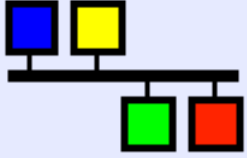


# EPICS

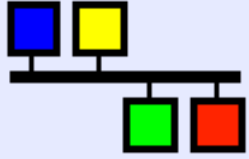


# Real-time Performance Improvement of “EPICS on F3RP61”

Yokogawa Electric Corporation



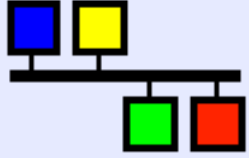
# EPICS



## agenda

- **EPICS on F3RP61**  
**Features of F3RP61**
- **Stability and Record**  
**Application Example**
- **Real-time Performance**  
**Latency Measurement**  
**Measured Performance**
- **Demonstration Video 2011**
- **Conclusions**

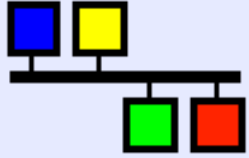
# EPICS



## EPICS on F3RP61

- **KEK placed a request for FA-M3-PLC's CPU, F3RP6x (e-RT3), to run Linux**
  - EPICS device support and driver for F3RP61 was developed by Mr. J.Odagiri (KEK)
- **To turn PLCs themselves into IOCs**
  - Most of ladder programs can be replaced with EPICS Sequencer
- **For fully EPICS-based front-end control**
  - Rapid application development cycle
  - Easier maintenance
  - Finer and more flexible control

# EPICS

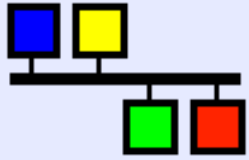


Pb free  
RoHS



## Features of F3RP61

- **Operating System**
  - Linux and VxWorks available
- **Processor and Interface**
  - PowerPC 533MHz
  - Ethernet x2, Serial IO, IEEE1394, CF Card
  - Can use many kind of PLC modules
- **Maintenance**
  - Operation under 55°C circumstance
  - Long term product supply
- **Other feature**
  - Multi CPU Function, I/O Open

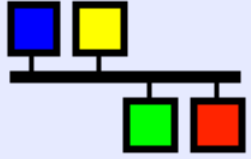


## Stability and Records

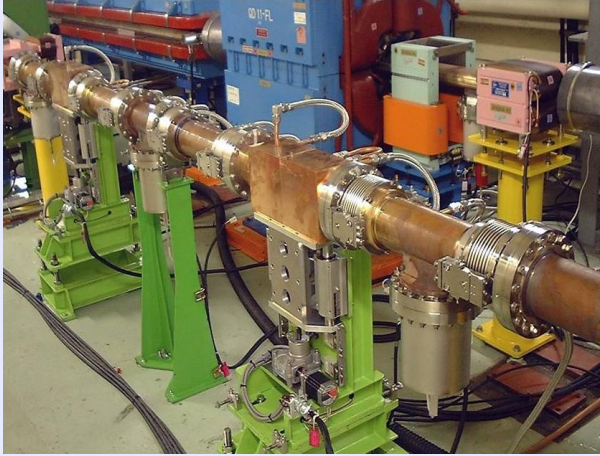
- **F3RP61 has served as IOC for more than two years to prove its stability**
- **The number of F3RP61-based IOCs has reached dozens in the KEK sites (Tsukuba and Tokai)**
  - KEKB (Main Ring / Linac) / PF-Ring / PF-AR / J-PARC / cERL etc.
- **Standard kernel 2.6.24.3/2.6.26.8-based**
  - Modification was minimized in the porting

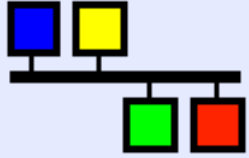


# EPICS



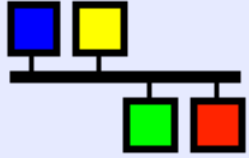
## Application Examples





## Real-time Performance

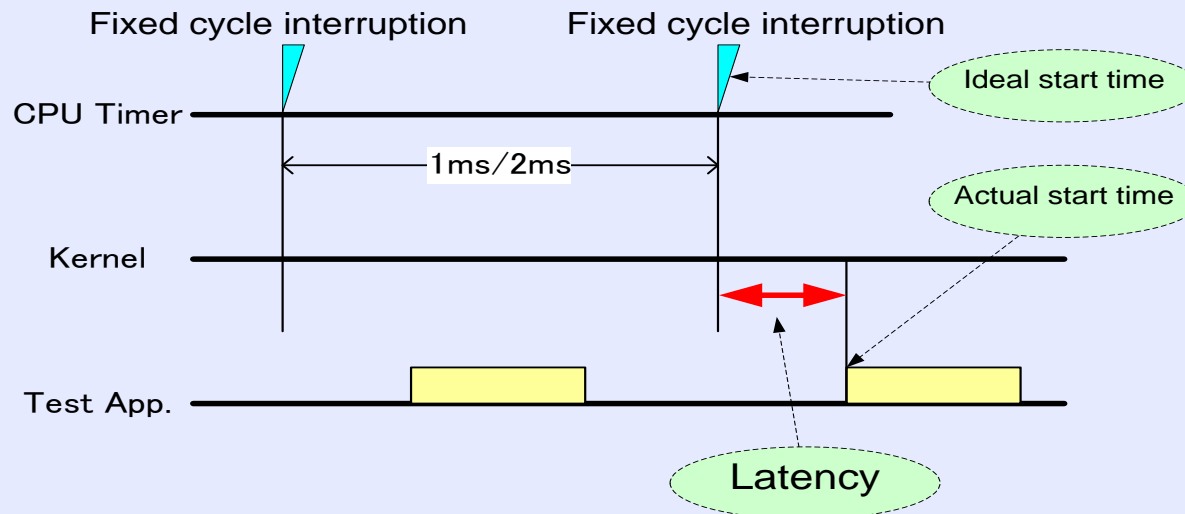
- Latest Board Support Package(BSP) supports **CONFIG\_PREEMPT\_RT** option
- All improvements are in the kernel
  - More preemptive than CONFIG\_PREEMPT
  - Large part of interrupt handlers were demoted to kernel threads to give way to real-time threads
- No changes in APIs
  - No need to modify applications already in operation
  - Just choosing **ulmageRT** in the BSP will do it for you



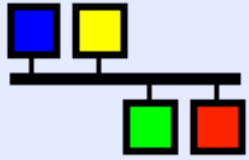
## Latency Measurement

### ➤ Latency Measurement by using fixed cycle interrupt

- With CPU load caused by hackbench
  - ✓ hackbench creates many processes communicating with each other under the scheduler's control



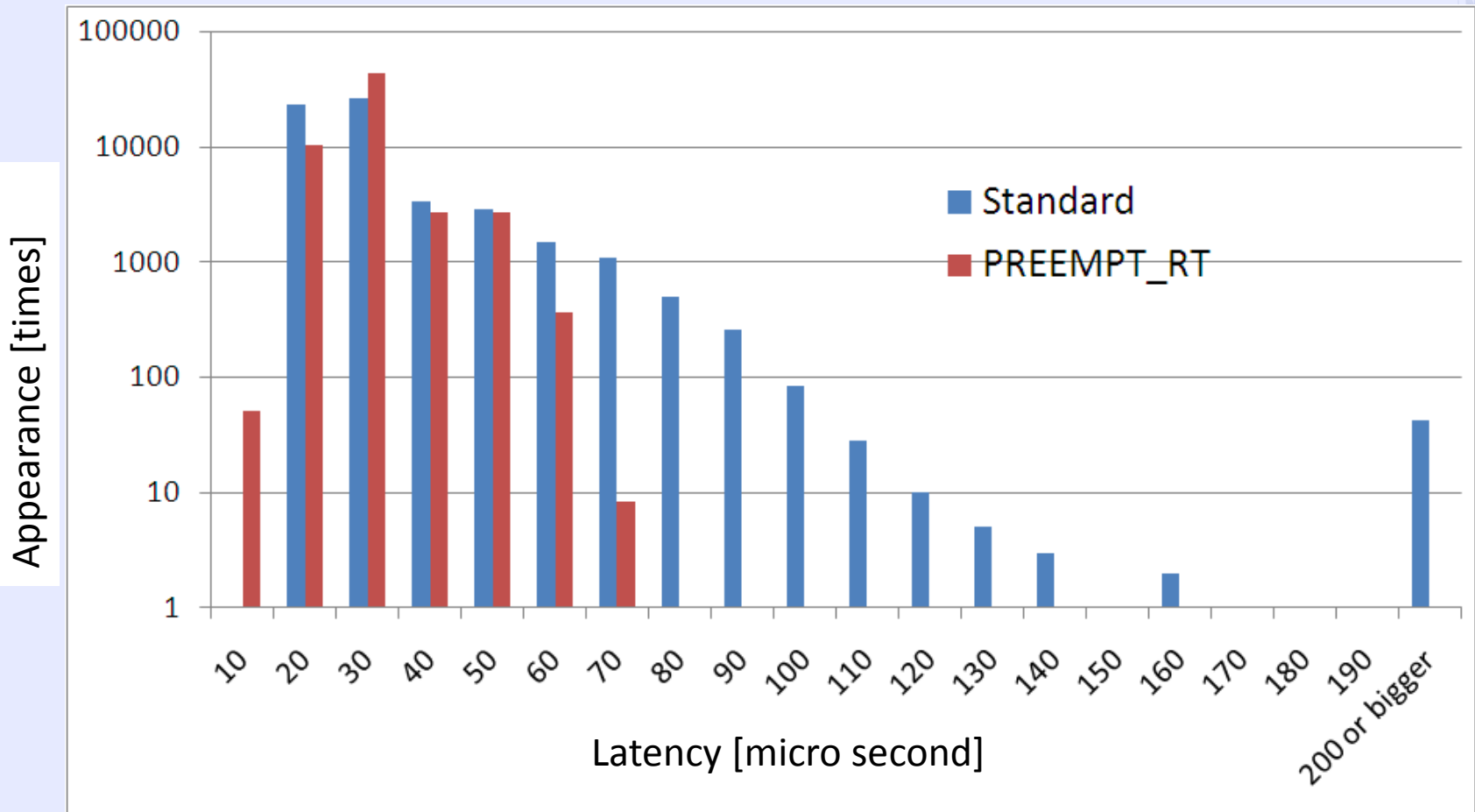


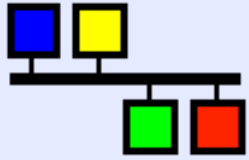


# Measured Performance

	Standard	PREEMPT_RT
Max. Latency	1,065 $\mu$ s	92 $\mu$ s

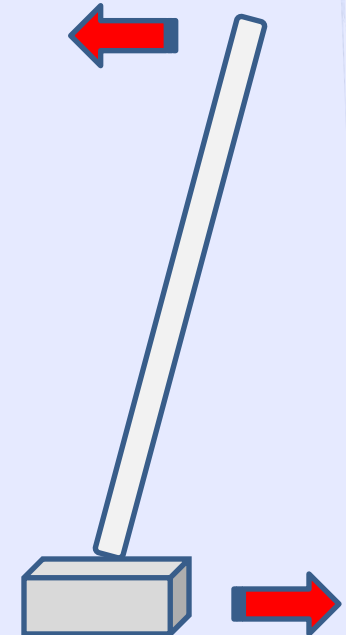
Table for Latency frequency distribution of application start of fixed cycle with I/O process(load : hackbench)

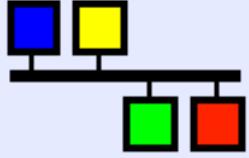




## Demonstration Video 2011

- **Inversed pendulum controlled by EPICS on F3RP61**
  - A metal bar on a movable cart
  - Monitor input
    - ✓ Angle of the pendulum
    - ✓ Position of the cart
  - Control output
    - ✓ Velocity of the cart
- **By using an EPICS special record**
  - Developed by Dr. N. Yamamoto (J-PARC)
  - To calculate the feedback output
  - By processing the record every “0.005 second”

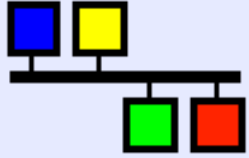




## Conclusions

- A new type of EPICS IOC was realized with F3RP61
- Widely adopted in EPICS-based accelerator control for various purposes
- Significantly improved real-time performance with **PREEMPT\_RT** patch
  - To Extend the range of applications

# EPICS



Thank you for your attention.

- **We do need feedback from EPICS users for further improvements**