

Product Update

New controller F3RP71 for EPICS IOC

18 May. 2017

Yutaka Kubota

Edge Controller Section, International Sales Dep.,
Control Instruments Sales Division, Product Sales
Center, IAPS BHQ
YOKOGAWA ELECTRIC CORPORATION

e-RT3 Plus
anyone anytime anywhere



Two types of Controller



■ Sequence CPU

- ◆ Cyclic execution Engine
 - VITESSE Engine
- ◆ Unique Ladder
 - Object Ladder
 - Macro Block
 - Script Coding
- ◆ Sensor control block
- ◆ Unique environment

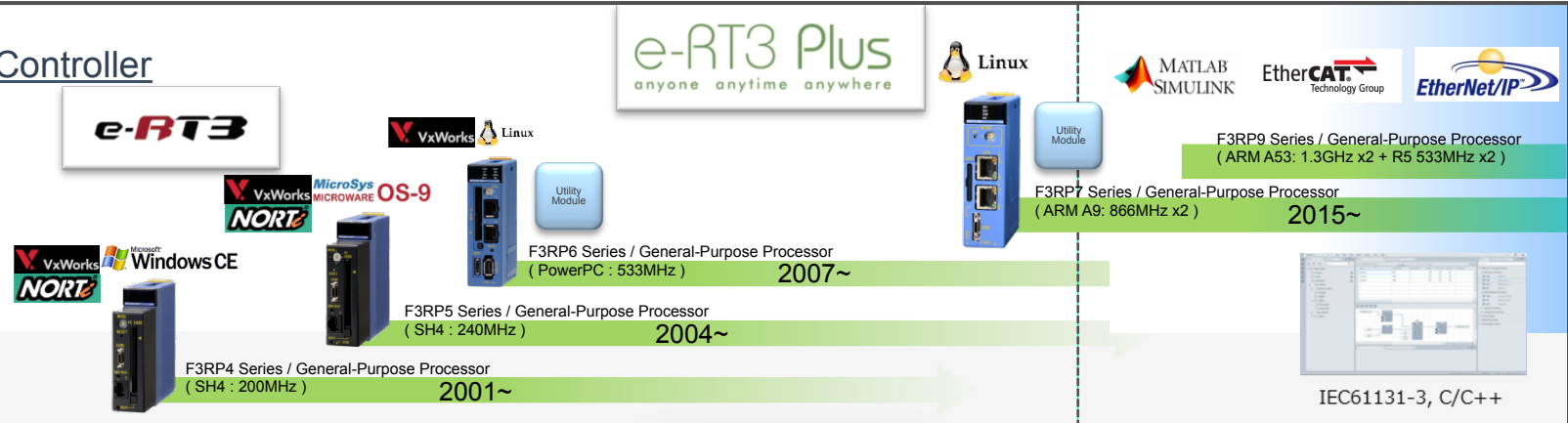
■ Real-time OS CPU

- ◆ RTOS (Real time Linux)
- ◆ C/C++ Language
- ◆ Easy to reuse Program
 - Library, Middleware
- ◆ Multi task function
- ◆ Standard interface

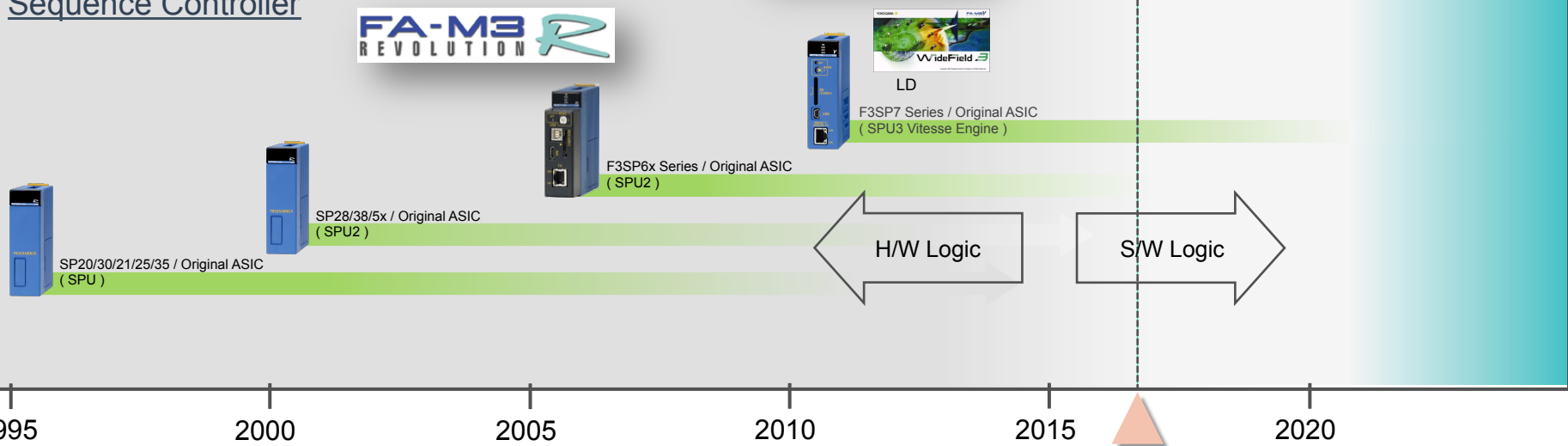


Product Roadmap

C Language Controller



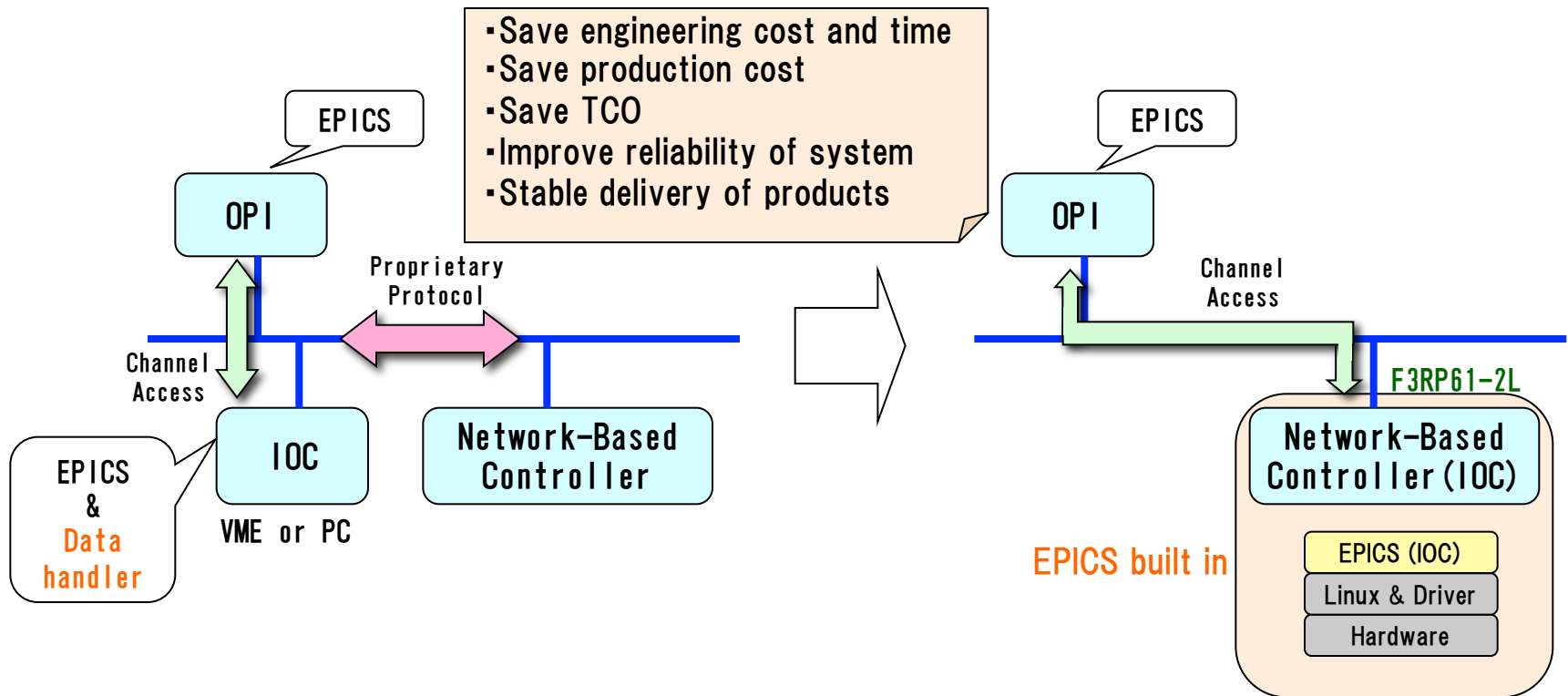
Sequence Controller



EPICS on e-RT3 2.0

EPICS built in F3RP61-2L gives us many benefit

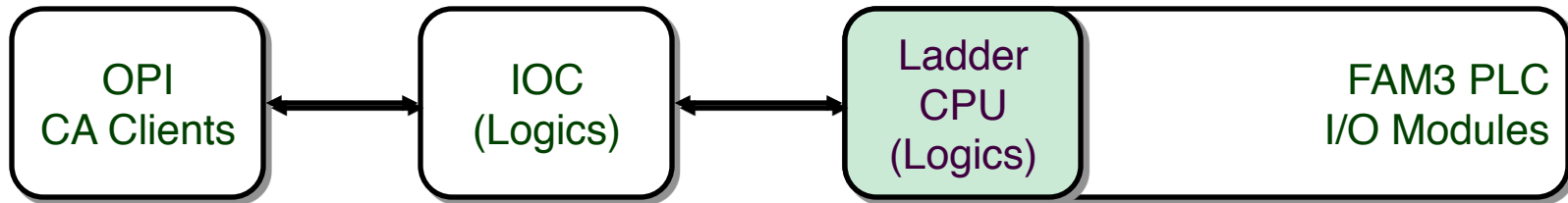
It is the result of good collaboration with KEK and Yokogawa.



Simple usage under EPICS

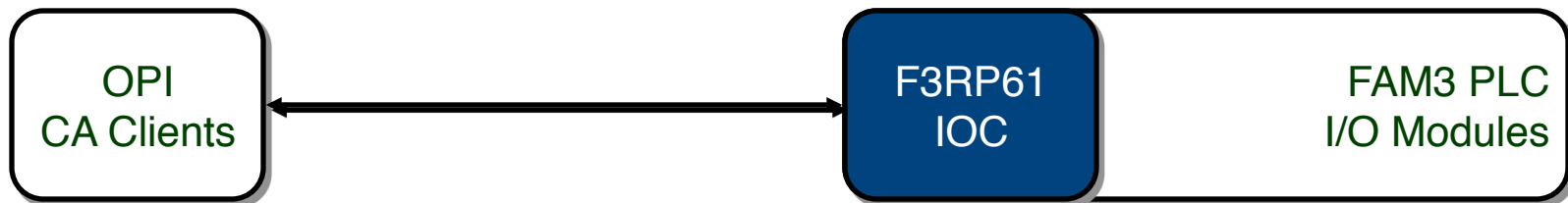
Conventional PLC usage

with asynchronous access

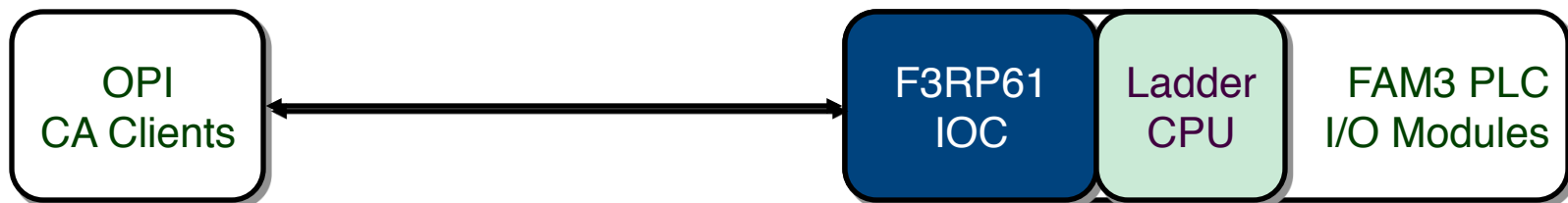


PLC usage with F3RP61

with only synchronous access and maybe with sequencer



If necessary, we can combine



Installation in Accelerator system

Yokogawa Supports ACCELERATOR Applications. We introduce the adopted experiences in the world.

KEK HIGH ENERGY ACCELERATOR RESEARCH ORGANIZATION (TOKAI Campus)



J-PARC Japan Proton Accelerator Research Complex

- > J-PARC Main Ring, Late takeoff (Septum Power Control, Positioning Control, InterLock Status Monitor)
- > J-PARC Main Ring, Beam Monitor (FCT of Beam loss·Monitor, Neutrino·Line)
- > J-PARC Hadron Experimental Facility (Interlock·Status Monitor)



Yokogawa's products complying



e-RT3 2.0
EPICS on F3RP61

e-RT3™
eMbedded M@chine Controller

MADOCA Operation check finished

HIROSHIMA UNIVERSITY

- > control of the low-level rf unit
 - > control of clearing electrodes for ion removal
- ※ MADOCA is a control framework developed in SPring-8.

STARS Operation check finished

※ STARS(Simple Transmission and Retrieval System) for small-scale control systems.

e-RT3 Worldwide Experiences

Japan

- ▶ Japan Synchrotron Radiation Research Institute (SPring-8)
- ▶ THE UNIVERSITY OF TOKYO
- ▶ HIROSHIMA UNIVERSITY
- ▶ NAGOYA UNIVERSITY
- ▶ TSUKUBA UNIVERSITY
- ▶ TOHOKU UNIVERSITY

Overseas

- ▶ **China** : Shanghai Synchrotron Radiation Facility (SSRF)
- ▶ **Taiwan** : National Synchrotron Radiation Research Center (NSRRC)
- ▶ **Korea** : Pohang Accelerator Laboratory

KEK HIGH ENERGY ACCELERATOR RESEARCH ORGANIZATION (Tsukuba Campus)



- > KEKB accelerator (Pulse Q electromagnet power control, movable mask positioning control)



RIKEN



- > RIBF 28GHz superconductivity ECR ion sources control









e-RT3 Plus
anyone anytime anywhere

F3RP7X Series

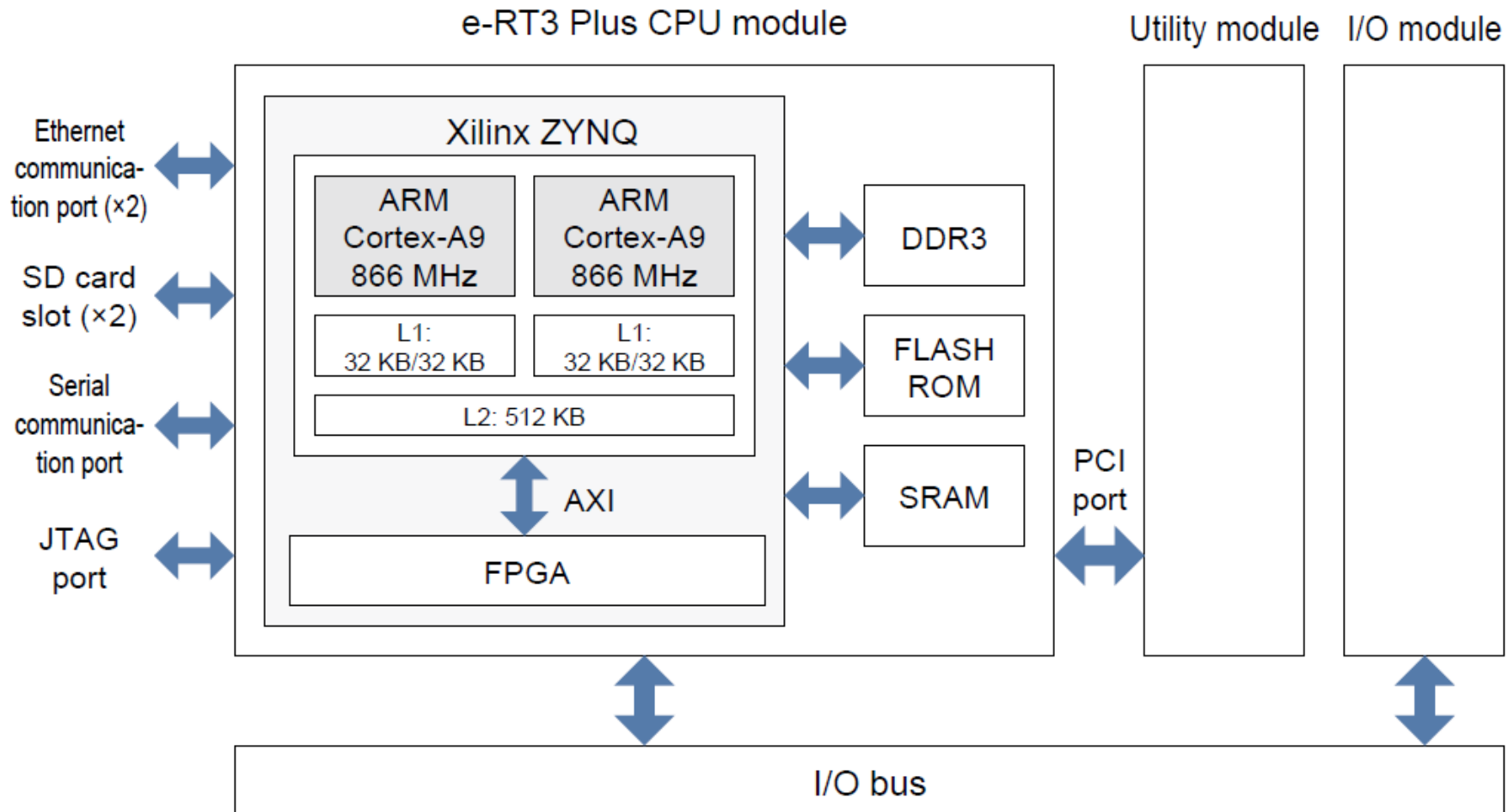
Differences from existing products

<u>Usability/Flexibility</u>			CPU Setting Tool / Device Monitoring Tool Smart Access / Preinstalled OS/OSS
<u>Expandability</u>		PCI Bus (32 bit)	PCI Bus (32 bit) FPGA installed
<u>Storage</u>	PC Card 1 Slot	CF Card 1 Slot	SD Card (SDHC) 2 Slot
<u>Network</u>	10BASE-T/100BASE-TX 1 Port	10BASE-T/100BASE-TX 2 Port	10BASE-T/100BASE-TX/1000BASE-T 2 Port
<u>Processor</u>	SH4 7750S 200MHz (RP4□) SH4 7750R 240MHz (RP5□)	PPC MPC8347E 533MHz	ARM Coretex-A9 800MHz Dual
<u>Supported OS</u>	VxWorks / NORTi / WinCE (RP4□) VxWorks / NORTi / OS-9 (RP5□)	Linux / VxWorks	Linux / VxWorks
	<p><u>4/5 Series</u></p> 	<p><u>6 Series</u></p>  <p>e-RT3 2.0 FUTURE POSSIBILITY EVOLUTION</p>	<p><u>7 Series</u></p>  <p>New</p> <p>e-RT3 PLUS</p>

Specification

		F3RP71-2L	F3RP71-1R	F3RP61-2L	F3RP61-2R
		 	 		
CPU	Core	ARM Cortex-A9 MPCore (dual) 866 MHz		PowerPC MPC8347E 533 MHz	
	L1 cache	32 KB/32 KB (I/D) each core		32 KB/32 KB (I/D)	
	L2 cache	512 KB shared by both cores		Not applicable	
OS		Linux 3.18.16 + patch-3.18.16-rt13		Linux 2.6.26.8 + patch-2.6.26.8-rt1	
Memory	Flash	256 MB/128 MB		64 MB	
	SDRAM	1 GB/256 MB (DDR3 533 MHz)		128 MB (DDR2 266 MHz)	
	SRAM	8 MB/Not applicable		4 MB/Not applicable	
I/F	Ethernet	1000BASE-T, 100BASE-TX, 10BASE-T (2 ports)		100BASE-TX, 10BASE-T (2 ports)	
	RS-232C	9.6 to 115.2 kbps (1 port)			
	Storage	SDHC card (2 slots)		CF card (1 slot)	
	PCI	For utility modules (32 bit)			



CPU Block Diagram



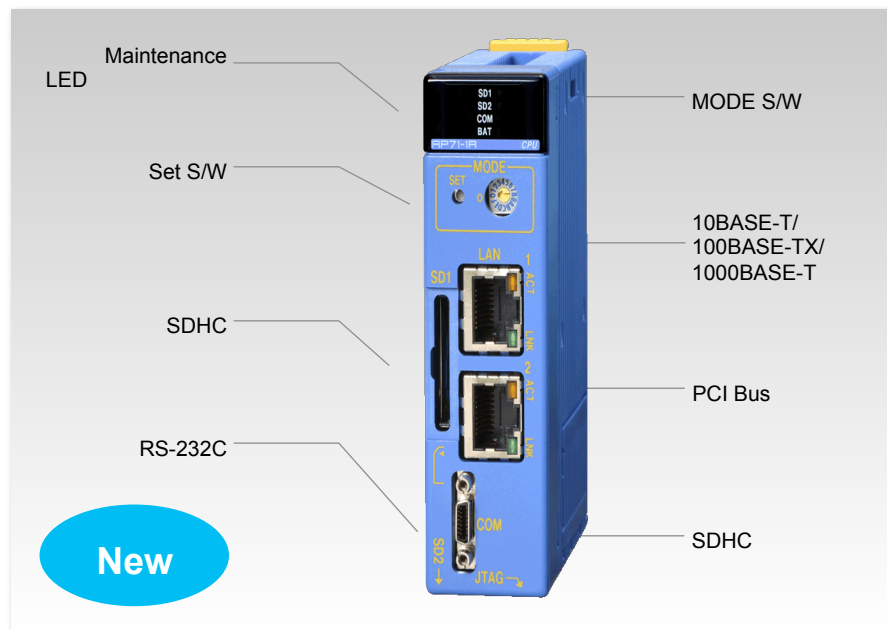
e-RT3 Plus “Basic Performance”

- Dual Core Processor
 - ◆ Throughput speed 4.3x
- Real-time performance
 - ◆ Latency (Up to 105x)
 - ◆ Jitter ($\leq x1/2$)
- Memory capacity
 - ◆ Flash ROM (max 4x)
 - ◆ SDRAM (max 8x)
 - ◆ SRAM (max 2x)



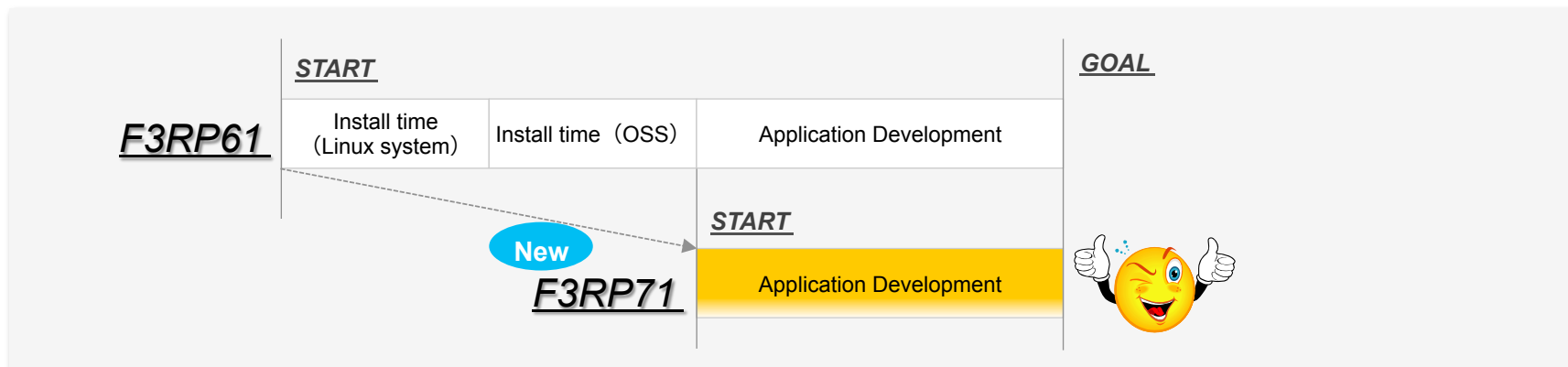
- Gigabit Ethernet [2 port] 
- SD Card [2 slot]
- I/O access speed up 

Performance Test 

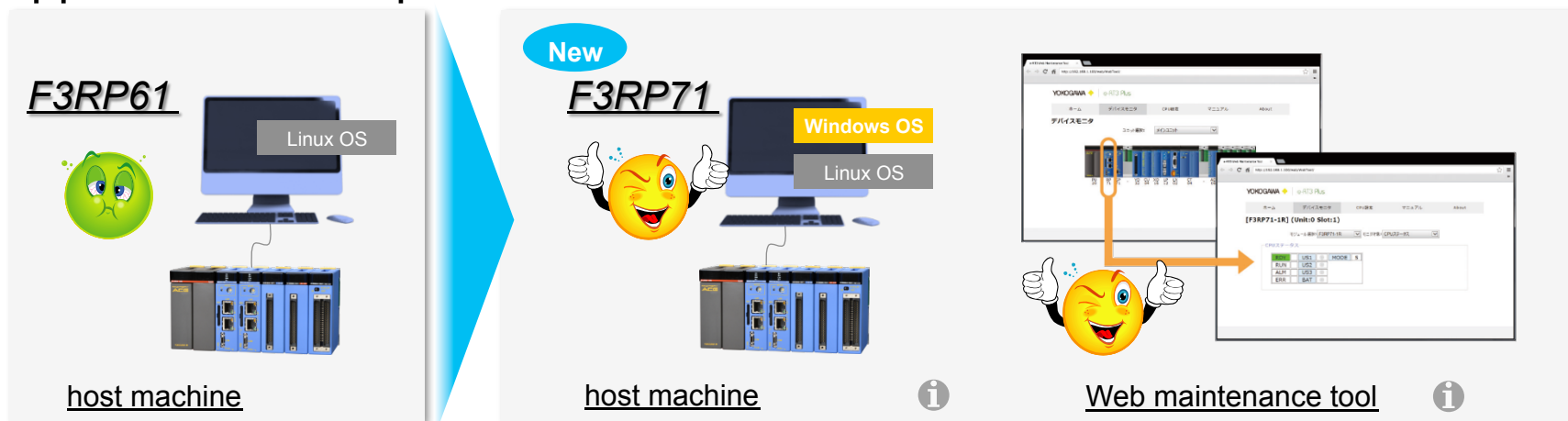


e-RT3 Plus “Accessible / Visible”

- Preinstall Linux system (Kernel, Device, OSS etc.)



- Application development on Windows



e-RT3 Plus “Applicable”

■ Applicable controller by OSS

- ◆ APACHE (HTTP Server)
- ◆ PHP (script language)
- ◆ TCPDF (Reporting)
- ◆ CUPS (printer server)
- ◆ PostgreSQL, SQLite3 (Database)

⋮



PostgreSQL



Over 90 kinds of OSS

i ※Open Source Software

Logger

Monitoring

Process Control

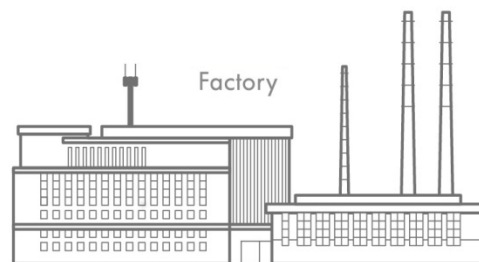
Inline Instrumental

Intelligent gateway

Machine control

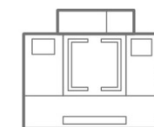


Infrastructure



Factory

Manufacturing equipment

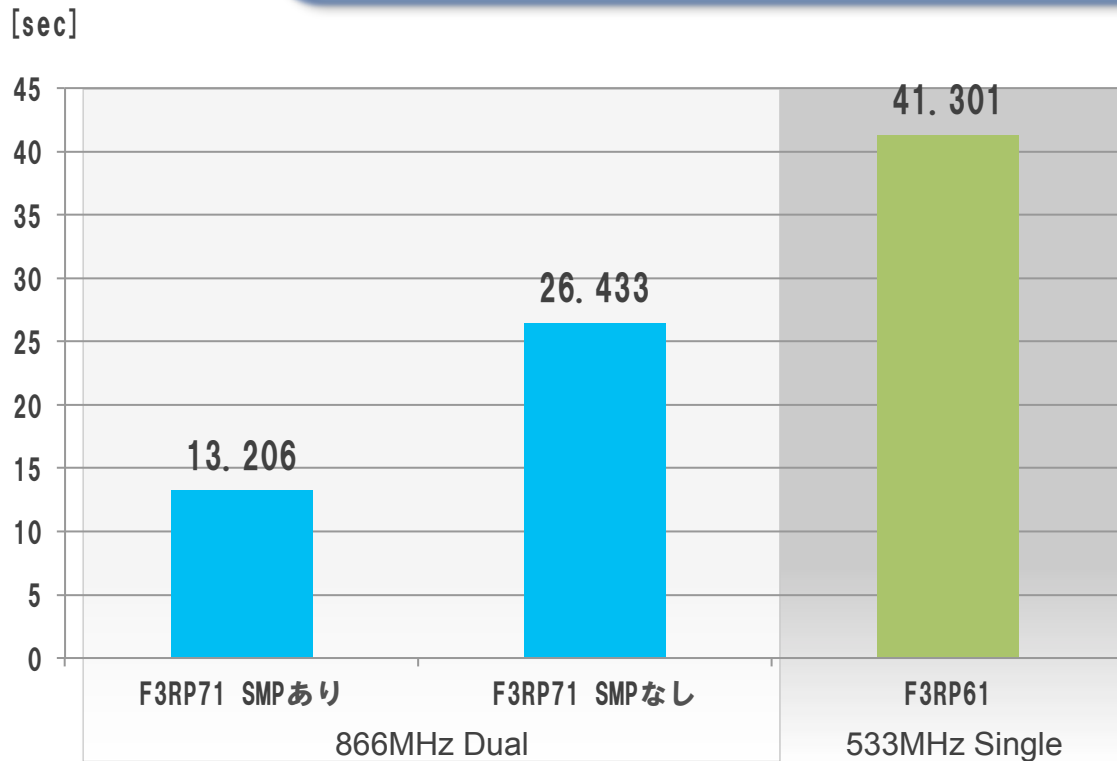
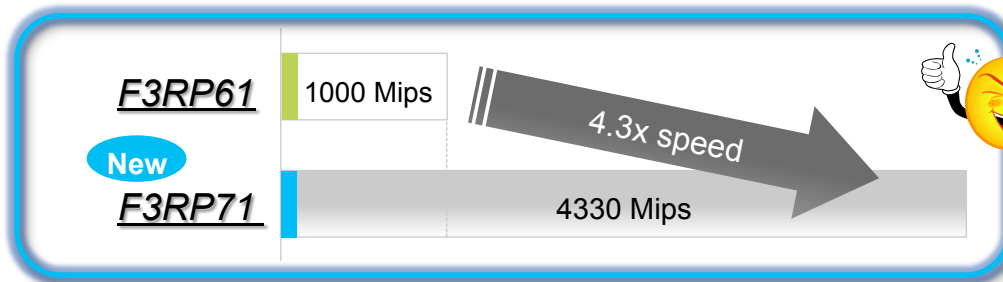


Co-innovating tomorrow™

Thank you for your attention.

Appendix

Processor performance test



x3.13

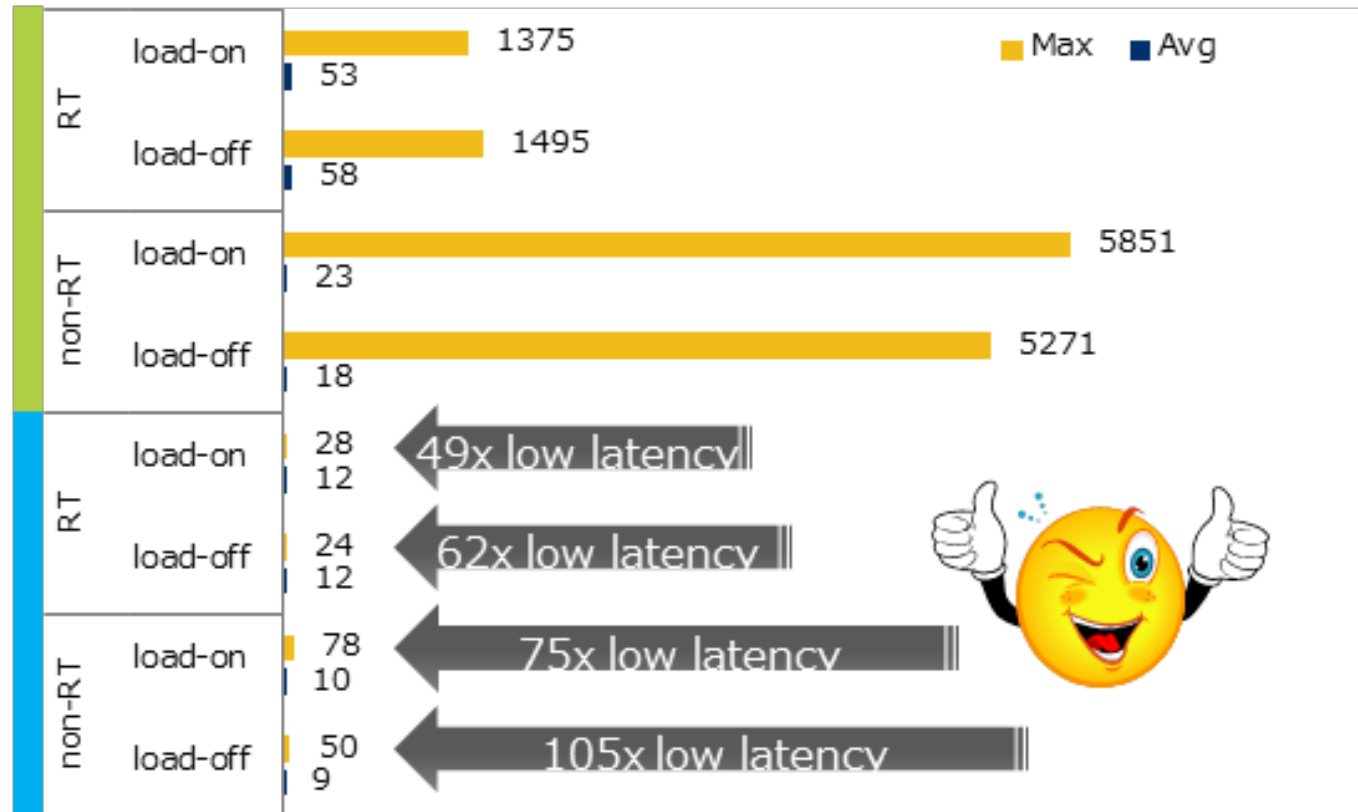
Executing Time of
10 Subtraction
Processes (0xFFFFFFFF
times)



F3RP61

New

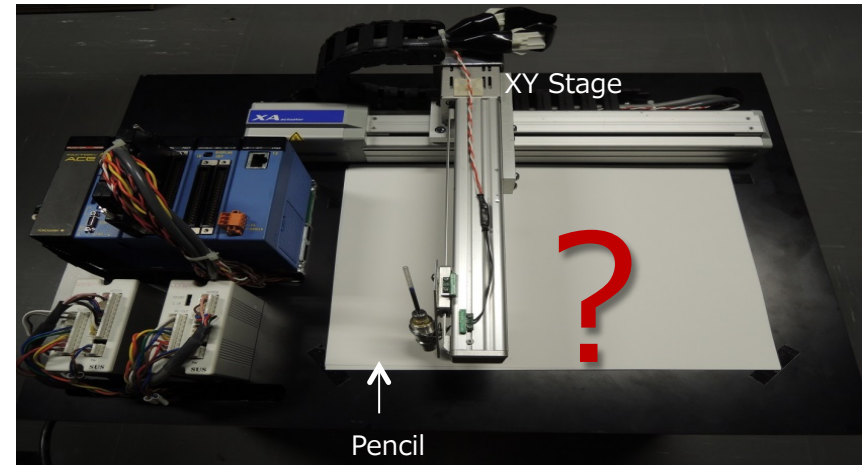
F3RP71



Performance

■ Drawing speed competition

- ◆ Plot points
 - 1266
- ◆ Load Application
 - Subtraction process x 10
- ◆ Processing time
 - 1min



VS





e-RT3 2.0
FUTURE POSSIBILITY EVOLUTION

2007 ~



VS

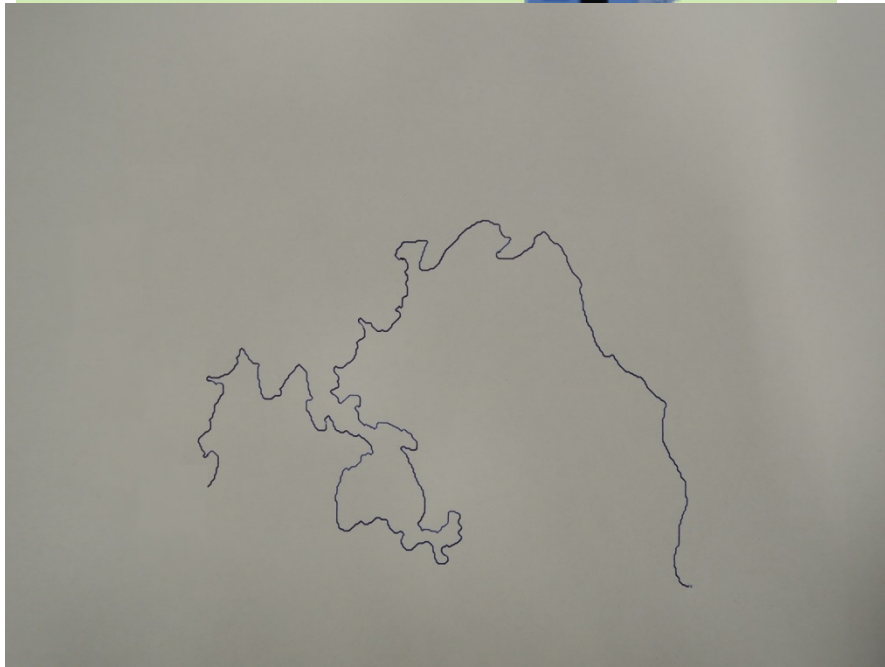
New

e-RT3 Plus
anyone anytime anywhere

2016 ~



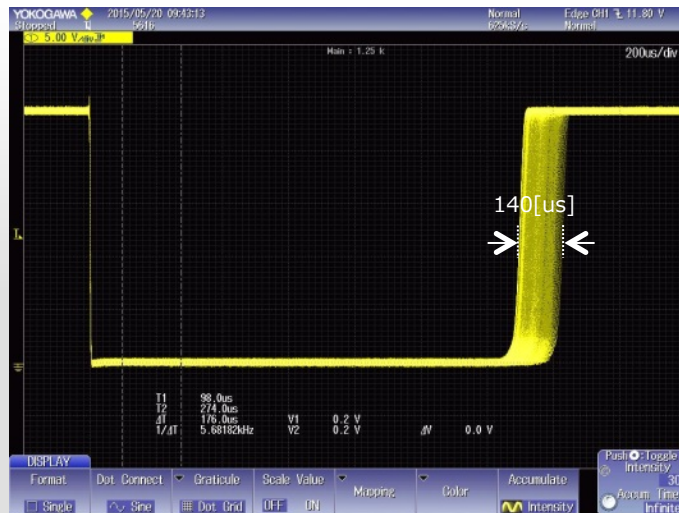
WORLDWIDE



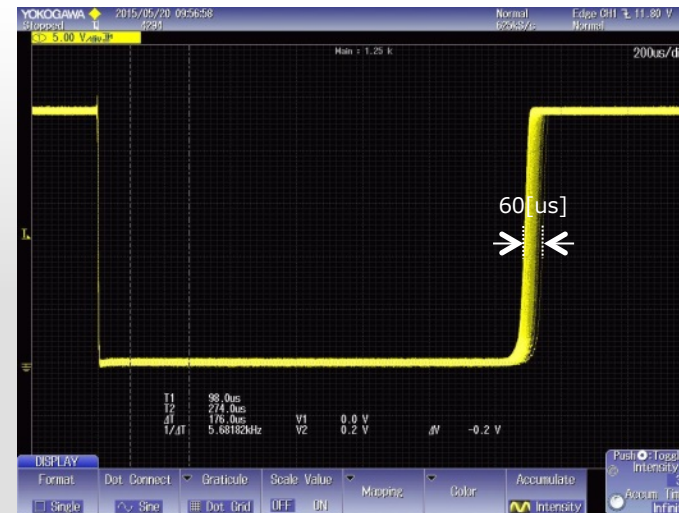


Linux

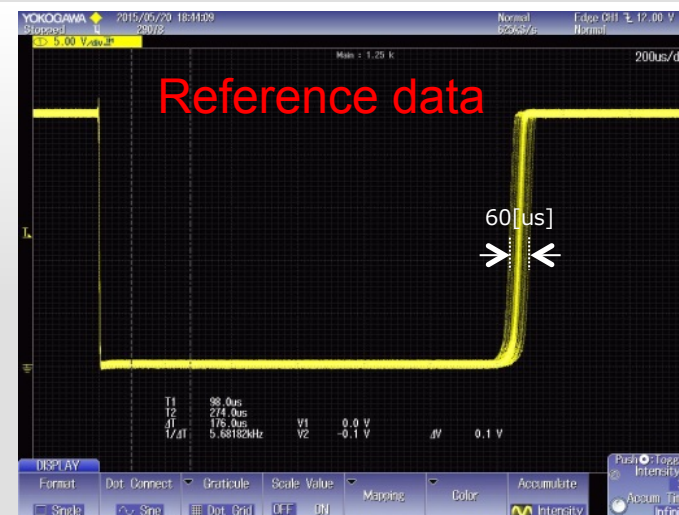
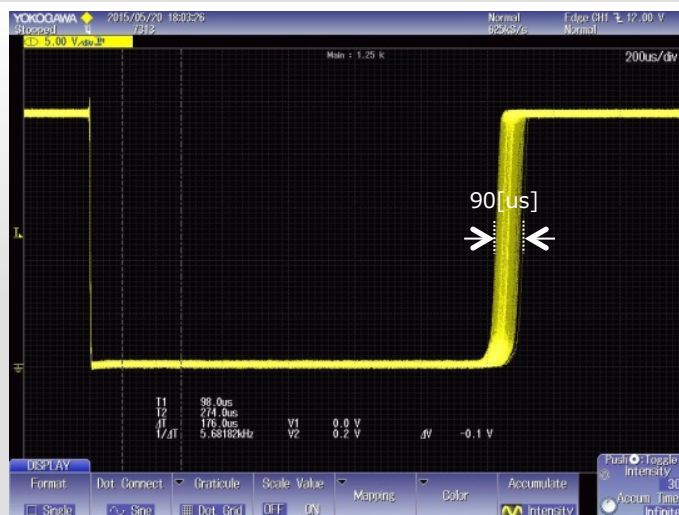
RP6 Series



RP7 Series



VxWorks





Relay access time

	Input		Output			
	Read		Read		Write	
	1 word	2 word	1 word	2 word	1 word	2 word
F3RP71	8.602	8.632	-	-	13.781	24.471
F3RP61	12.712	12.722	12.681	19.977	19.175	33.095

Read x1.5
Write x1.4

Register access time

	Read				
	1 word	8 word	10 word	64 word	100 word
F3RP71	8.296	-	50.491	-	472.436
F3RP61	11.119	51.701	-	376.048	-

	Write				
	1 word	8 word	10 word	64 word	100 word
F3RP71	8.479	-	51.164	-	477.343
F3RP61	10.903	50.008	-	363.036	-

Read ≐ x1.3
Write ≐ x1.2

I/O interrupt response time

	Linux		VxWorks	NORTi
	F3RP71	F3RP61	F3RP62	F3RP5x-3P
Response time (Min)	94	110	95	60
Response time (Max)	136	195	115	70
Average	107	-	-	-

Respond as fast as RP62 (VxWorks)

Development host machine Environment

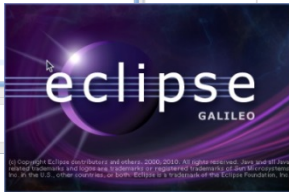
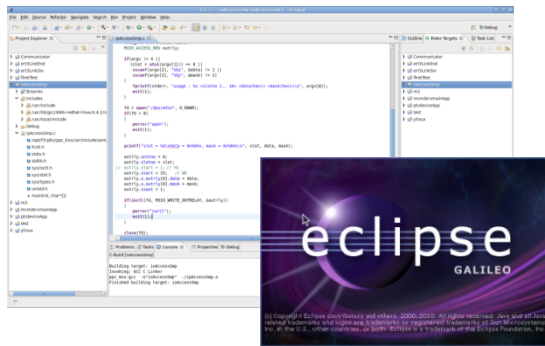


■ Xilinx SDK (Windows/Linux)

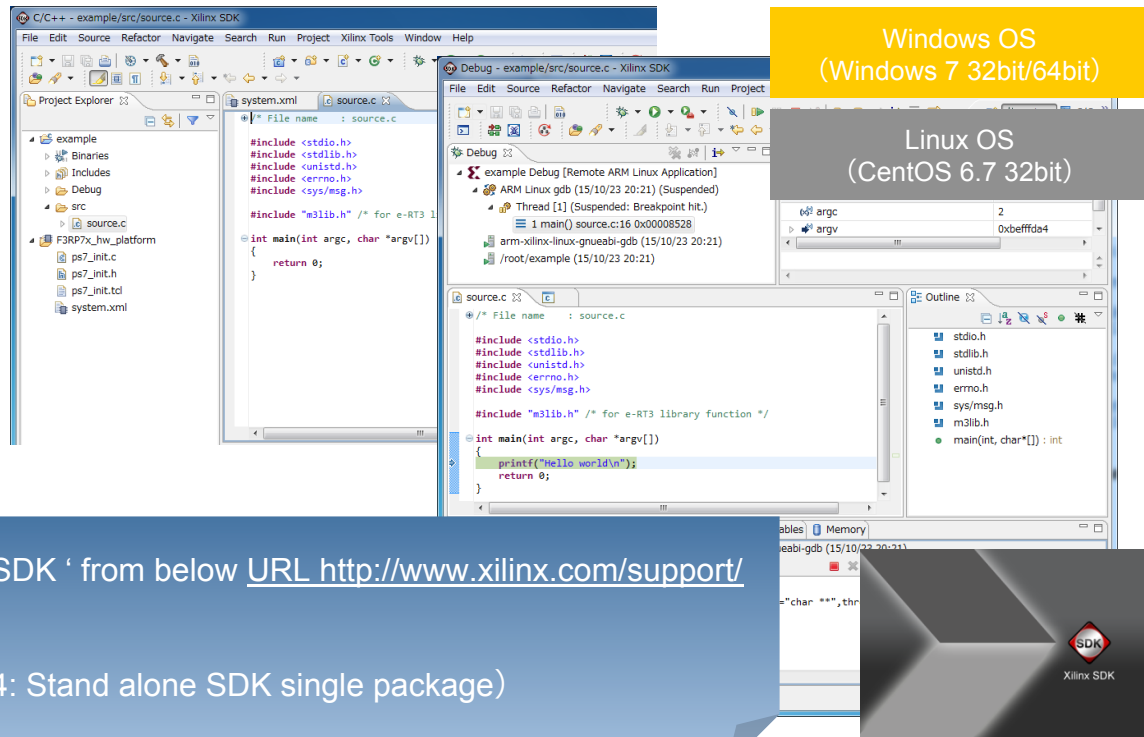
- ◆ Application Development
- ◆ Execution/Debug (Remote)
- ◆ File transfer etc.

Download From Yokogawa or Xilinx Web site

eclipse



Xilinx SDK



User can download the install file, Xilinx SDK ' from below URL <http://www.xilinx.com/support/download/index.htm>

Software Development Kit (Vivado 2013.4: Stand alone SDK single package)
Install file size : ≈2GB

Web maintenance tool



■ Device monitor

- ◆ CPU module monitor
- ◆ I/O device monitor
- ◆ Comment file

■ CPU config.

- ◆ Top/Login
- ◆ Service
- ◆ User setting
- ◆ IP address setting
- ◆ Calendar/Time setting
- ◆ Start script
- ◆ Memory · Log
- ◆ Device setting

■ Display Instruction Manual

Web browser LAN cable Web server mounted

The diagram illustrates the connection between a web browser and a web server. The web browser displays the Yokogawa e-RT3 Plus web interface, which includes a navigation menu (Home, Device Monitor, CPU Settings, Manual, About) and a main content area. The main content area shows the device monitor page, which displays a list of modules and their status. An orange arrow points from the device monitor page to a detailed view of a specific CPU module (F3RP71-1R) in Unit 0 Slot 1. This detailed view shows the CPU status table:

CPUステータス	
RDV	US1
RUN	US2
ALM	US3
ERR	BAT

Below the detailed view, there are four smaller screenshots of the web interface showing different configuration pages: 1. Start script configuration (起動スクリプト設定), 2. IP address setting (IPアドレス設定), 3. Device settings (デバイス設定), and 4. A splash screen for e-RT3 Plus with the slogan "READY for Linux".

Open Source Software list (90種類)



No.	Package name	Version	License	No.	Package name	Version	License	No.	Package name	Version	License
1	apache2	2.4.10	Apache License v2.0	31	libiconv	1.11.1	LGPLv2	61	php-fpm	5.6.4	PHP-3.01
2	bash	4.3.30	GPLv3	32	eglibc-gconv	2.19	GPLv2, LGPLv2.1	62	php-fpm-apache2	5.6.4	PHP-3.01
3	bison	3.0.4	GPLv3	33	libiodbc	3.52.10	BSD, LGPLv2.1	63	poppler	0.35.0	GPLv2
4	chkconfig	1.3.63	GPLv2	34	libsfsys (sysfsutils)	2.1.0	GPLv2, LGPLv2.1	64	popt	1.16	MIT
5	coreutils	8.23	GPLv3	35	termcap	2.0.8	GPLv2	65	postgresql	9.4.0	PostgreSQL
6	cracklib	2.9.2	LGPLv2.1	36	libuser	0.60	LGPLv2	66	postgresql-client	9.4.0	PostgreSQL
7	cups	2.0.2	GPLv2, LGPLv2	37	logrotate	3.8.8	GPLv2	67	procps	3.2.8	GPLv2, LGPLv2
8	dhclient	4.3.1	ISC	38	mktemp	1.7	ISC	68	psmisc	22.21	GPLv2
9	diffutils	3.3	GPLv3	39	module-init-tools	3.15	GPLv2	69	pure-ftpd	1.0.36	BSD
10	dosfstools	3.0.26	GPLv3	40	mtd-utils	1.5.1	GPLv2	70	python	2.7.3	PSFv2
11	e2fsprogs	1.42.12	GPLv2, LGPLv2, BSD, MIT	41	mtd-utils-jffs2	1.5.1	GPLv2	71	readline	6.3	GPLv3
12	e2fsprogs-libs	1.42.12	GPLv2	42	ncurses	5.9	MIT	72	rpcbind	0.2.2	BSD
13	ethtool	3.18	GPLv2	43	net-tools	1.60+26	GPLv2	73	rpm*1	5.4.14	LGPLv2.1
14	findutils	4.4.2	GPLv3	44	nfs-utils-client	1.3.1	GPLv2	74	sed	4.2.2	GPLv3
15	flex	2.5.39	BSD	45	ntp	4.2.8	NTP	75	shadow	4.2.1	BSD, Artistic-1.0
16	foomatic-filters	4.0.17	GPLv2	46	ntp-utils	4.2.8	NTP	76	sqlite3	3.8.8.3	PD
17	freetds	0.92.79	GPLv2	47	ntpdate	4.2.8	NTP	77	sudo	1.8.9p5	ISC, BSD, Zlib
18	inetutils-ftp	1.9.2	GPLv3	48	ntpd	4.2.8	NTP	78	syslogd	1.5	GPLv2, BSD
19	gawk	4.1.1	GPLv3	49	openssh	6.7p1	BSD	79	sysvinit	2.88dsf	GPLv2
20	gdbserver (gdb)	7.8.1	GPLv3	50	openssh-misc	6.7p1	BSD	80	tar	1.28	GPLv3
21	glib-2.0	2.43.2	GPLv2, LGPLv2	51	openssh-sftp	6.7p1	BSD	81	tcpdf	6.2.6	GPLv3
22	grep	2.21	GPLv3	52	openssh-sftp-server	6.7p1	BSD	82	inetutils-telnet	1.9.2	GPLv3
23	gzip	1.6	GPLv3	53	openssl	1.0.1j	OpenSSL	83	inetutils-telnetd	1.9.2	GPLv3
24	initscripts	1.0.0	GPLv2	54	libpam	1.1.8	BSD, GPLv2	84	unixodbc	2.3.2	GPLv2, LGPLv2.1
25	iproute2	3.18.0	GPLv2	55	pam-plugin-cracklib	1.1.8	BSD, GPLv2	85	util-linux	2.25.2	GPLv2, LGPLv2.1, BD
26	iptables	1.4.21	GPLv2	56	passwd	0.79	BSD, GPLv2	86	vim-tiny	7.4	Vim
27	iputils	s20121221	BSD, GPLv2	57	pciutils	3.3.0	GPLv2	87	cronie	1.4.12	ISC, BSD, GPLv2
28	less	458	GPLv3, BSD	58	perl	5.14.3	Artistic-1.0, GPLv1	88	xinetd	2.3.15	BSD
29	libcap	2.24	BSD, GPLv2	59	php	5.6.4	PHP-3.01	89	zile	2.4.11	GPLv3
30	libgcc	4.7.3	GCC RLE v3.1, GPLv3	60	php-cli	5.6.4	PHP-3.01	90	zlib	1.2.8	Zlib