LINUX FOUNDATION
COLLABORATIVE PROJECTS

CIVIL
INFRASTRUCTURE
PLATFORM

Introducing the Civil Infrastructure Platform

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Definition

Civil Infrastructure Systems are technical systems responsible for supervision, control, and management of infrastructure supporting human activities, including, for example,

- Electric power generation
- Energy distribution
- Oil and gas
- Water and wastewater
- Healthcare
- Communications
- Transportation
- Collections of buildings that make up urban & rural communities.

These networks deliver essential services, provide shelter, and support social interactions and economic development. They are society's lifelines.[1)]

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1) adapted from https://www.ce.udel.edu/current/graduate_program/civil.html

The evolution of civil infrastructure systems

Core characteristics	Business needs	Technology changes	
Industrial gradeness ▪ Reliability ▪ Functional Safety ▪ Security ▪ Real-time capabilities	**Maintenance costs** ▪ Low maintenance costs for commonly uses software components ▪ Low commissioning and update costs	**Proprietary nature** ▪ Systems are built from the ground up for each product ▪ little re-use of existing software building blocks ▪ Closed systems	**Commoditization** ▪ Increased utilization of commodity (open source) components, e.g., operating system, virtualization ▪ Extensibility, e.g., for analytics
Sustainability ▪ Product life-cycles of 10 – 60 years	**Development costs** ▪ Don't re-invent the wheel	**Stand-alone systems** ▪ Limited vulnerability ▪ Updates can only applied with physical access to the systems ▪ High commissioning efforts	**Connected systems** ▪ Interoperability due to advances in machine-to-machine connectivity ▪ Standardization of communication ▪ Plug and play based system designs
Conservative update strategy ▪ Firmware updates only if industrial gradeness is jeopardized ▪ Minimize risk of regression ▪ Keeping regression test and certification efforts low	**Development time** ▪ Shorter development times for more complex systems		

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Things to be done

- Join forces for commodity components
  - Ensure industrial gradeness for the operating system platform focusing on reliability, security, and functional safety.
  - Increase upstream work in order to increase quality and to avoid maintenance of patches
- Share maintenance costs
  - Long-term availability and long-term support are crucial
- Innovate for future technology
  - Support industrial IoT architectures and state-of-the art machine-to-machine connectivity

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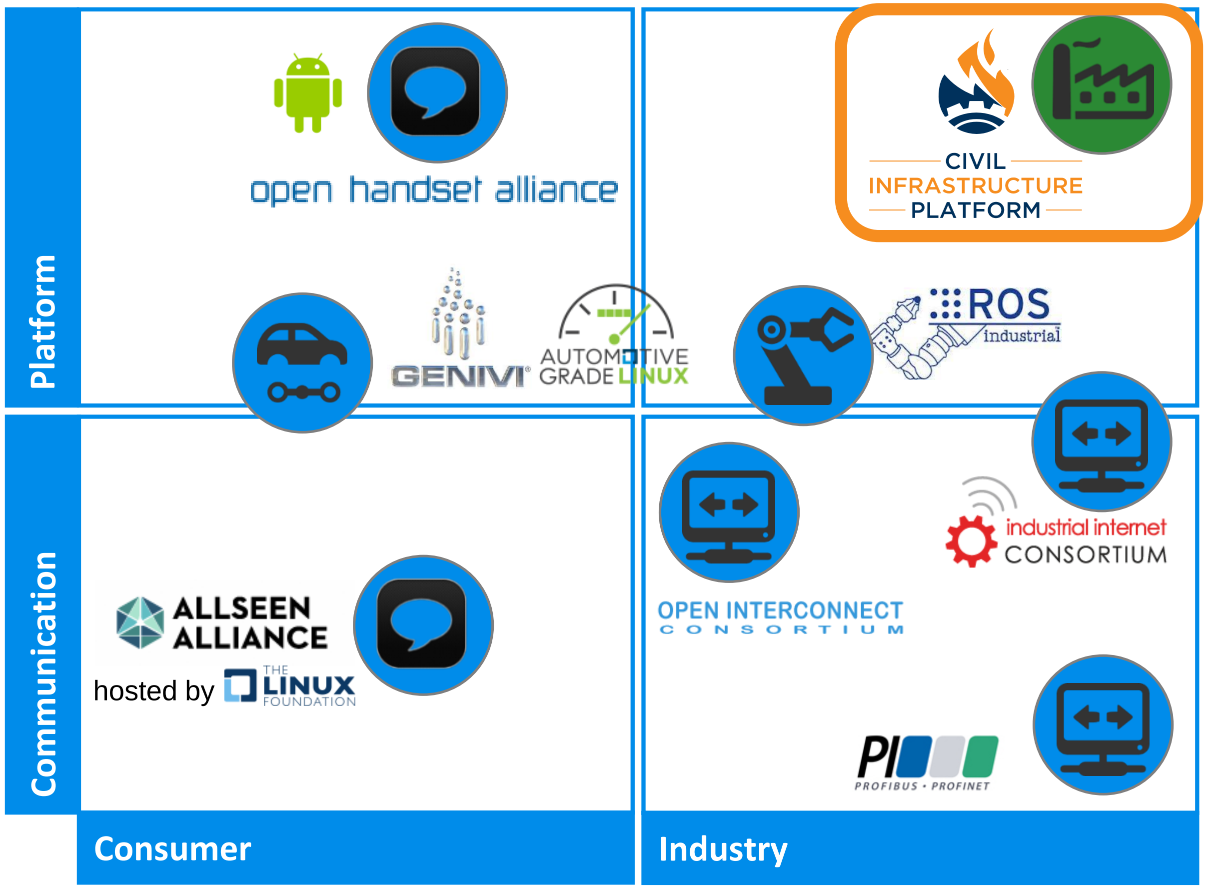
Comparison with existing Alliances

Other domains already benefit from collaborative development: drive instead of follow!



- Development speed
  for shorter product cycles
- High Software quality due to intense reviews and high test coverage
  (Linus's law)
- Standard platforms enable ecosystems
  (e.g. for development tools, system extensions, new business models)

In many domains
competing companies collaborate
in alliances already.

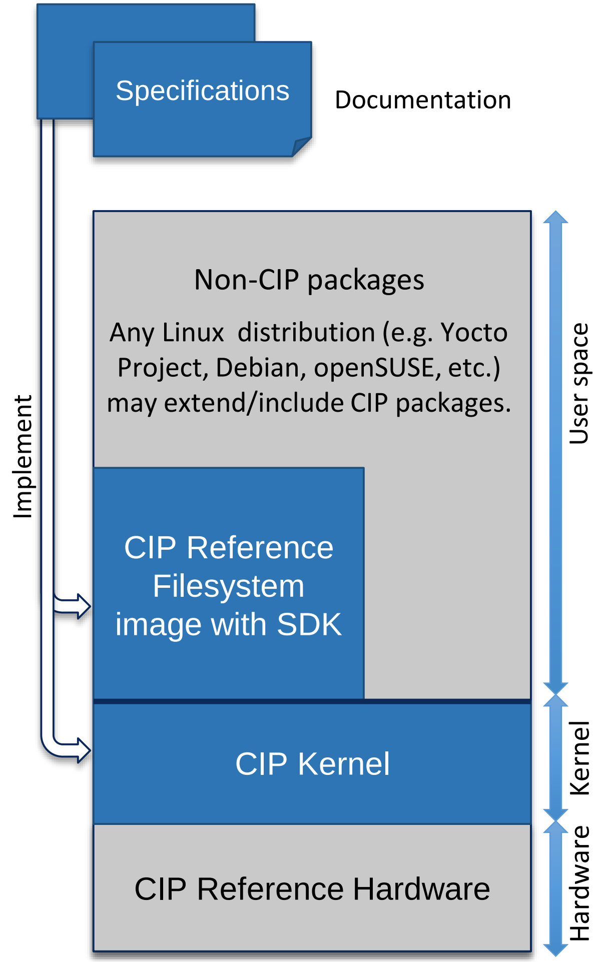
(GENIVI, for example)

Civil Infrastructure Platform to provide software building blocks that support reliable transportation, power, oil and gas, and healthcare infrastructure

Establish an **open source "base layer" of industrial grade software** to enable the use and implementation in infrastructure projects of software building blocks that meet the **safety, reliability, security and maintainability requirements**.

- Share development effort for development of industrial grade bases systems.
- Fill the gap between capabilities of the existing OSS and industrial requirements.
- Reference-implementation consisting of
  - Specification of on-device software stack and tools infrastructure
  - Linux kernel, file system, etc. selected reference hardware
  - Build environment and tools for companies to build their own distribution.
  - Test framework and test cases
  - SDK and APIs
- Trigger development of an emerging ecosystem including tools and domain specific extensions.

➔Initial focus will be on establishing a long term maintenance infrastructure for selected Open Source components, funded by participating membership fees.



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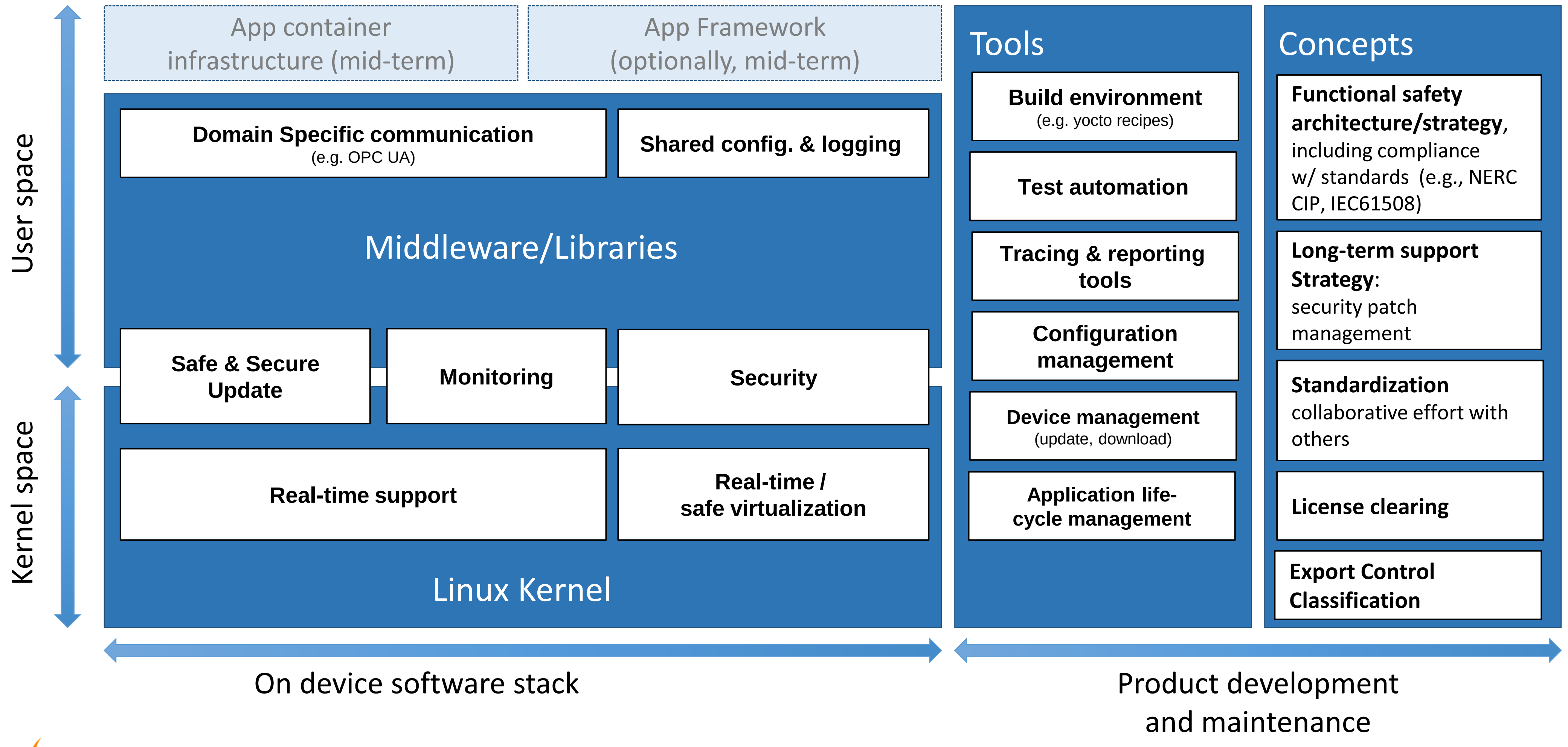
Scope of activities



Target Systems

Target systems

	Networked Node [1]	Embedded Control Unit [2]	Embedded Computer [3]	Embedded Server [4]
ARM offerings[1)]	M0/M0+/M3/M4	M4/7,A9,R4/5/7	ARM A9/A35,R7	ARM A53/A72
Intel offerings[1)]	Quark MCU	Quark SoC	Atom	Core, Xeon
Architecture, clock	8/16/32-bit,< 100 MHz	32-bit, <1 GHz	32/64-bit, <2 GHz	64-bit, >2 GHz
non-volatile storage	n MiB flash	n GiB flash	n GiB flash	n TiB flash/HDD
RAM	< 1 MiB	< 1 GiB	< 4 GiB	> 4 GiB
HW ref. platform	Arduino class board	Raspberry Pi class board	SoC-FPGA, e.g.Zync	industrial PC
application examples	Sensor, field device	control systems	special purpose & server based controllers	
	PLC	gateways		multi-purpose controllers

Out of scope:

- Enterprise IT and cloud system platforms.

Reference hardware for common software platform:

- Start from working the common HW platform (PC)
- Later extend it to smaller/low power devices.

1) Typical configurations Q1/2016 [1] ... [4] Device class no.

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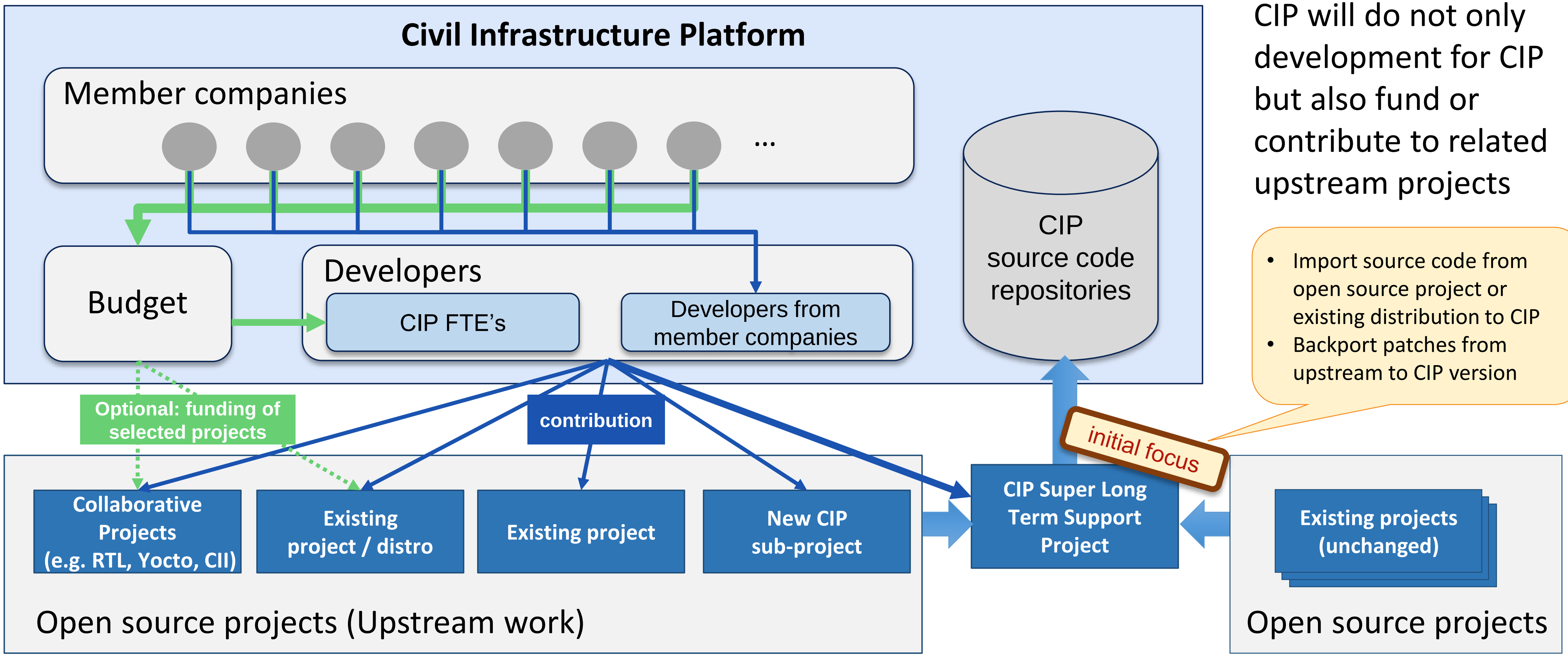
Relationship between CIP and other projects



CIP will do not only development for CIP but also fund or contribute to related upstream projects

- Import source code from open source project or existing distribution to CIP
- Backport patches from upstream to CIP version

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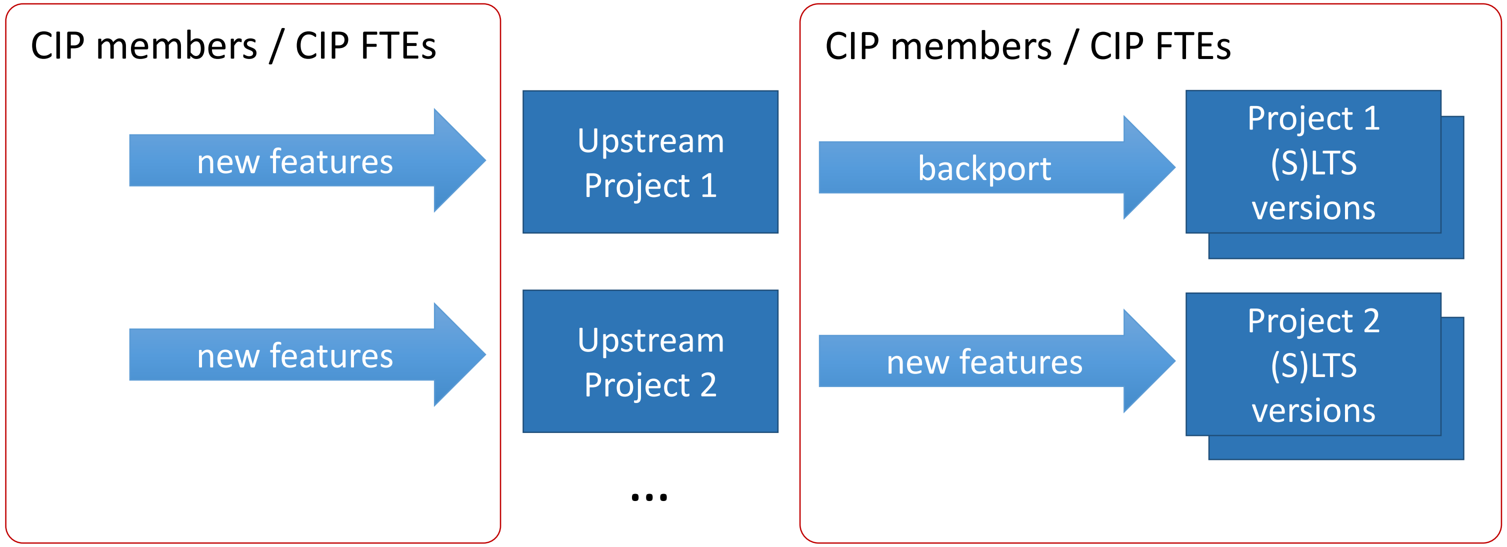
Upstream first policy for implementation of new features

All delta from mainline should be treated as technical debt.

- No parallel source trees, directly discuss features in upstream projects.
- Upstream first implementation. Take this to declared stable.
- Then back-port to long-term support versions drive by CIP employee or CIP members.



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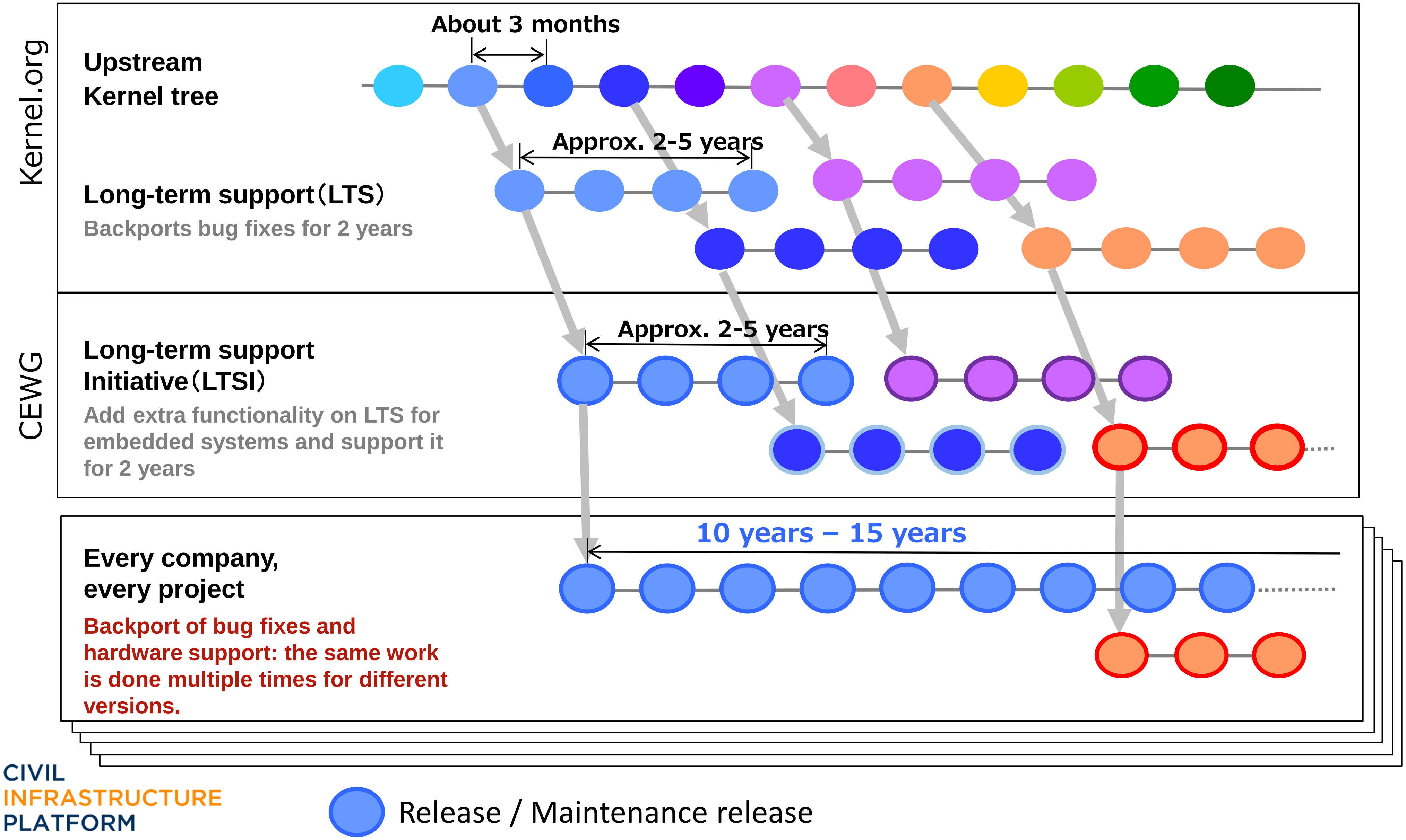
Super Long Term Support - Motivation



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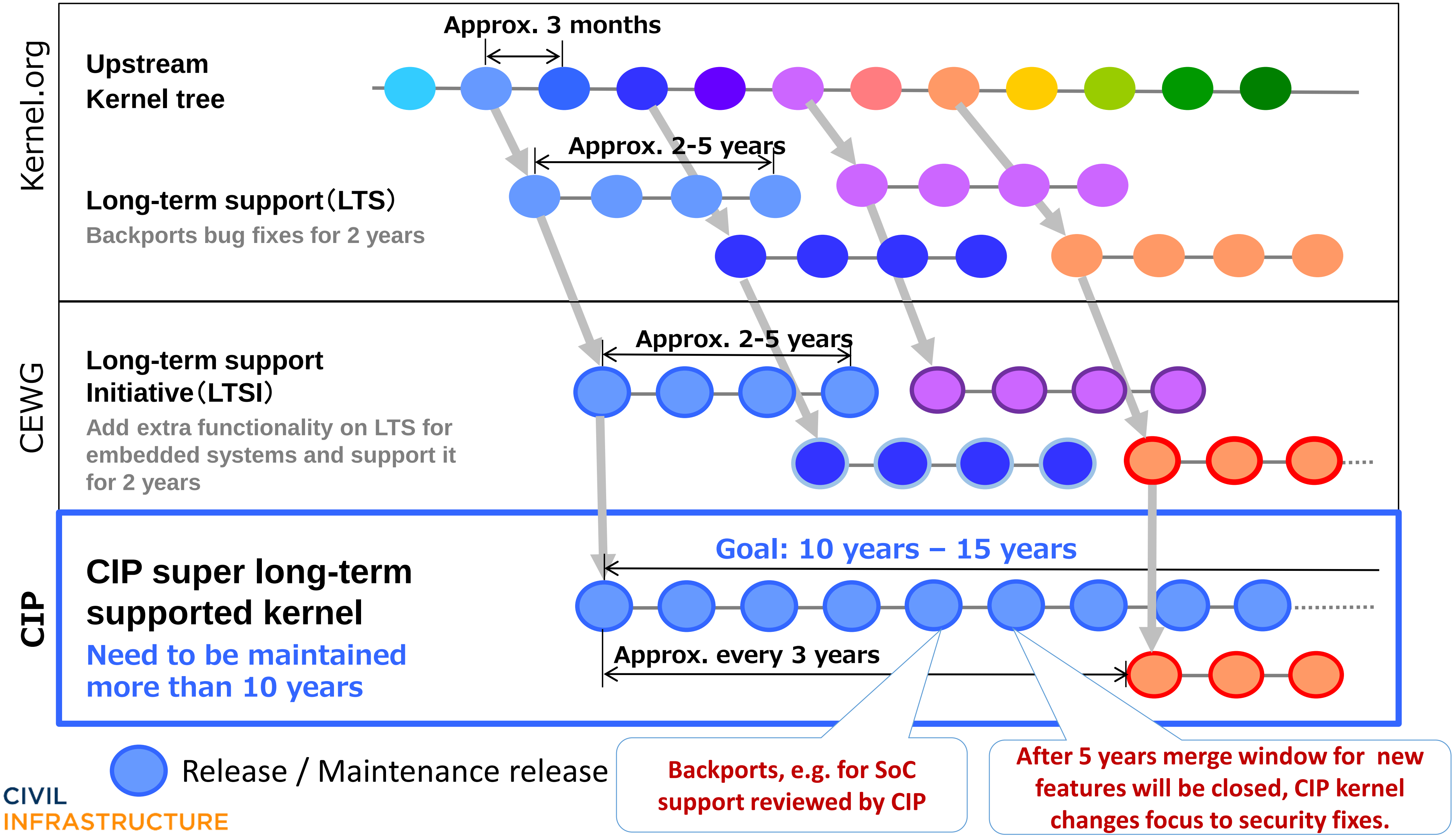
CIP kernel super long term support (SLTS) overview



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Package categorization

Maintain for Reproducible build

Super Long-term support

CIP development packages	• The "development packages" provide a reproducible environment for building the CIP kernel and related packages • This category should include all build dependencies, debug tools and test tools for CIP kernel and CIP core components • This category might not require to have security fixes
CIP core packages	• CIP will provide super long-term support for this category
CIP Linux Kernel	• Linux kernel itself which CIP will maintain • CIP will provide super long-term support for this category
Hardware (Development board / QEMU)	

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Candidates for Super Long-term Maintenance

An Example minimal set of “CIP kernel” and “CIP core” packages for initial scope

Super Long-term support

Kernel (SLTS)

Core Packages (SLTS)

- Kernel
  - Linux kernel (cooperation with LTSI)
  - PREEMPT_RT patch
- Bootloader
  - U-boot
- Shells / Utilities
  - Busybox
- Base libraries
  - Glibc
- Tool Chain
  - Binutils
  - GCC
- Security
  - Openssl
  - Openssh

Maintain for Reproducible build

Dev packages

- Flex
- Bison
- autoconf
- automake
- bc
- bison
- Bzip2
- Curl
- Db
- Dbus
- Expat
- Flex
- gawk
- Gdb
- Git
- Glib
- Gmp
- Gzip
- gettext
- Kbd
- Libibverbs
- Libtool
- Libxml2
- Mpclib
- Mpfr4
- Ncurses
- Make
- M4
- pax-utils
- Pciutils
- Perl
- pkg-config
- Popt
- Procps
- Quilt
- Readline
- sysfsutils
- Tar
- Unifdef
- Zlib

NOTE: The maintenance effort varies considerably for different packages.

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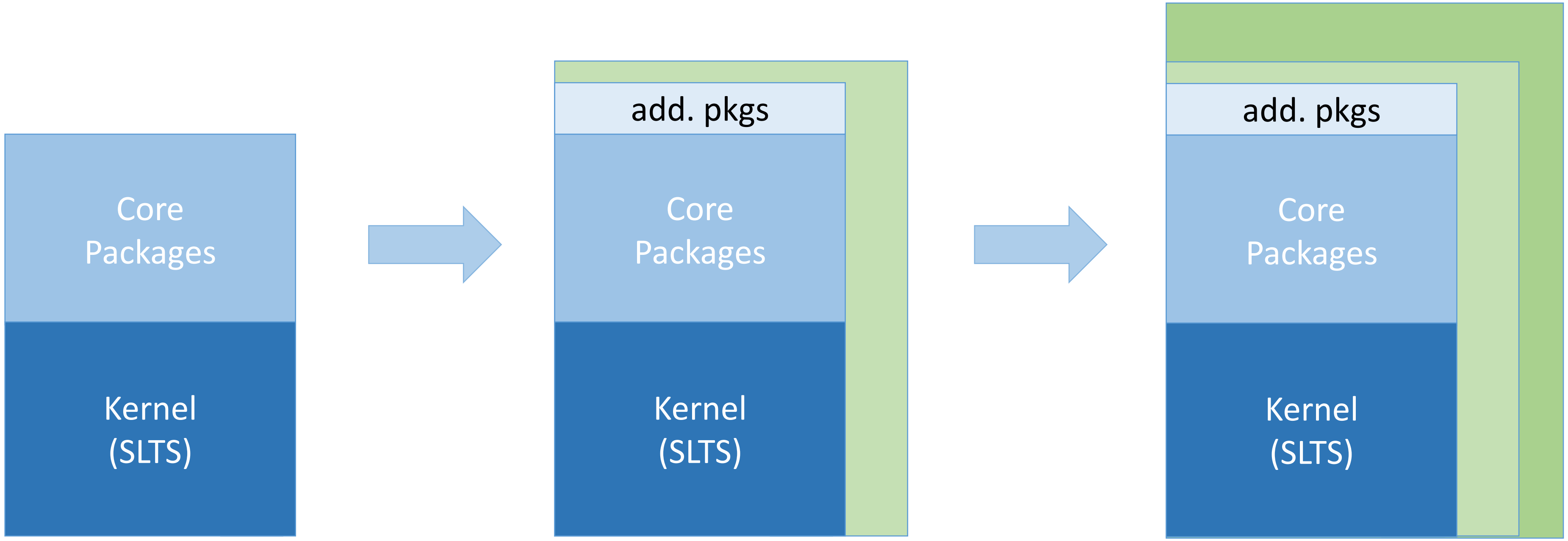
Development plan

CIP will increase development effort to create industrial grade commin base-layer



Phase 1:

- Define supported kernel subsystems, arch.
- Initial SLTS component selection
- Select SLTS versions
- Set-up maintenance infrastructure (build, test)

Phase 2:

- Patch collection, stabilization, back port of patches for CIP kernel packages
- Support more subsystems
- Additional core packages

Phase 3:

- Domain specific enhancements, e.g. communication protocols, industrial IoT middleware
- Optionally: more subystems
- Optionally: more core packages

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Milestones

- 2015:
  - Set up collaborative software project.
  - Proposals for base components collected and evaluated.
  - Maintenance strategy defined
- 2016:
  - Project launch announcement at Embedded Linux Conference 2016
  - Requirements defined, base use cases defined, technical & non-technical processes established (license clearing, long-term support), maintenance plan
  - Common software stack defined, related core projects agreed (e.g. PREEMT_RT, Xenomai), maintenance infrastructure set up
  - Domain specific extensions defined, tool chain defined, test strategy defined
  - Maintenance operational and running
- 2017:
  - Realization phase of selected components
- 2018:
  - Advancement, improvements, new features

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Please join!

Maintainers wanted

Meet us at ELC


Yoshitake Kobayashi (Toshiba)


Jan Kiszka (Siemens)


Urs Gleim (Siemens)


Wolfgang Mauerer (Siemens)


Takuo Koguchi (Hitachi)


Paul Sherwood (Codethink)

Platinum Members

HITACHI Inspire the Next

SIEMENS

TOSHIBA

Silver Members

Codethink

Plat'Home
There, we are. Internet of Things

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Civil Infrastructure Platform: Executive Summary

- Civil infrastructure systems are currently built from the ground up, **with little re-use of existing software** building blocks. However, existing software platforms are **not yet industrial grade** (in addressing safety, reliability, security and other requirements for infrastructure). At the same time, rapid advances in machine-to-machine connectivity are driving **change in industrial system architectures**.

- The Linux Foundation proposes the creation of the Civil Infrastructure Platform ("CIP") as a Linux Foundation Collaborative Project. The Civil Infrastructure Platform will establish an **open source "base layer"** of industrial grade software to enable the use and implementation in infrastructure projects of software building blocks that meet the **safety, reliability, security and other requirements** of industrial and civil infrastructure.

- Initial focus will be on establishing a **long term maintenance infrastructure** for selected Open Source components, funded by participating membership fees.

- Mid-term focus will be extended to **filling gaps** commonly **agreed addressing civil infrastructure systems' requirements.**

- The Civil Infrastructure Platform shall be **hosted by the Linux Foundation as an internal Linux Foundation project**, leveraging the resources and infrastructure of the Linux Foundation, including the Linux Foundation's relationships with other open source projects.

Contact Information and Resources

To get the latest information, please contact:

- Noriaki Fukuyasu fukuyasu@linuxfoundation.org
- Urs Gleim urs.gleim@siemens.com
- Yoshitake Kobayashi yoshitake.kobayashi@toshiba.co.jp

Other resources

- CIP Web site https://www.cip-project.org

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Questions?

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Thank you!

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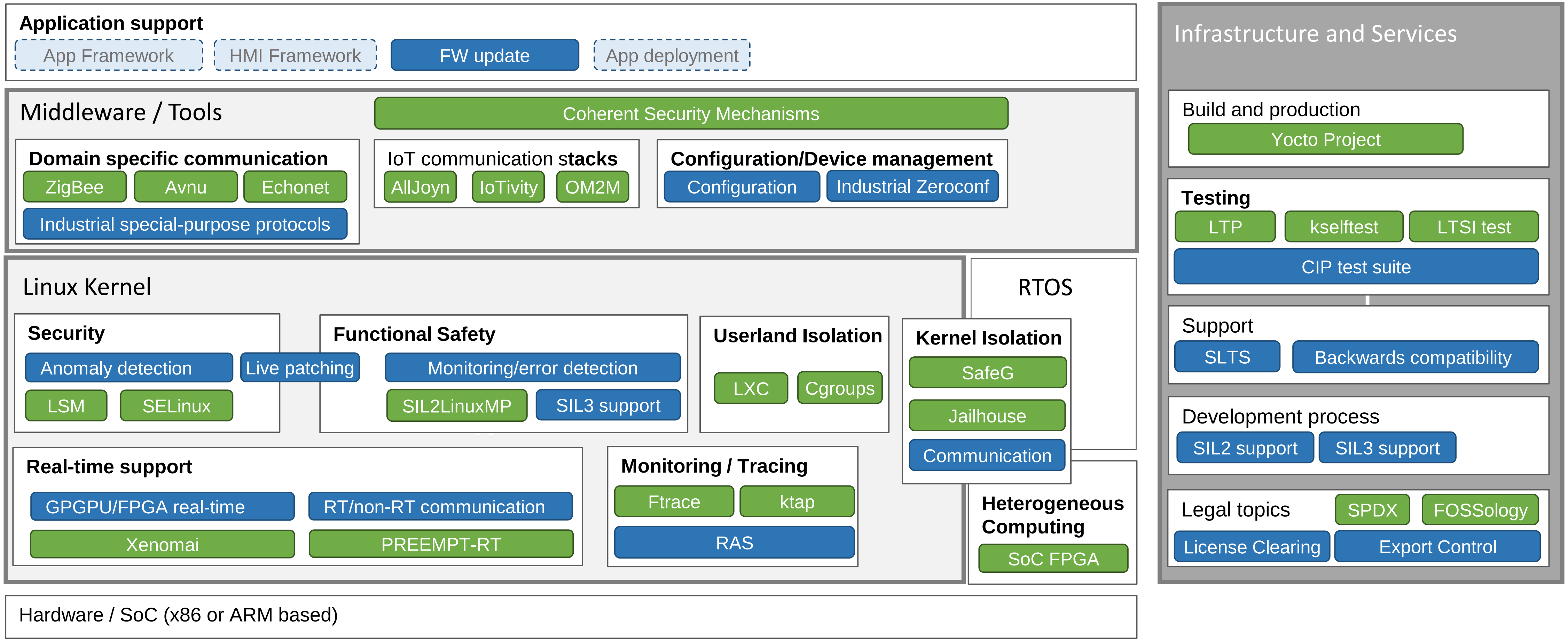
Backup: Topics and related projects (subject to change)



Legend: To be specified / implemented by CIP | Integration / cooperation

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