Brief history of the MARTe framework

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Outline

Where we started from - JETRT

From JETRT to MARTe

Conclusions
PPCC Control systems in the mid 90s

PPCC systems for plasma magnetic control

The two main systems run at JET by the Plasma Position and Current Control Group were (and still are!):

- **Shape Controller (SC)** C code deployed on a VxWorks/VME/Motorola68k platform
- **the Vertical Stabilization System (VS)** C code deployed on 4 Texas Instruments DSPs

  - The code was *tailored* for the specific platform
  - Lack of modularity
  - Different software solutions to interface with the JET software infrastructure (pre-pulse system configuration, post-pulse data collection, ...)

M. Lennholm et al.,
Plasma control at JET,
A new framework for RT applications

- In 2001/2002 the revamping of the SC was planned in order to add the eXtreme Shape Controller algorithm (XSC)
- Within the PPCC group, it was decided to move to a common framework for the development of real-time applications
A new framework for RT applications

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Aims (User Requirements)

- Standardize the development of real-time applications
- Increase the code reusability
- Separate (as much as possible) the user application from the software required to interface with the plant infrastructure
- Reduce the time needed for commissioning
A new framework for RT applications

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**High Level System Requirements**

The new framework would have been:

- **portable (multi-OS and multi-platform)**
- **modular – the user application would have been easily plugged into an executor of real-time application**
- written in C++ (object oriented approach)
Separation between application and infrastructure software

Why we want to separate application from infrastructure software?

- Scientists (process experts) can abstract from the plant interfaces
- Increase code reusability
- Achieve standardization
The JETRT framework was developed in 2002/2003 to deploy the XSC.
JETRT is based on the cross-platform BaseLib library (developed within the PPCC group).
Services and servers

1. Identification of the services
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2. Definition of the servers interface
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3. Implementation (technological solutions)
The Real-time Application Plug-in that can be used to:

- ▶
- ▶
- ▶
- ▶

A Generic JETRT Real-Time Application in the JET environment

JETRT framework test and validation tools

VxWorks platform

- ATM RTDN Data Feeder
- HD Data Feeder
- JETRTApp

- User app plug-in

- Open-loop Simulator
- User app plug-in
- Simulink Speed-loop Simulator

- JET pulses data

- User app plug-in

Windows platform

- User app plug-in
- Simulink model

- JET pulses data

The User Application plug-in

- User App
- Plug-in
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The **Real-time Application Plug-in** that can be used to:

- perform offline validation against a plant model
- perform real-time validation with hardware-in-the-loop
- run the real-time system on the plant
The new SC (including the XSC) was deployed on a 400 MHz G4 PowerPC running VxWorks

- 2 ms control loop (but it can easily run at 1 ms)

Commissioning of the JETRT framework and of the XSC

- Thanks to portability, an exhaustive debug of both the JETRT framework and the XSC was performed
  - offline, on a Windows–based platform
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Only 3 days of testing on the plant were needed for the commissioning of the new system
MARTe History

G. De Tommasi

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MARTe - The origins (Fall Winter 2004/05)
JETRT limitations

- JETRT didn’t provide a real separation between the user application from the plant-interface software!
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From JETRT to MARTe

- More modularity → Generic Application Modules (GAMs)
- Real separation → Dynamic Data Buffer (DDB)
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...what happened after is a well-known story
What I like (as a user)...

- I need to know very few things about the framework to write my GAMs
- I can make the functional tests in my office without any specific hardware
- I’m sure that the code I’m writing will be the one deployed on the plant
- I can easily build a web-based HMI that will not affect the system performance
- If someone develops something interesting, I can easily use it in my project
...and what I don't

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  - Lack of tools that facilitate the system setup
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- Writing the *config* files by hand!
  - Lack of tools that facilitate the system setup
- Although some of effort has been done so far...
  - documentation is one of the weakest point for MARTe
What (I think) is important for the ITER framework

Long term scenario

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- Possibility of testing the real-time software with a simple PC (no need of special DAQ hardware)
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- Automatic code generation(?)