THE LINUX FOUNDATION PROJECTS

Staying Smart:
Open Source's Role in Smart City Evolution

CIVIL INFRASTRUCTURE PLATFORM

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Civil Infrastructure and its Challenges

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IoT today – connecting systems

Connected Cars

Find and rent cars via smart phone.
Monitor fleets and provide service.

Industry

Collect data to improve processes (cost, quality, speed).
Minimize downtimes by predictive maintenance.

Smart City

Multimodal transportation, intelligent traffic control, smart energy management, emergency management, …

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“Hidden” Industrial IoT Systems

Transport

Rail automation

Vehicle control

Automatic ticket gates

Energy

Power Generation

Turbine Control

Turbine Control

Others

Building automation

Broadcasting

Healthcare

Industry

Industry automation

CNC control

Industrial communication

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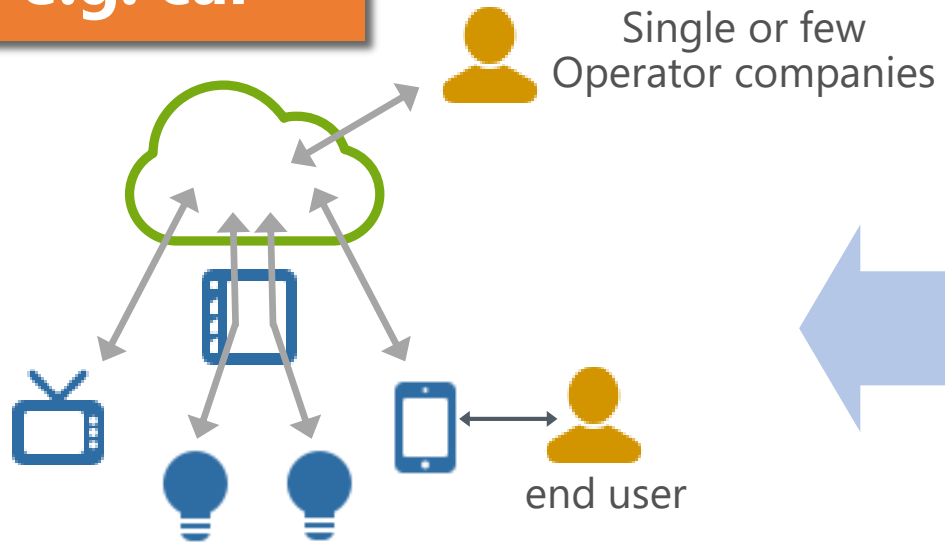
Smart Cities combine consumer & industrial IoT

Consumer IoT

End user interfaces and comfort features

e.g. car

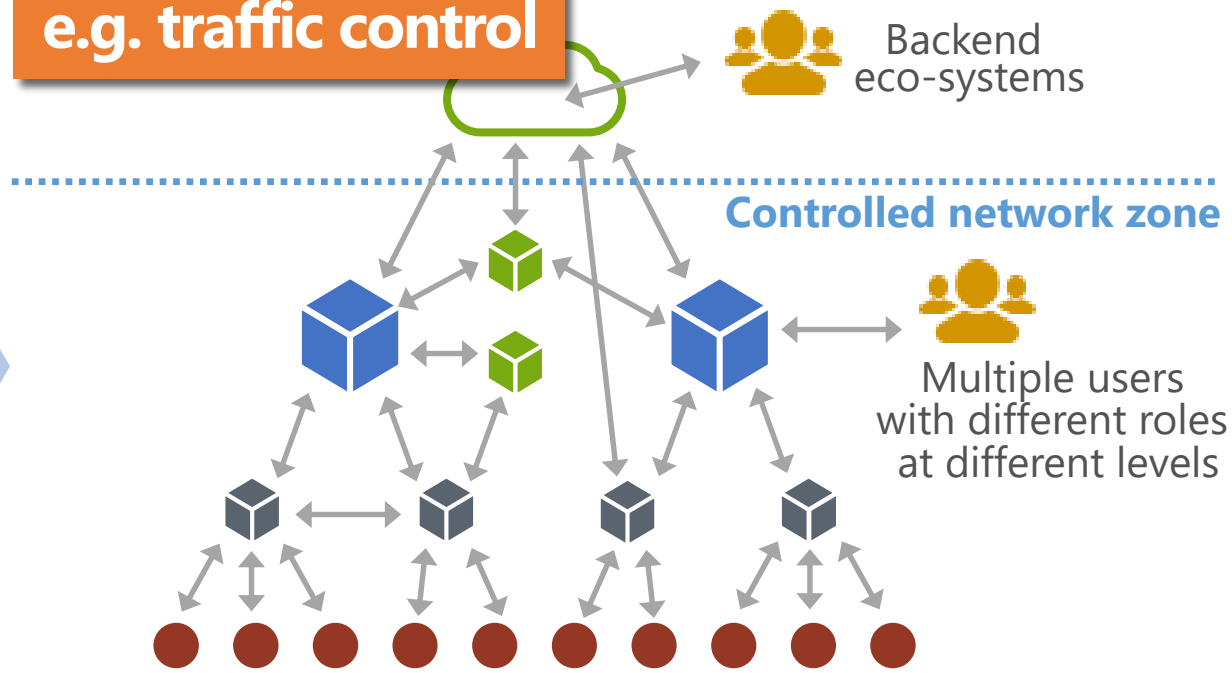


Permanent cloud connection required.
Quality and availability: Best effort
Low-cost / high volume

Industrial (grade) IoT

Digital backbone of connected systems

e.g. traffic control



Complex systems: local intelligence + centralized Intelligence 24/7 operation even with no connection to backend.
Guaranteed latency, throughput, and responsiveness.

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Smart Cities need a Smart Infrastructure

IoT technology to be applied to industrial systems

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A Power Plant System:

25-60 years products life-cycle

Very reluctant to perform product updates and upgrades of hardware and base software platform

Image: http://zdnet1.cbsistatic.com/hub/i/r/2016/02/29/10863f77-89b2-40c0-9d8c-dbaa5feb65be/resize/770xauto/490141cef9bddc0db66b492698b53a50/powerplant.jpg

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Security

...for millions of devices

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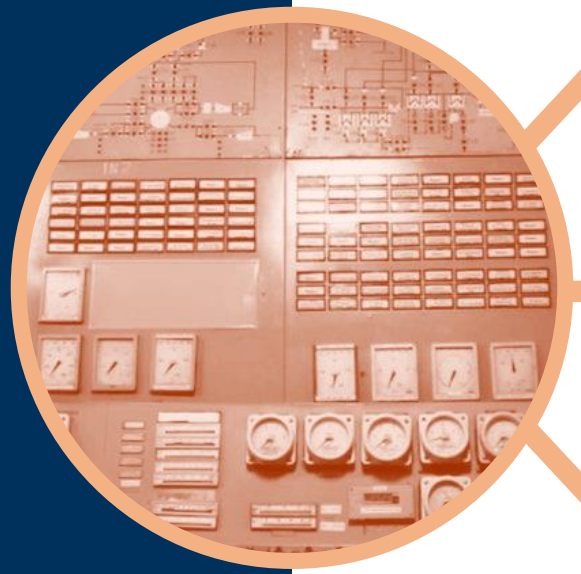
The key challenges

- Apply IoT concepts to industrial systems.
- Ensure quality and longevity of products.
- Keep millions of connected systems secure.



Industrial gradeness

- Reliability
- Functional Safety
- Real-time capabilities

Sustainability

- Product life-cycles of decades
- Backwards compatibility
- Standards

Security

- Security & vunerability managment
- Firmware updates
- Minimize risk of regressions

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Solving the Key Challenges

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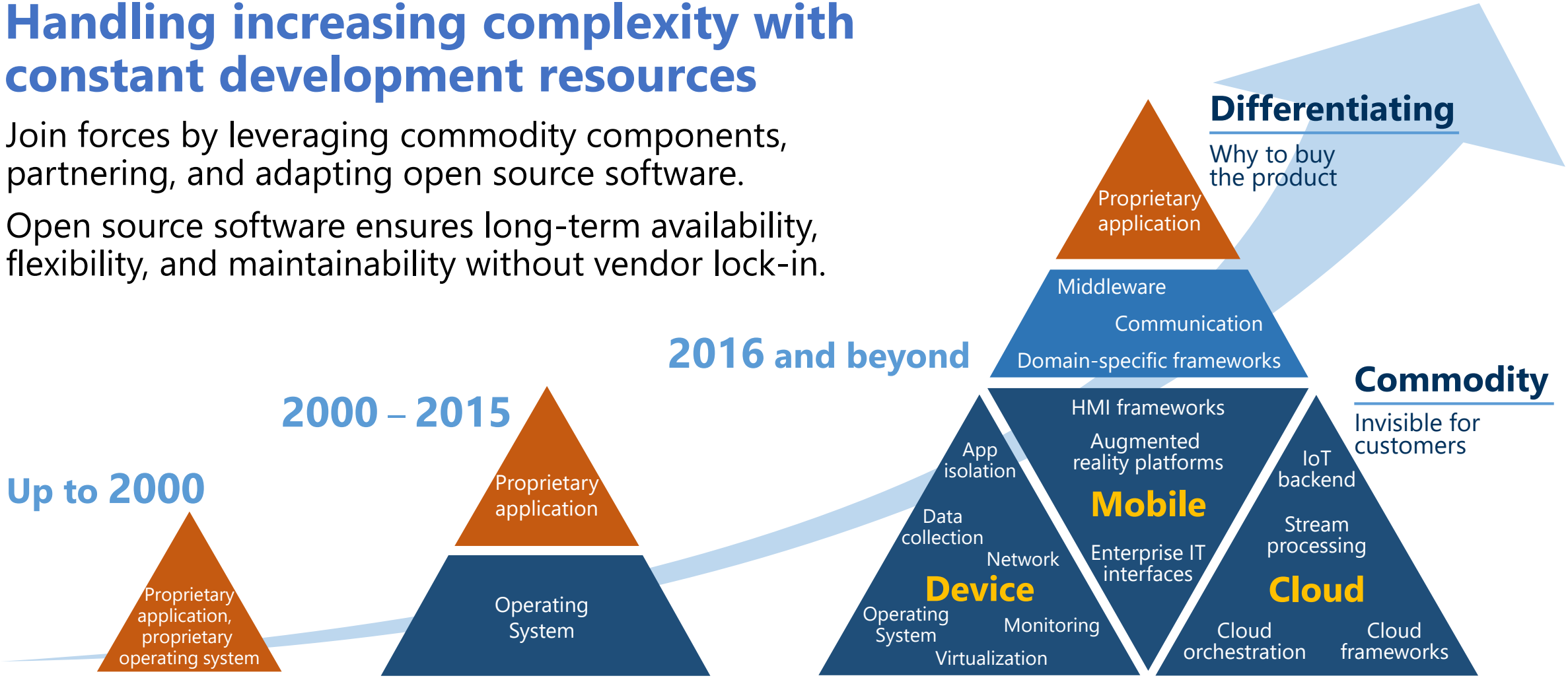
Speed and efficiency : focus on differentiating parts

Handling increasing complexity with constant development resources

Join forces by leveraging commodity components, partnering, and adapting open source software.

Open source software ensures long-term availability, flexibility, and maintainability without vendor lock-in.



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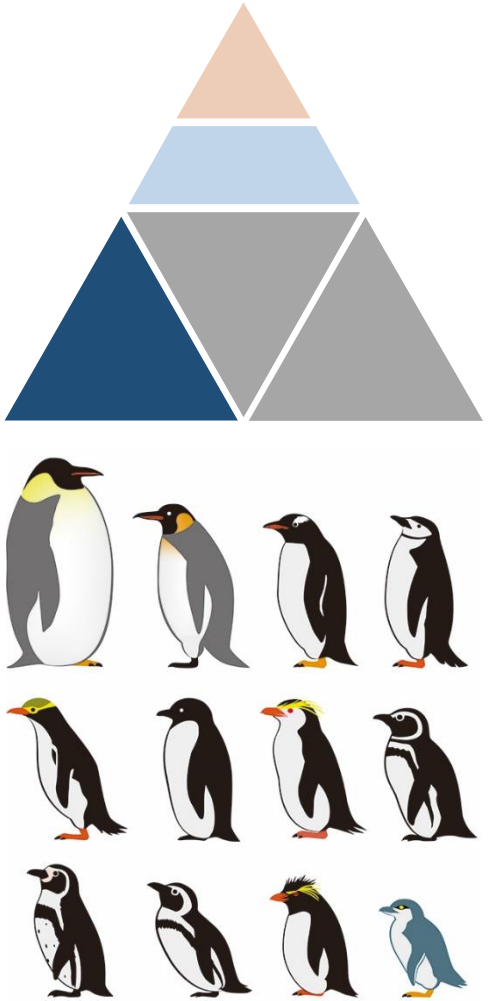
Facts and Issues : Smart City uses Commodity Software

Facts

- Millions or trillions smart devices
- Similar software components (e.g. Linux)
- Industrial IoT requirements
  - ✓ Security
  - ✓ Sustainability
  - ✓ Industrial-grade



Issues

- A lot of products have to meet IIoT requirements
- Same development and maintenance efforts spent by many companies or even business units
- **No common solution** for base building blocks

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CIP is the Solution

Establishing an
Open Source Base Layer
of industrial-grade software
to enable the use and
implementation of software
building blocks for
Civil Infrastructure Systems

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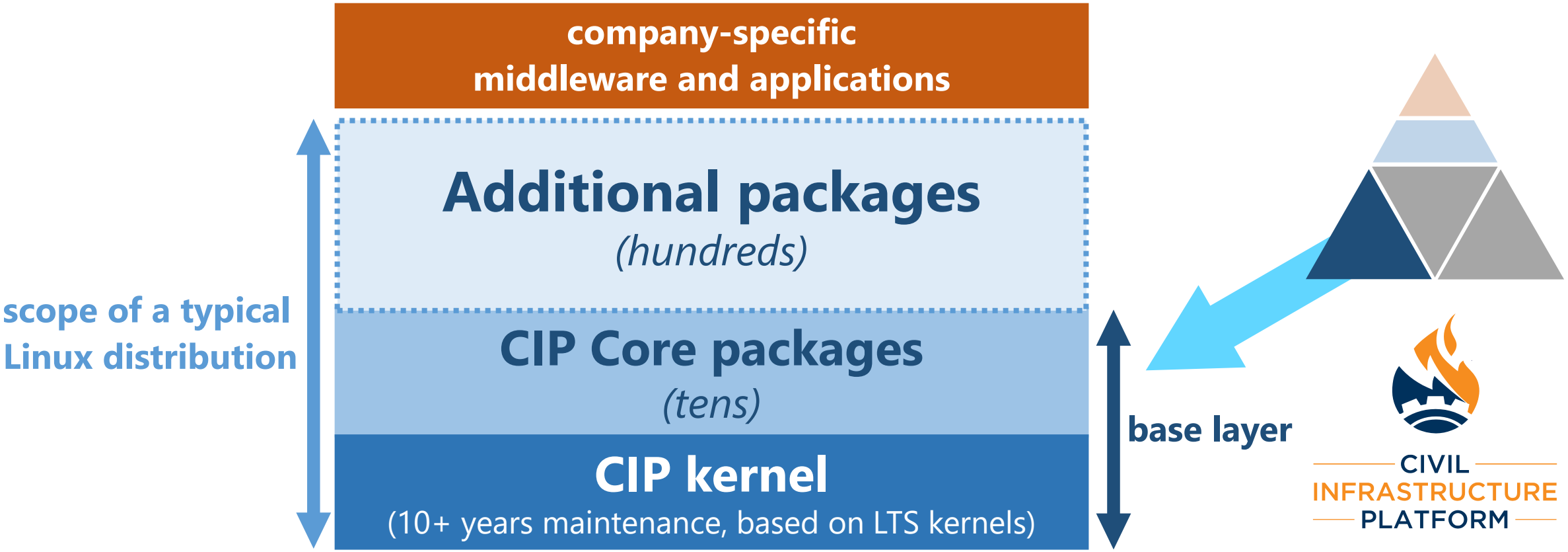
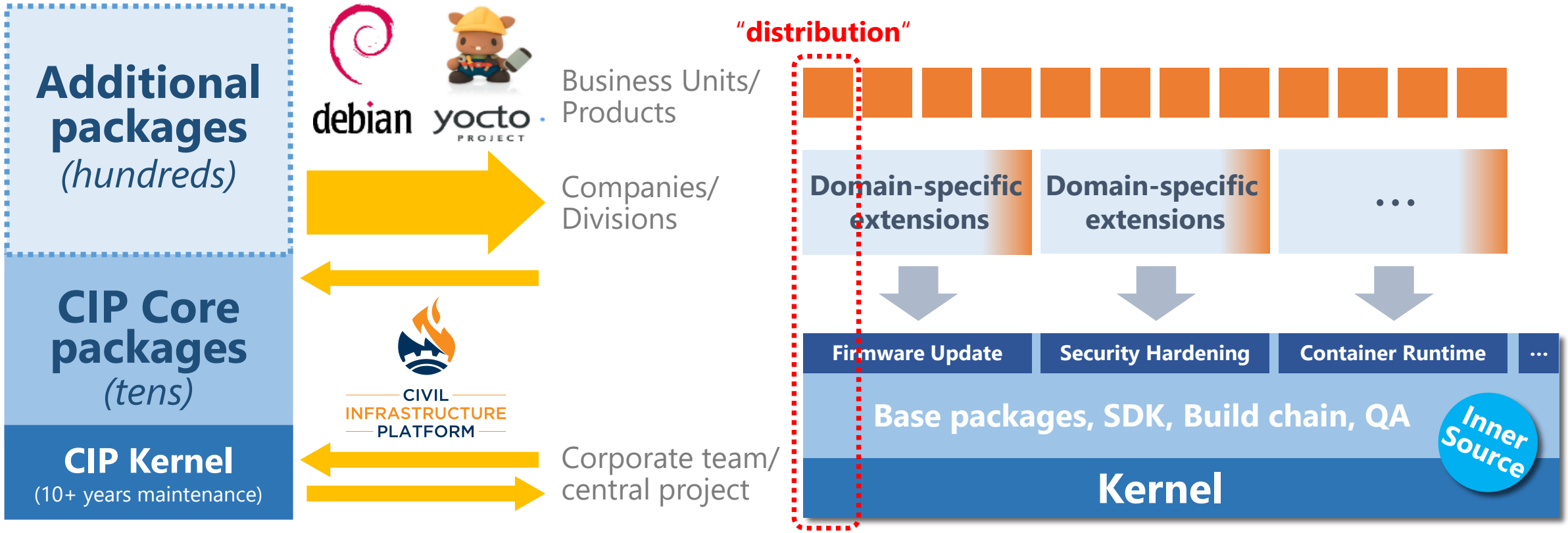
What is “Open Source Base Layer (OSBL)” ?

Layered Linux distribution for industrial products, utilizing and influencing the relevant Open Source projects:



CIP Civil Infrastructue Platform Project (https://www.cip-project.org/) **LTS** Long Term Support

Mapping CIP into the company



Up to 70% effort reduction achievable for OSS license clearing and vulnerability monitoring, kernel and package maintenance, application adaptation and testing for an individual product.

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OSS Open Source Software **QA** quality ssurance **SDK** software development kit

The backbone of CIP are the member companies

CIP Core packages

CIP kernel

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RENESAS SIEMENS TOSHIBA

Codethink cybertrust HITACHI Inspire the Next MOXA Plat' Home There, we are. Internet of Things

Budget ¥ € £ $

Developers, maintainers

Optional: funding of selected projects

Contribution & usage/integration

Open Source Projects (Upstream work)

Real-Time LINUX debian Reproducible Builds EDGE X FOUNDRY

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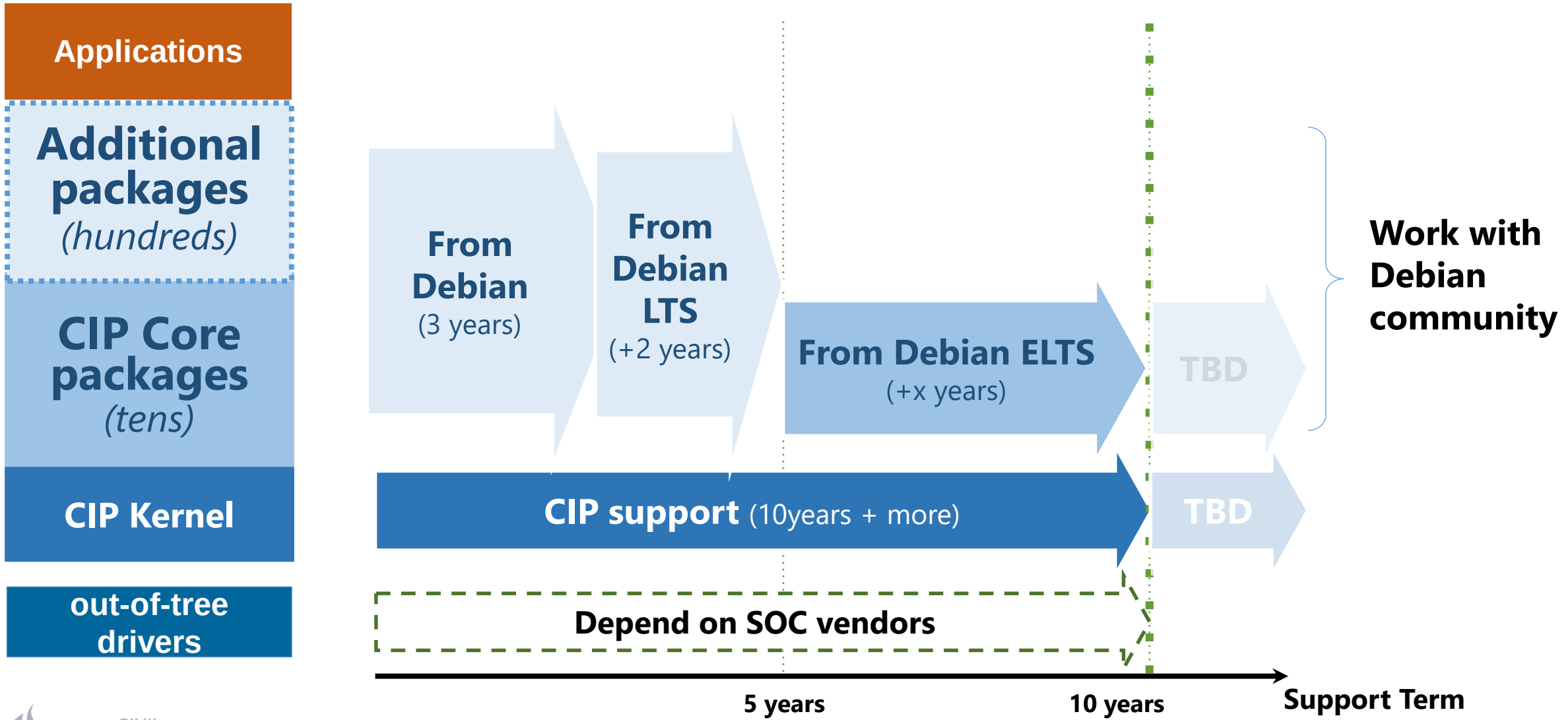
CIP: add. HW support & extended maintenance



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CIP lays the Foundation for Sustainable Smart Cities

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Scope of activities

User space

Kernel space

App container infrastructure (mid-term)

App Framework (optionally, mid-term)

Domain Specific communication (e.g. OPC UA)

Shared config. & logging

Multimedia

Middleware/Libraries

3 **CIP Core Packages**

6 **Safe & Secure Update**

Monitoring

5 **Security**

2 **Real-time support**

Real-time / safe virtualization

Linux Kernel

1 **Super Long Term Supported Kernel (STLS)**

Tools

3 **Build environment** (e.g. bitbake, dpkg)

4 **Test automation**

Tracing & reporting tools

Configuration management

Device management (update, download)

Application life-cycle management

Concepts

Functional safety architecture/strategy, including compliance w/standards (e.g.,NERC CIP, IEC61508)

1 **3** **Long-term support Strategy**: security patch management

Standardization collaborative effort with others

License clearing

Export Control Classification

On-device software stack

Product development and maintenance

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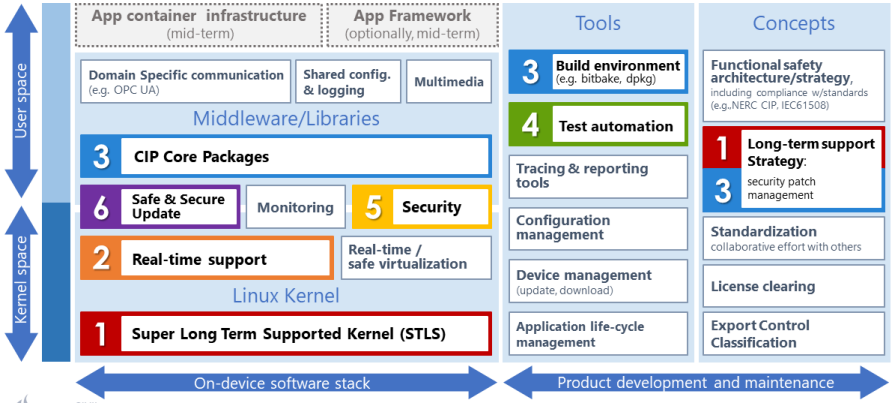
CIP governance structure and projects

Governing Board (GB)

Technical Steering Committee (TSC)



1 SLTS kernel	2 Real-time	3 CIP Core	4 Testing	5 Security WG(*)	6 Software Update WG	(*): Workgroup
✔	✔	✔	✔	✔	✔	Industrial grade
✔		✔	✔		✔	Sustainability
✔		✔	✔	✔	✔	Security

CIP Projects and its scopes

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Collaborative development with other OSS projects

Contribute, Collaborate and use by CIP

mainline LTS debian LAVA Reproducible Builds yocto PROJECT

Real-Time LINUX KernelCI EDGE X FOUNDRY™

Contributing by CIP members as future candidates

Jailhouse fossology

Fuego hawkBit 360

Upstream Projects

2 Use the upstream code

1 Upstream first

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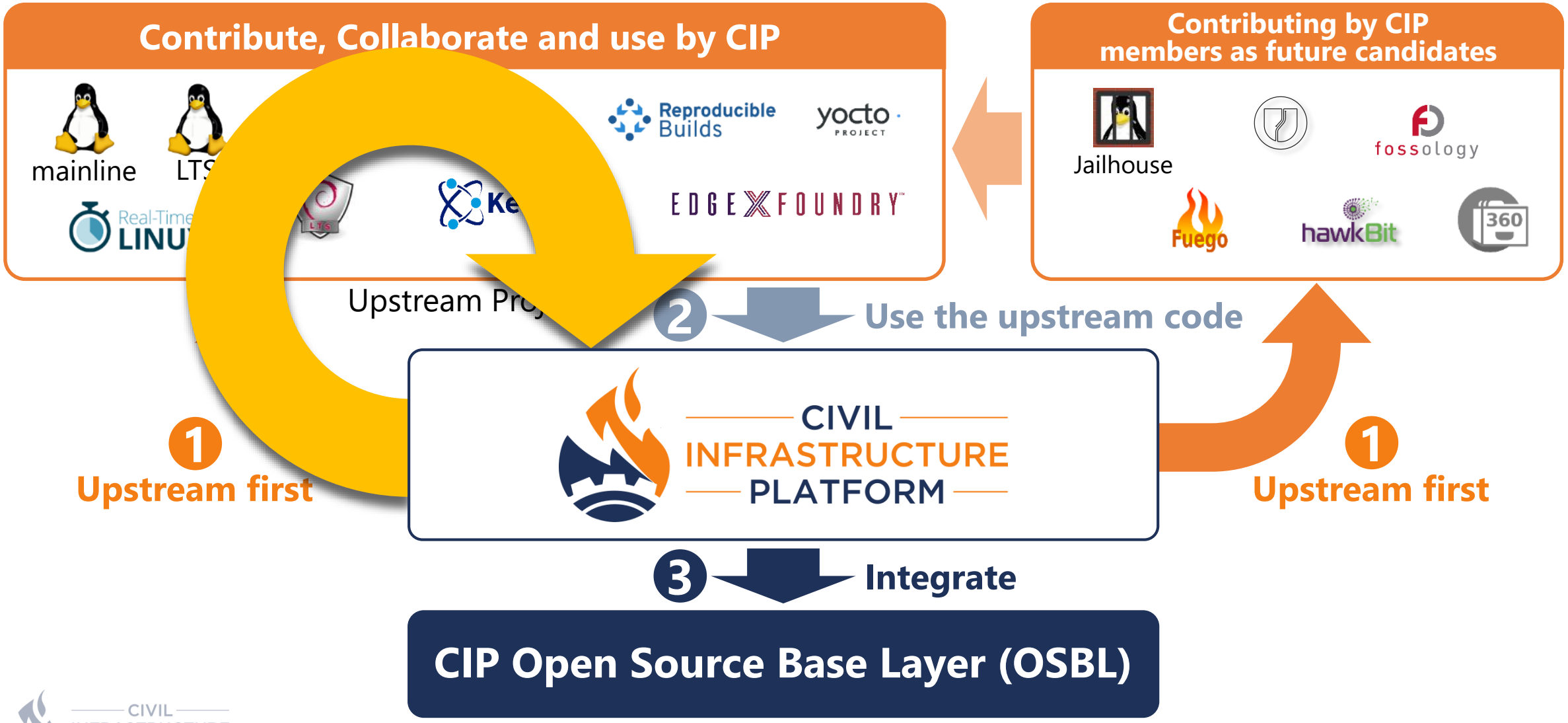
1 Upstream first

3 Integrate

CIP Open Source Base Layer (OSBL)

Collaborative development with other OSS projects



1 CIP SLTS kernel development (Upstream first development)

Goal

- Providing CIP kernels with more than 10 years maintenance period
  - Super Long Time Stable kernel

Mentor：**Ben Hutchings**

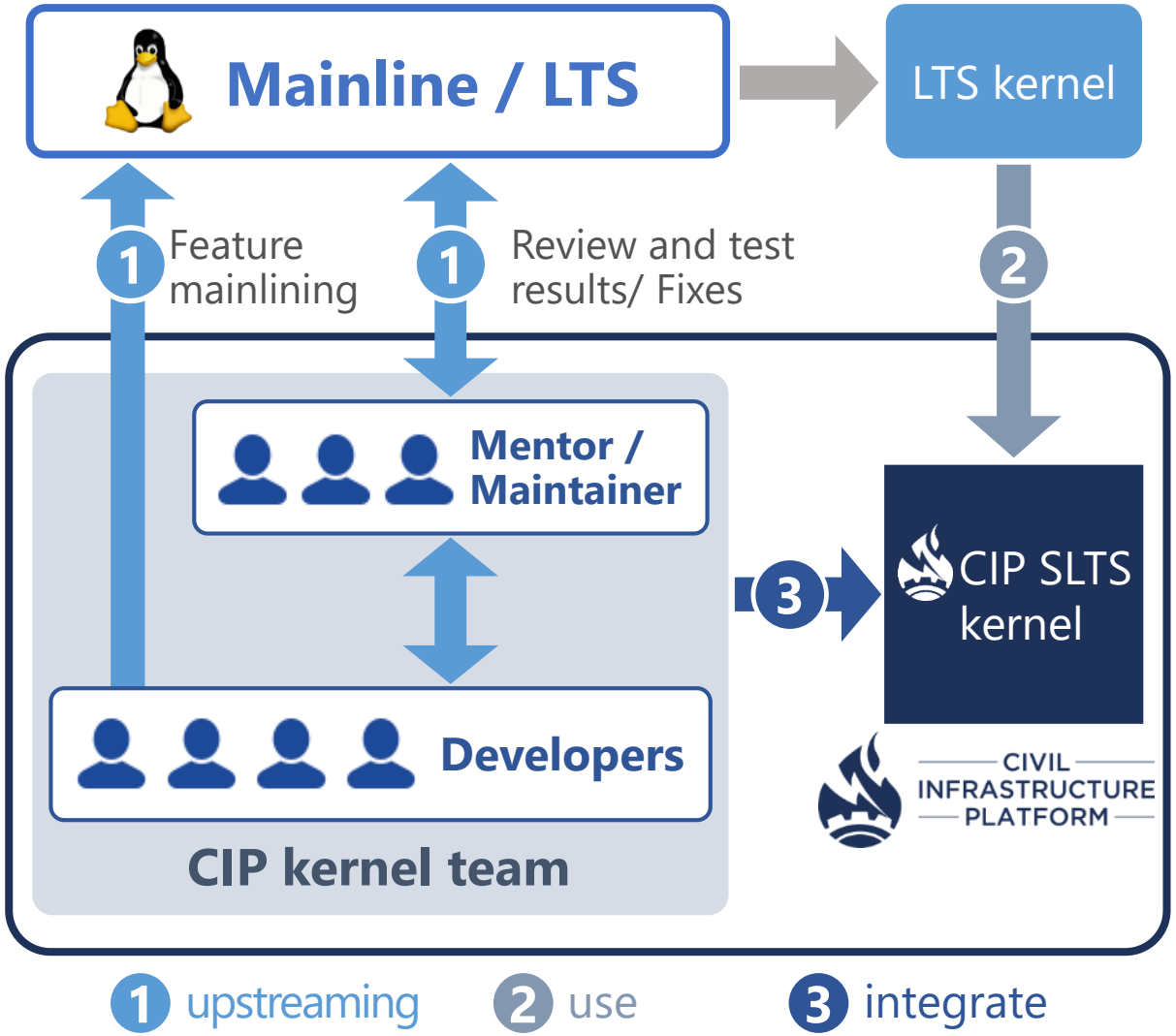
Maintainers：**Nobuhiro Iwamatsu, Pavel Machek**

Status

- CIP SLTS kernels has been released
  - V4.19.78-cip12 (October 12th)
  - V4.4.196-cip38 (October 12th)
- Created CVE tracker
- Participate to LTS review process

Resources

- https://git.kernel.org/pub/scm/linux/kernel/git/cip
- https://gitlab.com/cip-project/cip-kernel/cip-kernel-sec



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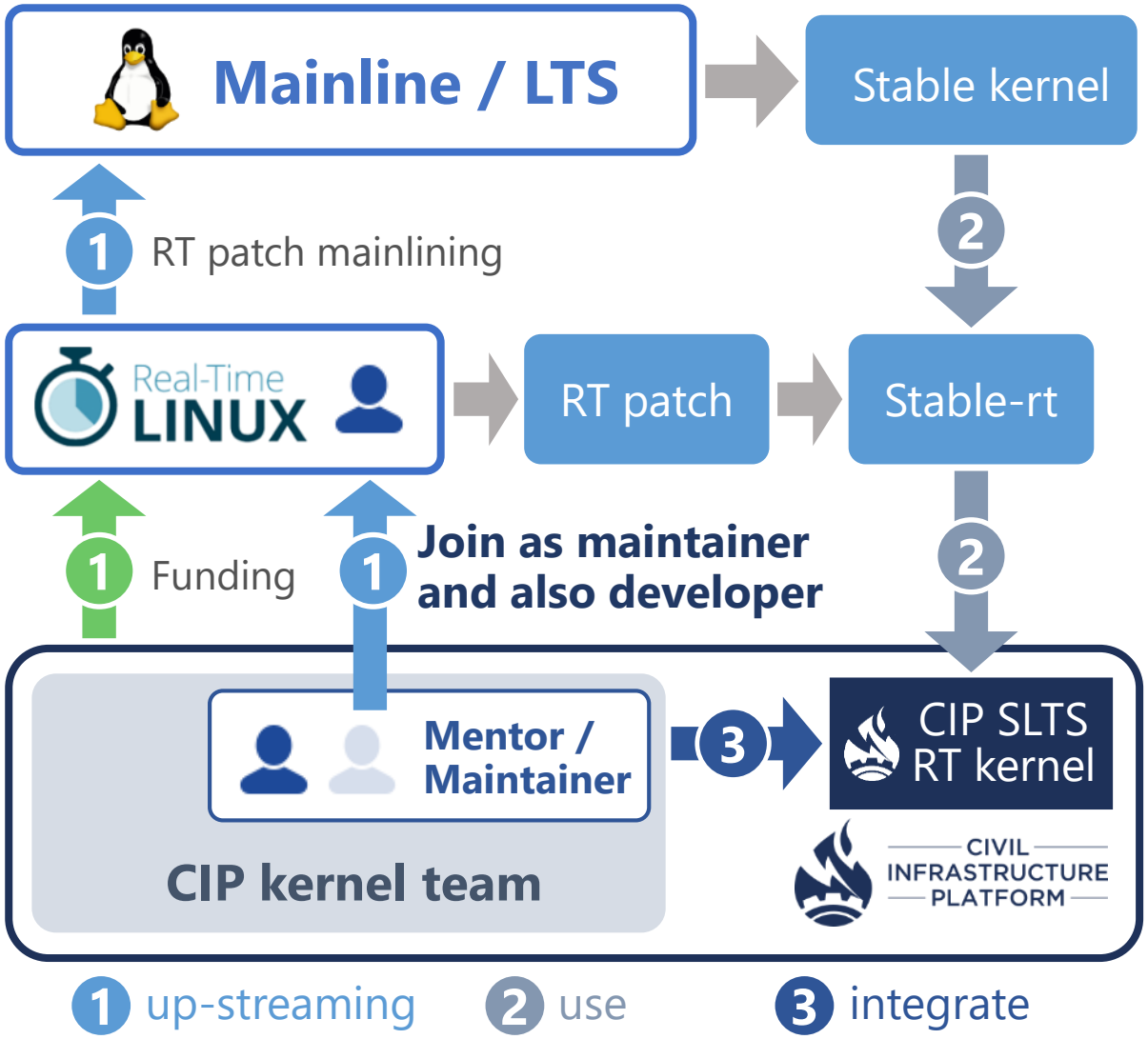
2 Real-time Linux development (PREEMPT_RT)

Goal

- CIP joins RT Linux project as Gold member to Work with them to upstream Real-time enhancement
- Provide CIP SLTS kernel with real-time enhancement by using RT patch

Current status

- CIP SLTS RT kernels has been released
  - v4.19.72-cip10-rt3 (October 2nd)
  - 4.4.190-cip36-rt25 (October 3rd)
  - https://git.kernel.org/pub/scm/Linux /kernel/git/cip



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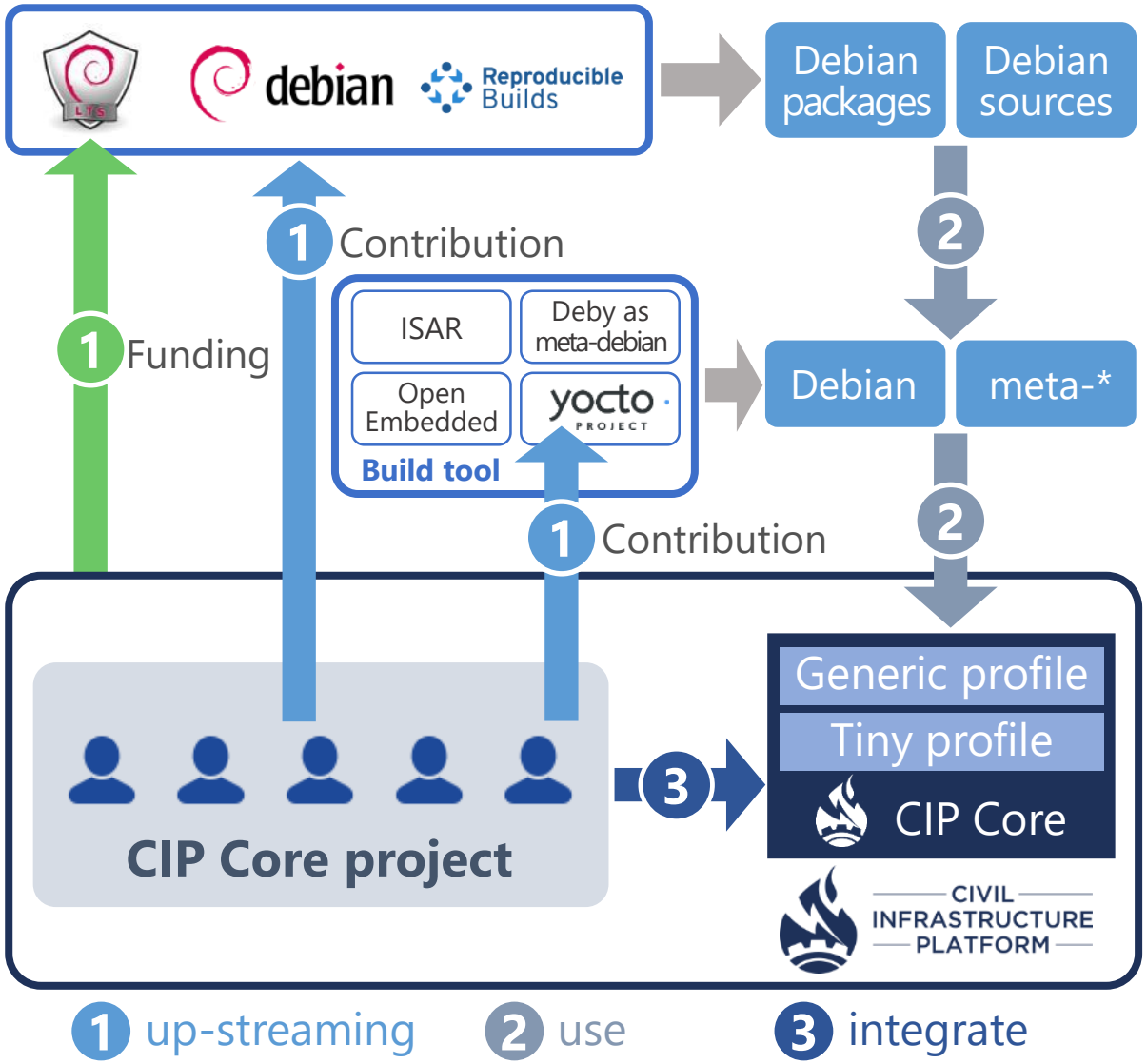
3 CIP Core

Goal

- Provide a reference implementation with CIP core packages for testing
- Following implementations are provided
  - **Tiny profile** ➢ E.g. Small IoT devices
  - **Generic profile** ➢ E.g. IoT gateways

Status

- CIP Core profiles are available
  - https://gitlab.com/cip-project/cip-core



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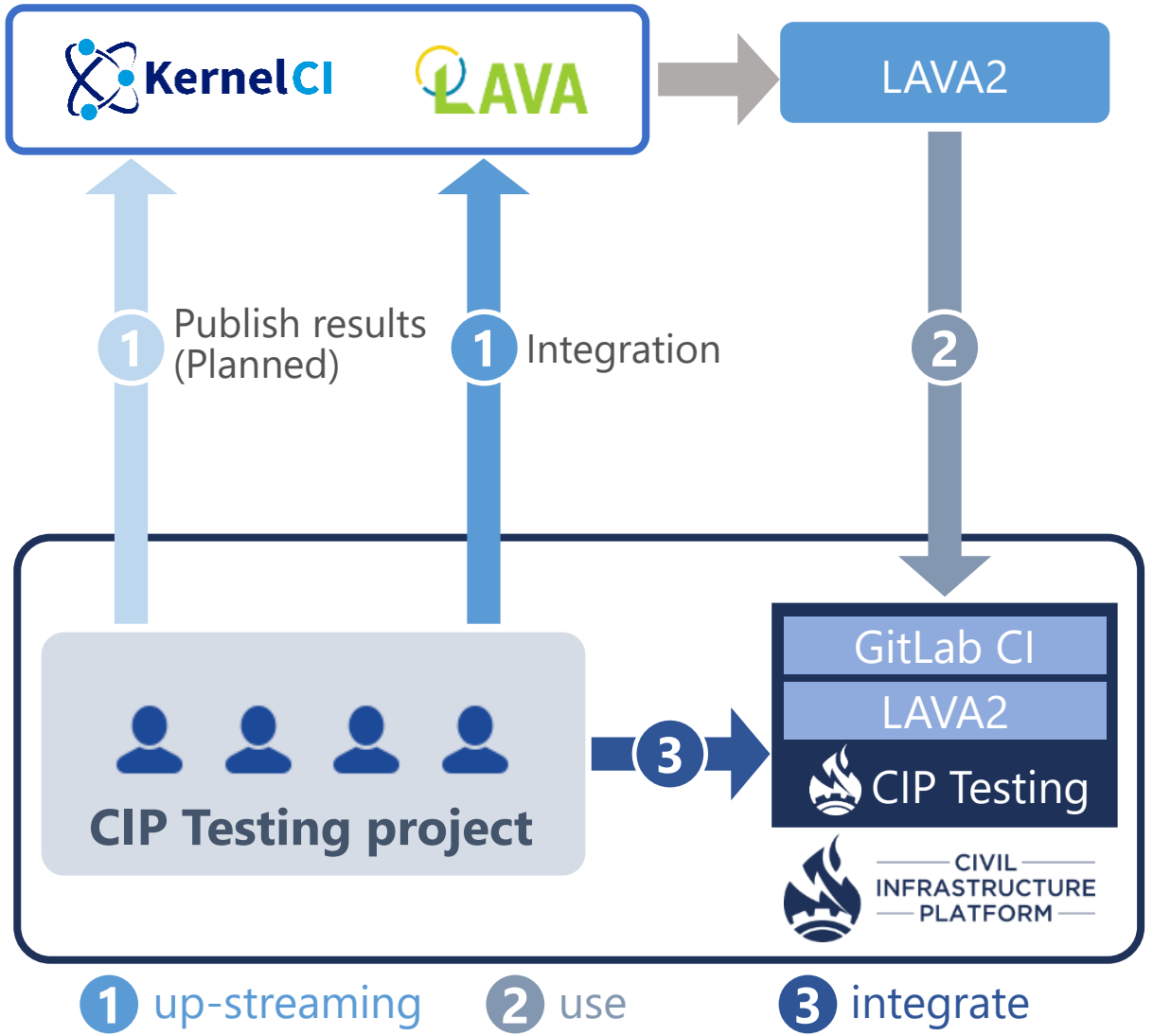
4 CIP Testing

Goal

- Providing a test environment to test the CIP kernel and CIP Core

Current status

- Moved to distributed testing environment on AWS with LAVA
- Integrated with GitLab-CI



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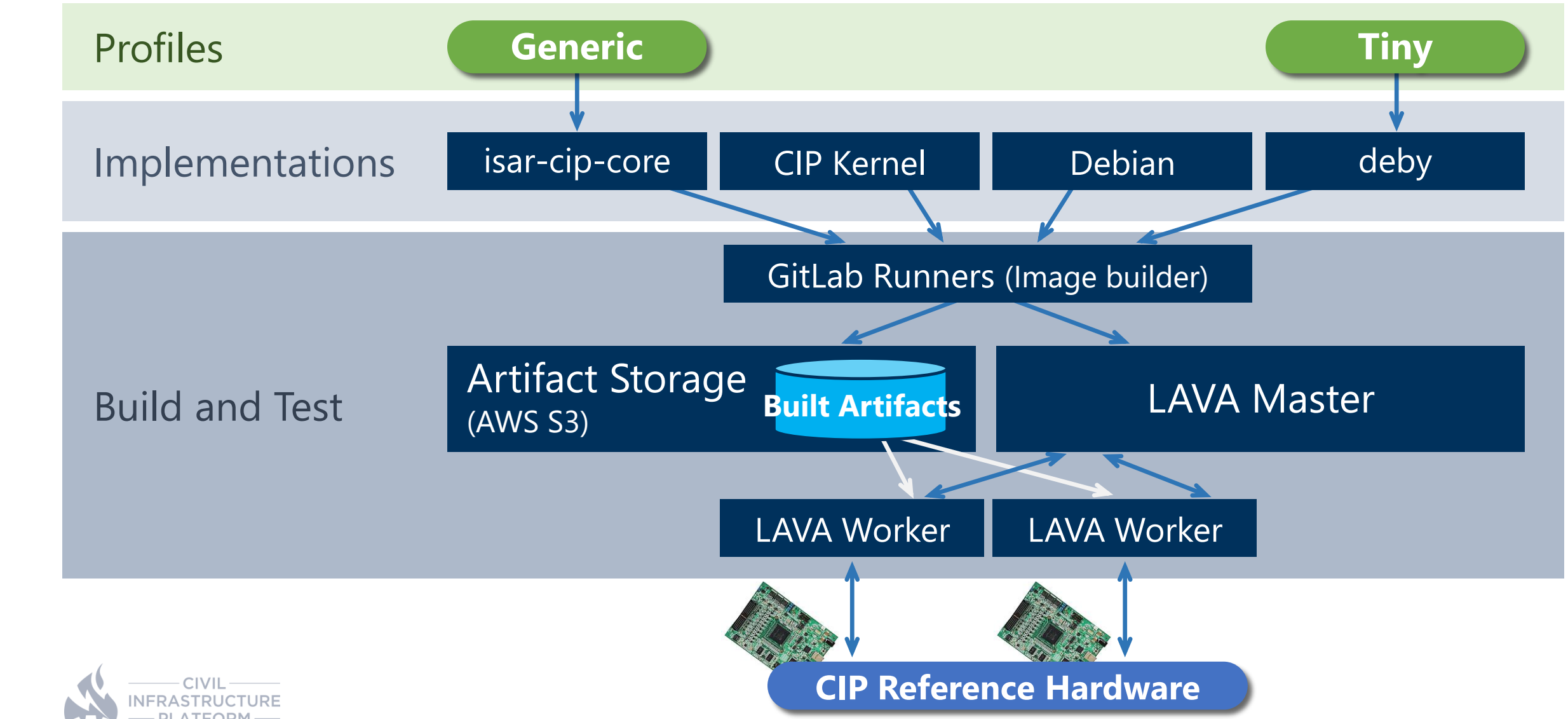
4 CIP Testing (Architecture with CIP Core)



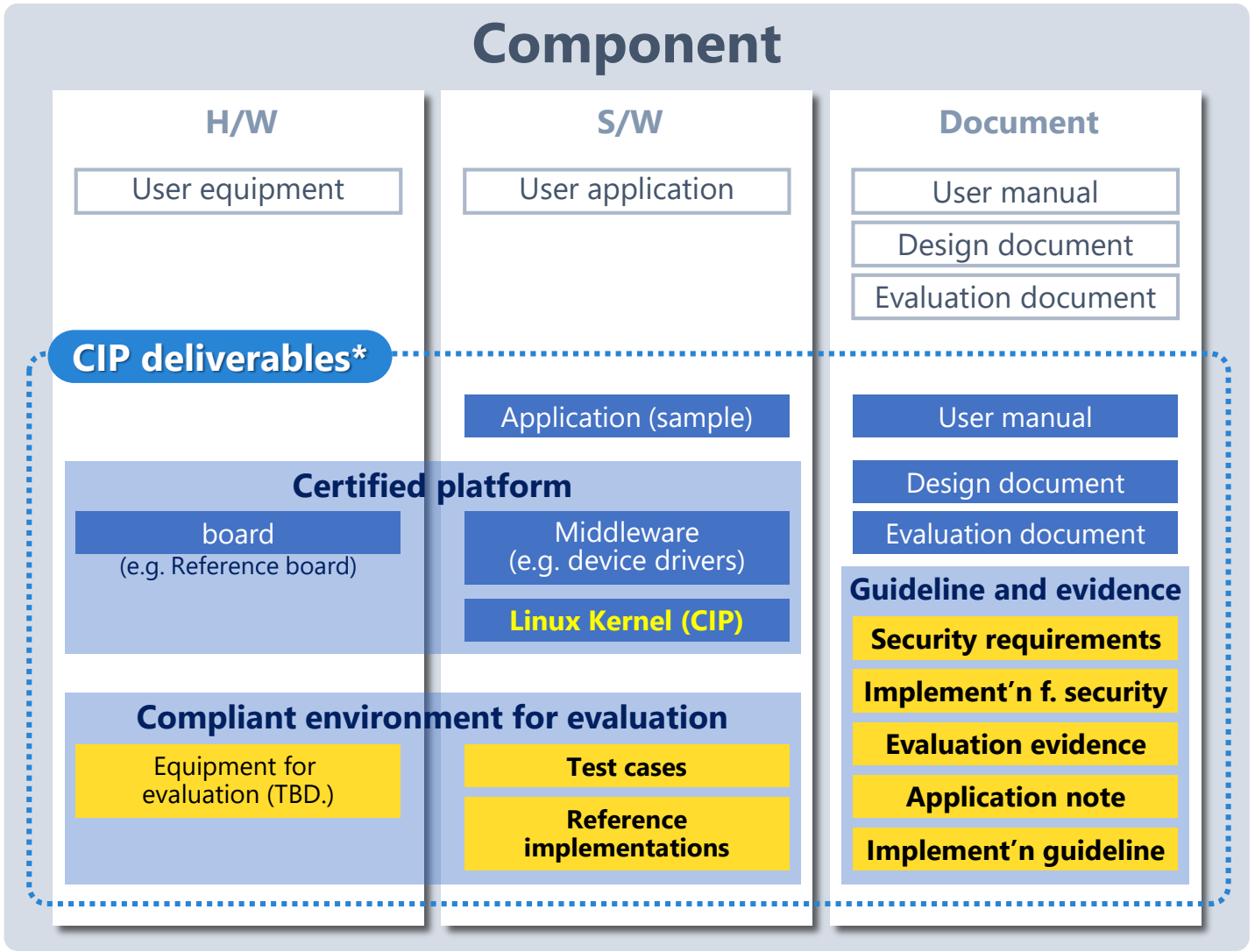
5 Security working group

Goal

- Provide guidelines and reference implementations to help developers to meet cybersecurity standard requirements (IEC 62443)

Status

- Started for feasibility study



* this image represents the planning and is for illustrative purpose only

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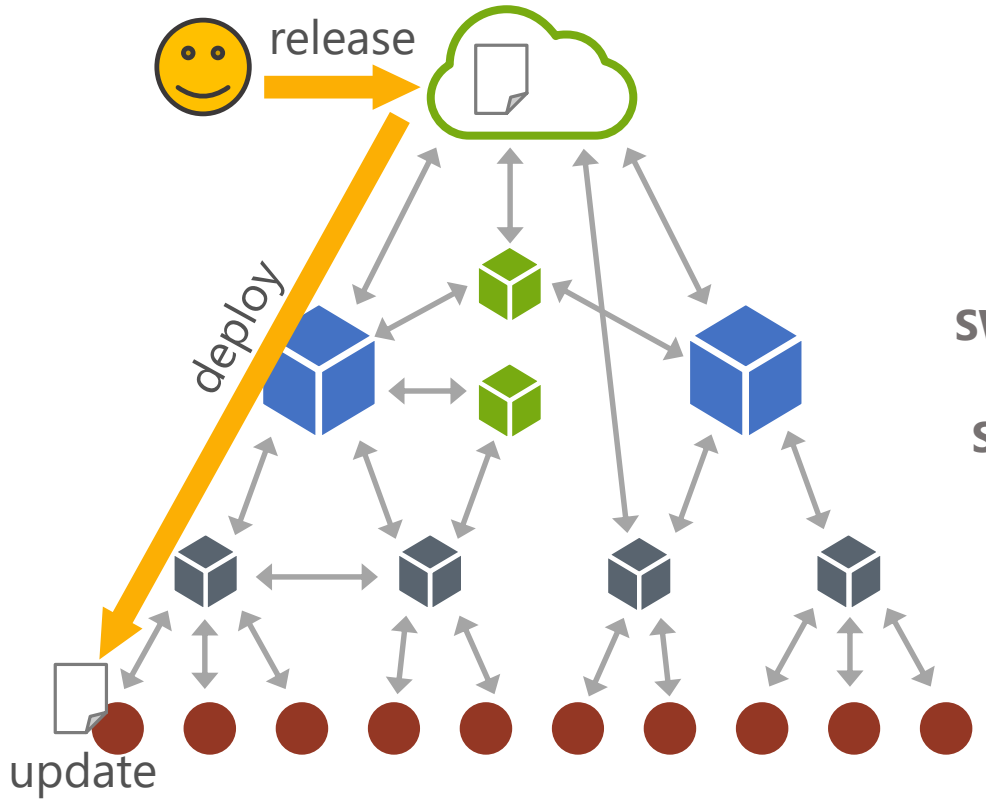
6 Software update working group

Goal

- Incorporate a common solution for software updates into CIP core
  - Device management
  - Deployment
  - Safe update

Status

- Selected OSS update tools



hawkBit
Eclipse IoT hawkBit

SWUpdate
/
Suricatta

SWUpdate

Summary

- CIP today focuses on
  - **Kernel maintenance:** maintaining Linux kernels for very long time including real-time support
  - **Testing:** providing a test infrastructure and evolve tests
  - **CIP Core packages:** a set of industrial-grade components that require very long-term maintenance including the required build tool chains
  - **Security:** Improving to have security features and to follow Cyber Security Standard
  - **Software update:** Incorporate a common solution for software updates into CIP core
  - **Collaboration:** Linux, Debian/Debian-LTS, Real Time Linux, Reproducible Builds, EdgeX Foundry

Conclusion

- Our Civilization needs an Open Source Base Layer of industrial-grade software
  - CIP provides this, using Linux
- Sustainability is ensured by
  - The backing of big industrial and semiconductor companies
  - Close cooperation with and building with mature Open Source projects (Debian, Real-time Linux, Reproducible builds, KernelCI, …)
  - Providing suitable tool chains
  - Ensuring in-depth tests
- **Contribution and collaboration with upstream projects are the key CIP activities to make sustainable infrastructure**

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Join us

CIP for sustainable Smart Cities with Open Source Software

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RENESAS

SIEMENS

TOSHIBA

Codethink

cybertrust

HITACHI
Inspire the Next

MOXA

Plat' Home
There, we are. Internet of Things

Contact Information and Resources

To get the latest information, please contact:

- CIP Mailing list: cip-dev@lists.cip-project.org

Other resources

- Twitter: @cip_project
- CIP web site: https://www.cip-project.org
- CIP news: https://www.cip-project.org/news/in-the-news
- CIP wiki: https://wiki.linuxfoundation.org/civilinfrastructureplatform/
- CIP source code
  - CIP GitLab: https://gitlab.com/cip-project
  - CIP kernel: git://git.kernel.org/pub/scm/linux/kernel/git/cip/linux-cip.git

Questions?

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