DMG</a>
LabVIEW 2013	<a href="#">RADE 13</a>	<a href="#">RADE 13</a>	<a href="#">RADE 13</a>	RADE is installed centrally	<a href="#">RADE 13 OSX DMG</a>

- If the installation doesn't start automatically run RADE\_13.exe from \\cern.ch\dfs\Services\PMA\rade\builds\RADE\_13.exe

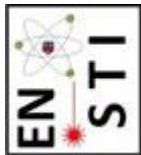
**Beta-version of RADE for LabVIEW-2010**

Windows	Linux
Windows version	<a href="#">RADE-10-beta.rpm</a>

**Installing on Mac**



The mac package is not signed so in order to install the RADE framework on your machine you have to allow all applications in your security settings (Preferences >> Security & Privacy):



## Online Installer





## Distribution

RADE-Installer.vi rev. 145

Log In  Add  LabVIEW version

LV version  Remove 

 Nexus 

Name	Category	Local version	Remote version	Status	Developer	Source
MTA Lib				not installed	oddoa	
RBAC				not installed	oddoa	
JAPC				not installed	vshaipov	
RADAR				not installed	vshaipov	
CMW Wrapper				not installed	ostrue	

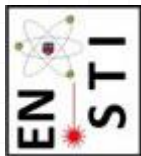
00:49:40.767 --> executing: core:idle

RADE Installer

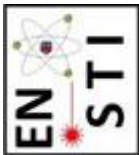
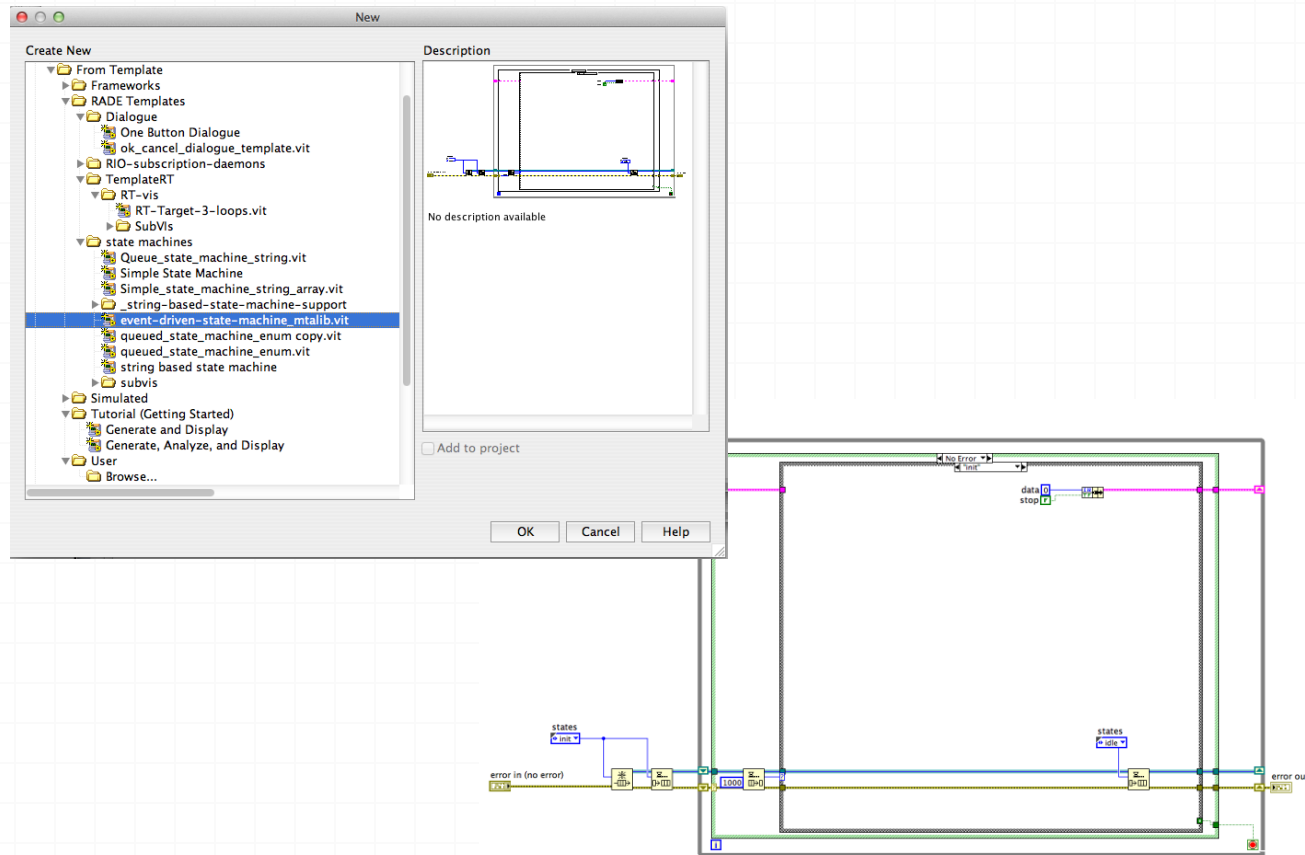


# Distribution

Name \ /	Version	Repository	Company
Biometric Login Toolkit	1.0.1.25	NI LabVIEW Tools Network	Blue Ridge Test
Biometric Login Toolkit API	1.1.0.18	NI LabVIEW Tools Network	Blue Ridge Test
Biometric Login Toolkit Base Comp	1.1.0.22	NI LabVIEW Tools Network	Blue Ridge Test
Biometric Login Toolkit Base Comp	1.1.0.22	NI LabVIEW Tools Network	Blue Ridge Test
Biometric Login Toolkit Documental	1.1.0.28	NI LabVIEW Tools Network	Blue Ridge Test
Biometric Login Toolkit Documental	1.1.0.28	NI LabVIEW Tools Network	Blue Ridge Test
Biometric Login Toolkit Server	1.1.0.23	NI LabVIEW Tools Network	Blue Ridge Test
Biometric Login Toolkit Server (Sys	1.1.0.23	NI LabVIEW Tools Network	Blue Ridge Test
FPGA IP (IPNet): Digital Buses and	1.0.0.1	NI LabVIEW Tools Network	NI
FPGA IP (IPNet): LabVIEW FPGA E	1.0.0	NI LabVIEW Tools Network	NI
jk_labs_tool_vi_tester	1.1.2.164-1	VI Package Network	JKI Labs
jk_lb_easysmi	2.0-1	VI Package Network	JKI
jk_lb_rcf_create_enum_from_stri	1.0.1-1	VI Package Network	JKI Labs
jk_lb_rcf_create_enum_on_disabl	1.0.1-1	VI Package Network	JKI Labs
jk_lb_rcf_disconnect_from_typed	1.0.1-1	VI Package Network	JKI Labs
jk_lb_rcf_justify_text	1.0.1-1	VI Package Network	JKI Labs
jk_lb_rcf_wire_error_case_struct	1.2.1-1	VI Package Network	JKI Labs
jk_lb_state_machine	2.0.0-1	VI Package Network	JKI
jk_rsc_toolkits_palette	1.1-1	VI Package Network	JKI Software
jk_tool_right_click_framework	1.0.2.208-1	VI Package Network	JKI Labs
jk_tool_tartoisesn	2.0.1.135-1	VI Package Network	JKI
LabVIEW Interface for Arduino	1.2.0.13	Unpublished	National Instruments
LabVIEW Scripting	1.0.0.11	NI LabVIEW Tools Network	NI Labs
MGE 3D Array	1.0.0.19	NI LabVIEW Tools Network	MGE
MGE 2D Array	1.0.0.13	NI LabVIEW Tools Network	MGE



# Dedicated Templates



# Project Generation

The screenshot displays the RADE Project Generator application window. The title bar reads "radegen-main.vi". The interface features the RADE logo on the left and the CERN logo on the right. Below the logos, the text "PROJECT GENERATOR" is prominently displayed in red. The "Project Type" is set to "Event driven state machine". There are "CREATE" and "CUSTOMIZE" buttons, along with a "Show Log?" checkbox.

A "Message" dialog box is open, showing configuration options for a project. The "Project Name" is "My-RADE-Project". The "Base Path" is "Macintosh HD:testproj". The "Project Name" field also contains "My-RADE-Project". There are "Cancel" and "Apply" buttons at the bottom of the dialog.

A "Project Explorer" window is also visible, showing a tree view of the project structure. The root is "Project: My-RADE-Project.lvproj", which contains "My Computer", "Dependencies", "Build Specifications", and "My-RADE-Project".

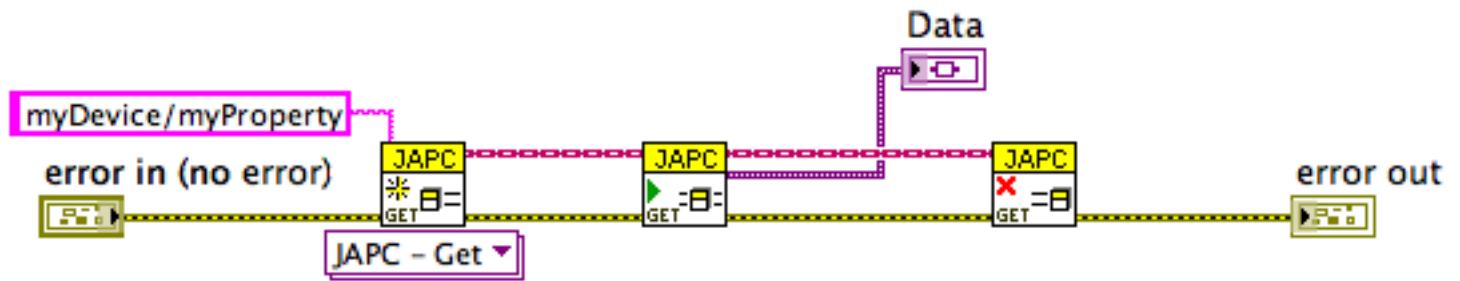
A log window at the bottom left shows a series of messages, including "#MSG resizing GUI", "#MSG setting control attr", and "#PROMPT Select name and path".





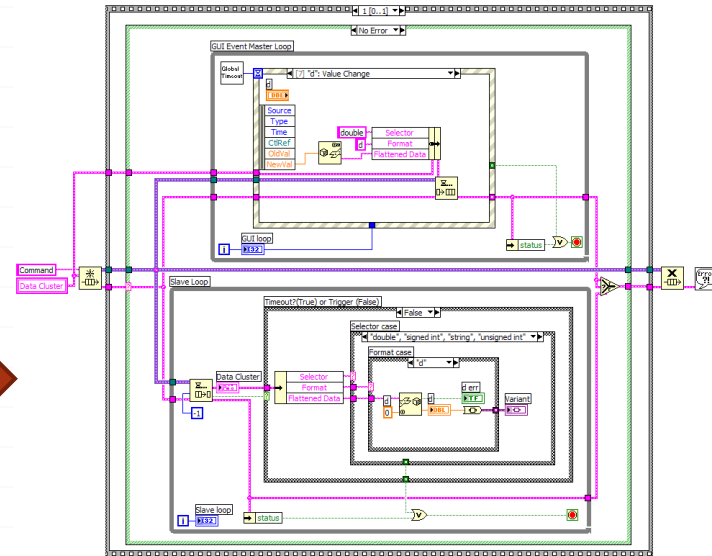
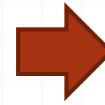
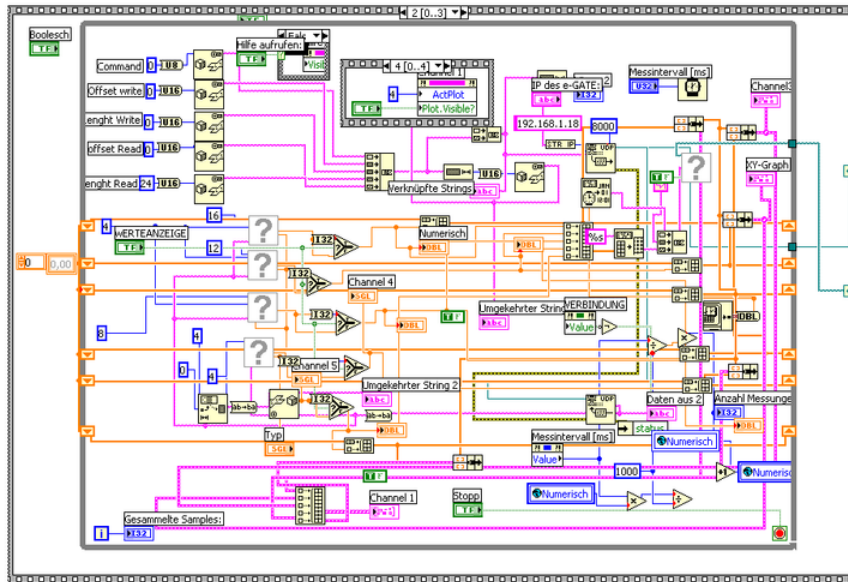
# Typical design

Create, Use & Destroy

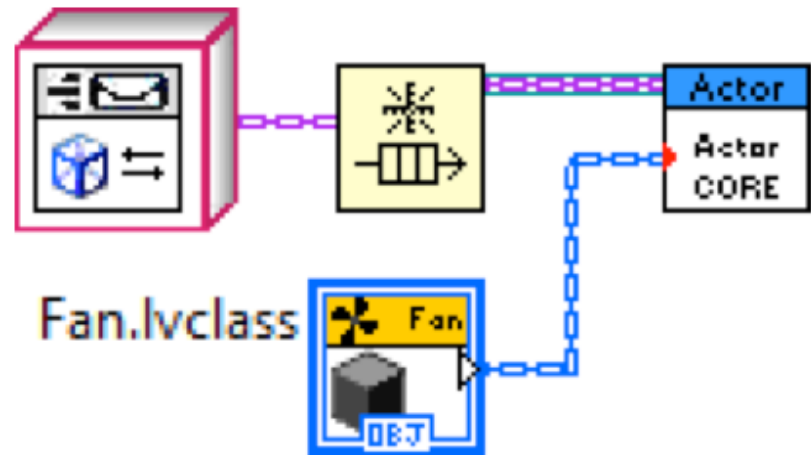
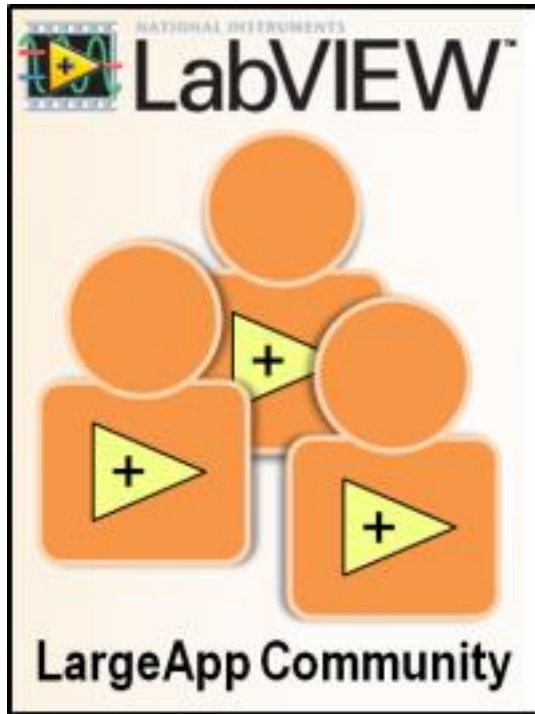


# Development help

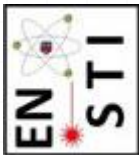
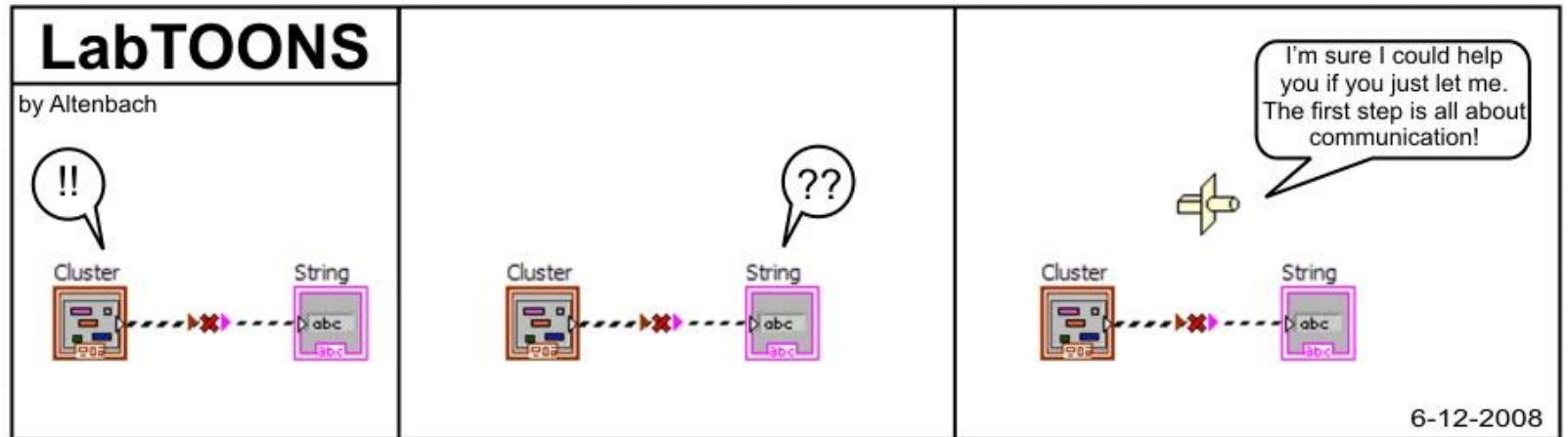
- Design patterns and templates in RADE
- LabVIEW Guides  
<http://j2eeps.cern.ch/wikis/display/EN/LabVIEW+Guides>
- Code review: make maintainable, and performant



# Peer Programming



# The missing link



# Middleware integration



Operators

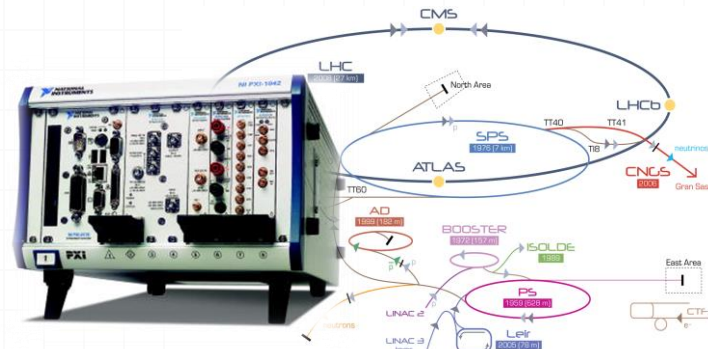
## Clients

- RIO palette (Rade Input/Output)
  - Get, Set and Subscribe

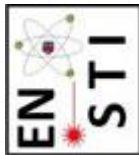


## Server

- Device/property/field definitions



PXI on the accelerator complex



# Distributed Architecture

SLC



LABVIEW RT



System I/O



I/O



RAM



CPUs



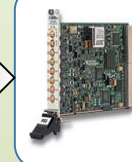
NI Real-Time Linux



CPUs,  
RAM



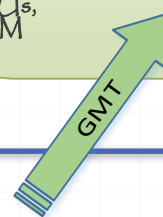
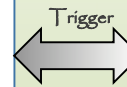
I/O



I/O



CPUs,  
RAM



# Outline

- MTA
- Why RADE?
- The challenge
- The Scope
- Coping with large applications
- RADE today
- Future





# RADE today

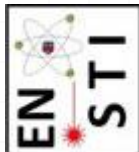


- RADE has become adult
- LabVIEW has started getting out of the Lab
- Copes with the classical software development challenges
- Enables LabVIEW to be used for accelerator applications

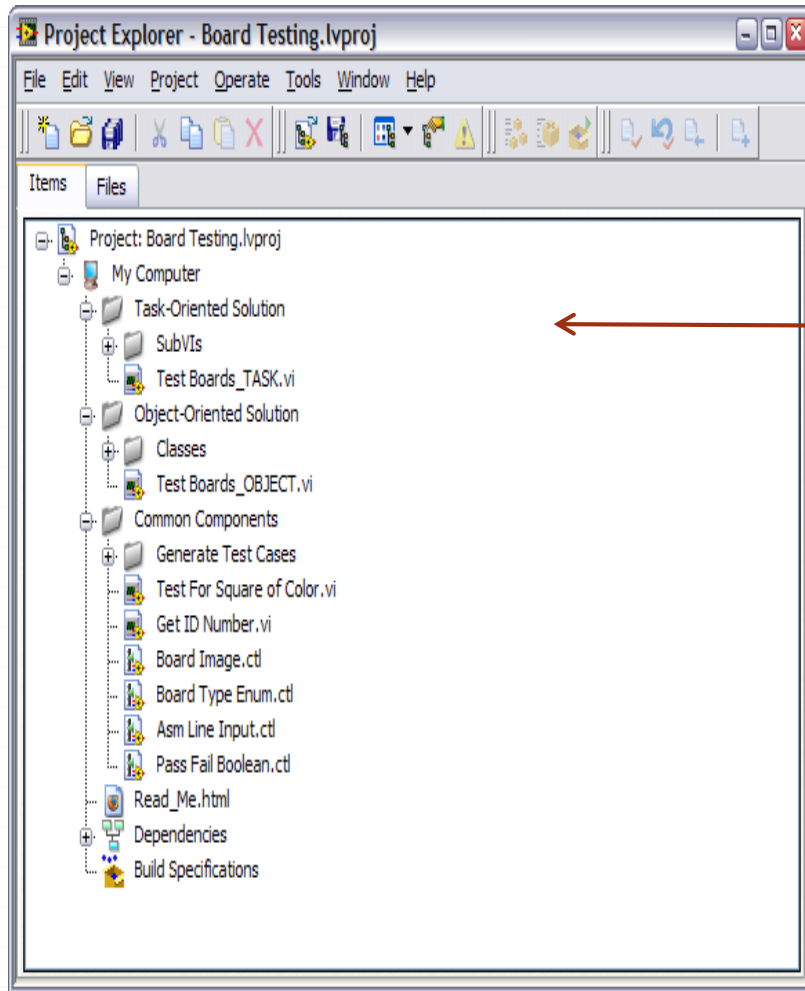
# Outline

- MTA
- Why RADE?
- The challenge
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- RADE today
- Future





# Future Challenges





# Large system management

- How to manage a large installation?

Management System

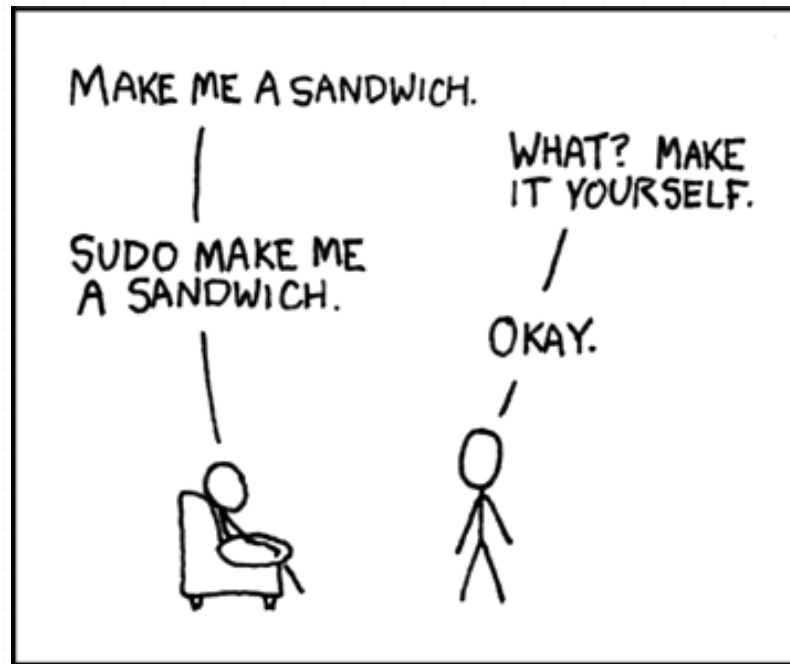
- Monitoring
- Security
- Re-install
- Updates



# Watch these!

- [The LHC](#) by Brian Cox
- [Extreme programming](#) by Elisabeth Hendrickson
- [What the agile manifesto left out](#) by Brian Marick
- [Practicing Continuous Integration](#) by David Cramer
- [The Actor Framework](#) by Stephen Mercer
- [ZMQ is the answer](#) by Ian Barber

# Questions





# www.cern.ch/RADE

RADE

About

Download

Support

Training

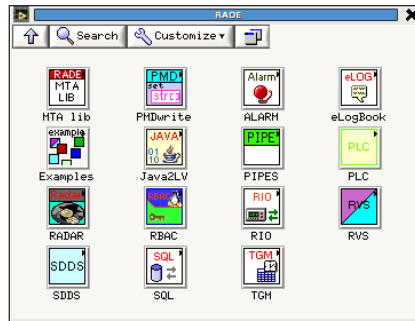


RADE is a Rapid Application Development Environment based on LabVIEW.

It's the solution at CERN to develop expert tools, machine development analysis and independent test facilities in integration with the CERN control systems.

- [RADE Modules](#)
- [What is new in RADE?](#)

## RADE Modules



Library	Icon	Description
MTALib		MTA library. Contains extensions of standard LabVIEW functions for Array, Boolean, Comparison and other palettes.
ALARM		Activating and terminating alarms for the LHC ALARM System.
eLogBook		Adding events and file-attachment to events into eLogBook.
RIO		RADE Input/Output provides an access to a live data from the front-ends. Provides GET, SET and Subscription possibilities for any RDA supported device. RIO is the combination of JAPC and FESA palettes of RADE's previous versions.
PIPES		Using pipes for Read and Write operations.