IoT today – connecting systems

Connected Cars

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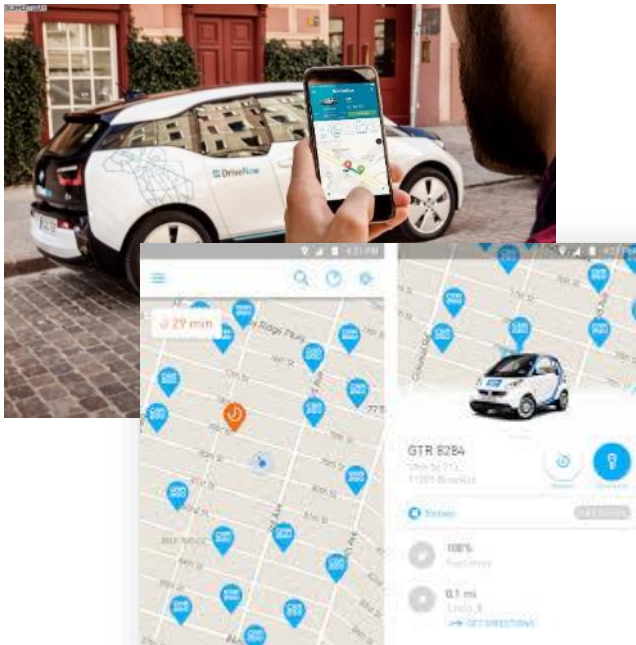
Smart City

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

Industry

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

Challenges when applying IoT to Civil Infrastructure

"Hidden" Industrial IoT Systems

Transport

Rail automation

Vehicle control

Automatic ticket gates

Energy

Power Generation

Turbine Control
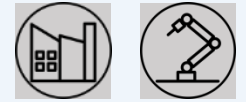
Others

Building automation

Broadcasting

Healthcare

Industry

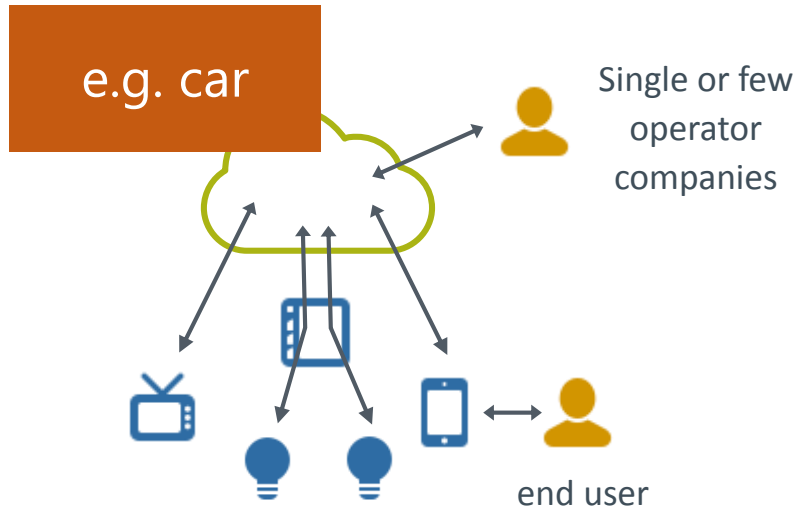**Industry automation**

CNC control

Industrial communication

Smart Cities combine consumer & industrial IoT

Consumer IoT

End user interfaces and comfort features

e.g. car

Single or few operator companies

end user

Industrial (grade) IoT

Digital backbone of connected systems

traffic control

Backend eco-systems

Controlled network zone

Multiple users with different roles at different levels
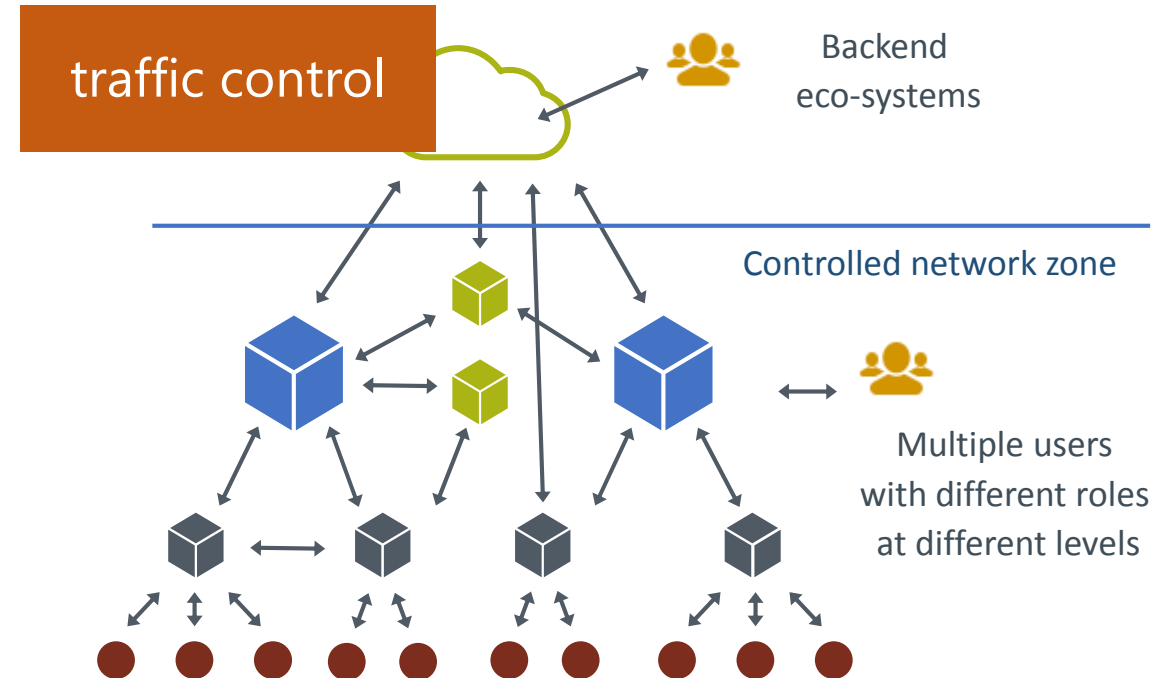
Permanent cloud connection required.
Quality and availability: Best effort
Low-cost / high volume

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

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/490141c0fbd6c0d06Sb492698b53a50/powerplant.jpg

Security

…for millions of devices

The key challenges

- **Apply IoT concepts to industrial systems.**

- **Ensure quality and longevity of products.**

- **Keep millions of connected systems secure.**
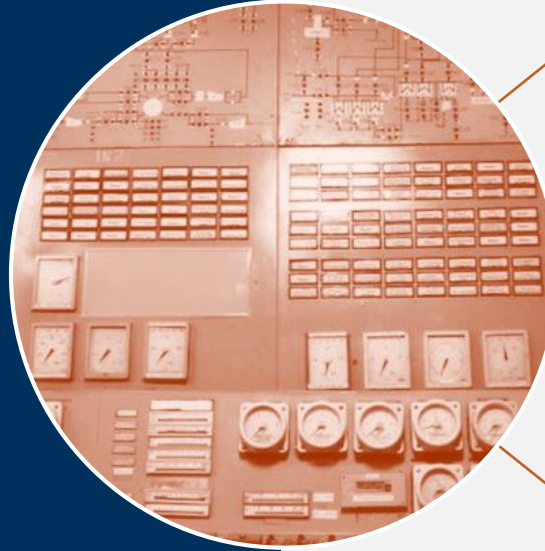
Industrial grade
- Reliability
- Functional Safety
- Real-time capabilities

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

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

Open Source meets Industrial Challenges

What is Open Source Software (OSS)

Source Wikimedia Commons
(Creative Commons Attribution 2.0 Generic license)

Example: Linux Foundation
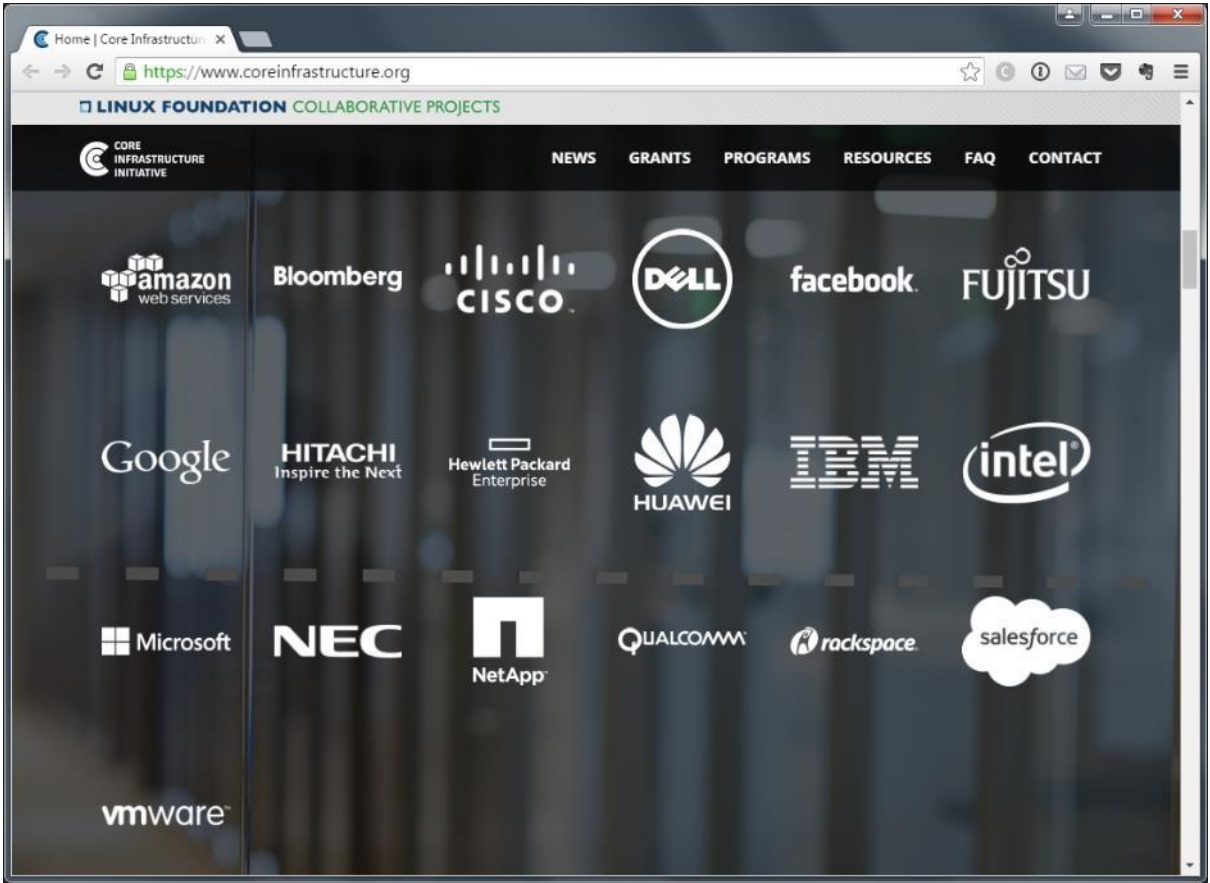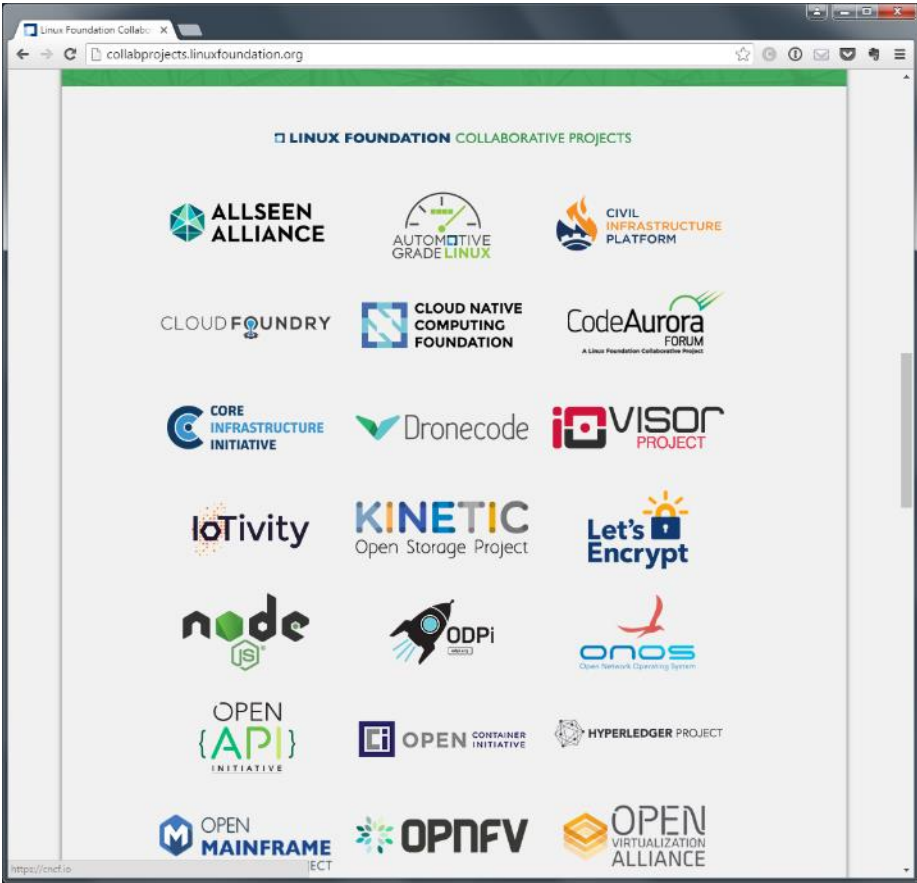
Example: Linux Foundation

The Linux Foundation is a Critical Part of the Tech Ecosystem

1320+
Members From
41 Countries

100%
of Fortune 100
Tech & Telecom

30,000+
Developers
Contributing Code

150+
Open Source
Projects

$15.7B
Shared
Value

In 2018, the Linux Foundation added a new member every day.

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Speed and efficiency: focus on differentiating parts

Handling increasing complexity with constant development resources

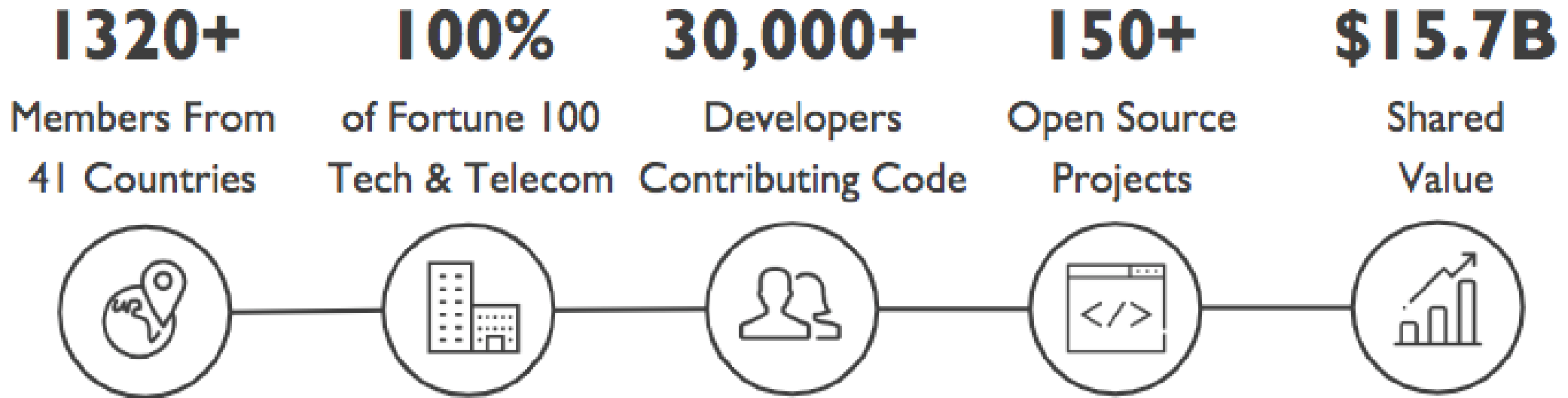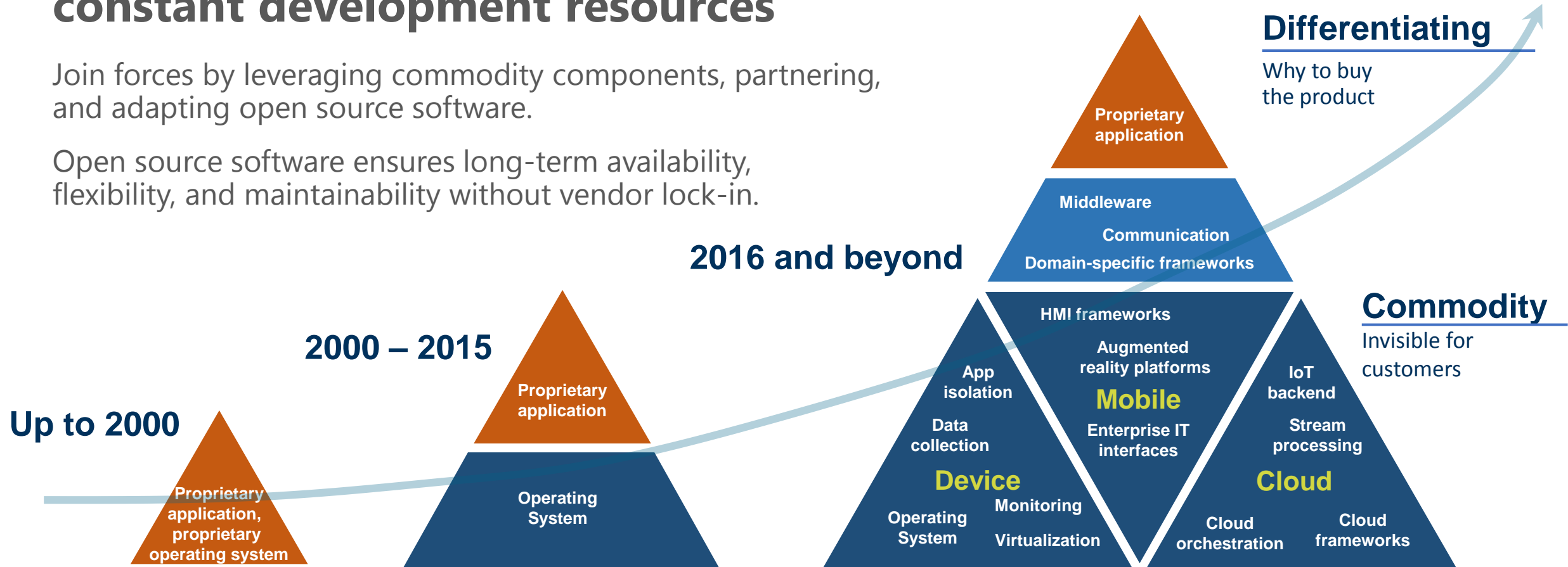Join forces by leveraging commodity components, partnering, and adapting open source software.

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

2016 and beyond

2000 – 2015

Up to 2000

Differentiating
Why to buy the product

Commodity
Invisible for customers

Proprietary application, proprietary operating system

Proprietary application

Operating System

Proprietary application

Middleware

Communication

Domain-specific frameworks

HMI frameworks

Augmented reality platforms

App isolation

Data collection

Mobile

Enterprise IT interfaces

IoT backend

Stream processing

Device

Operating System

Monitoring

Virtualization

Cloud

Cloud orchestration

Cloud frameworks

How to solve the Key Challenges
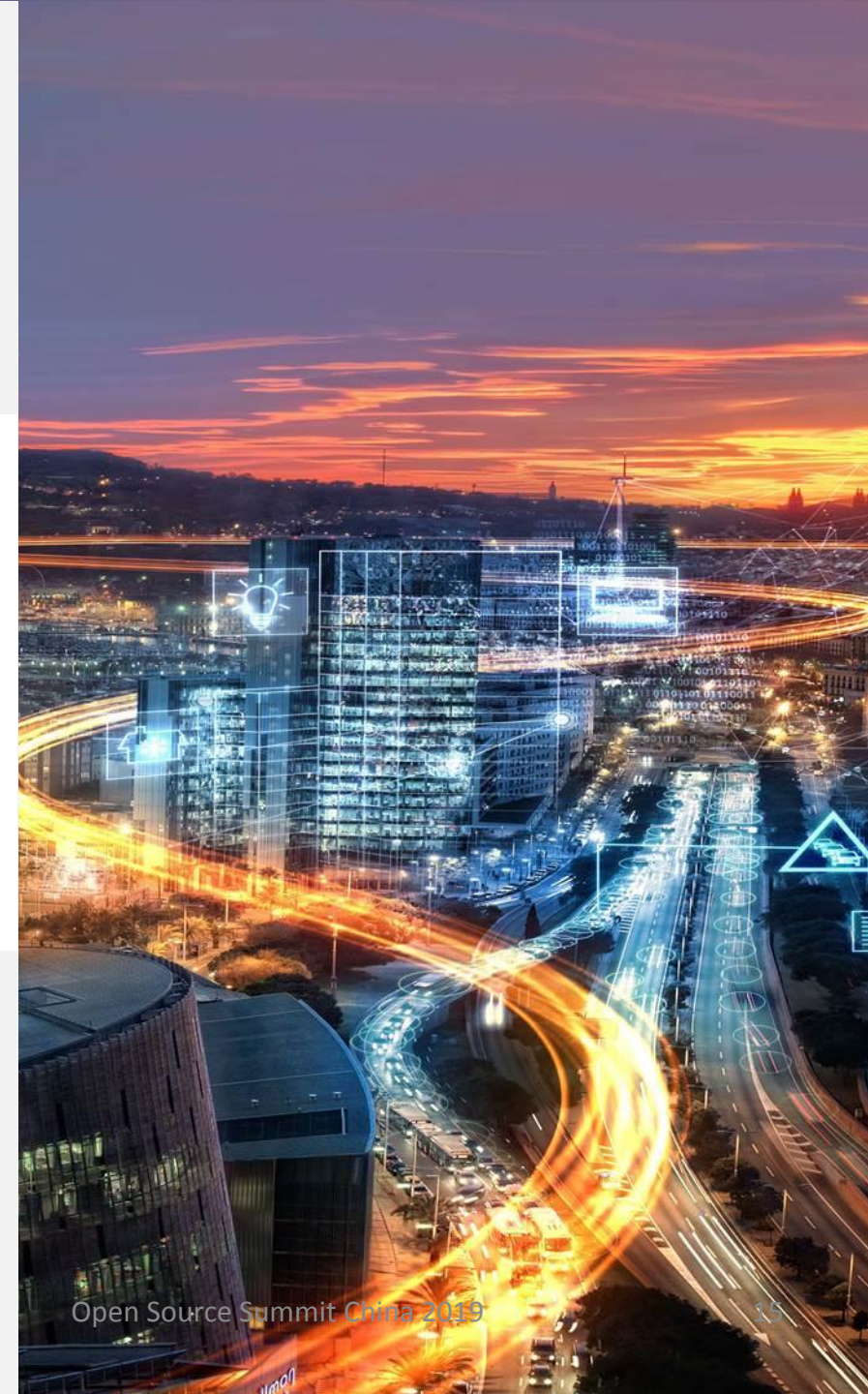
Facts and Issues: Smart City uses Commodity Software

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
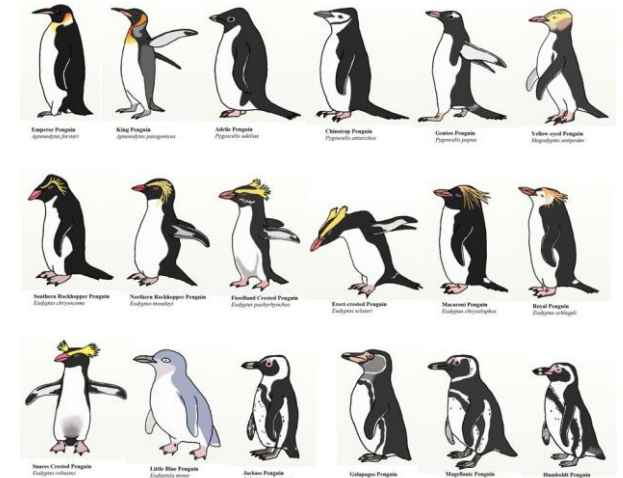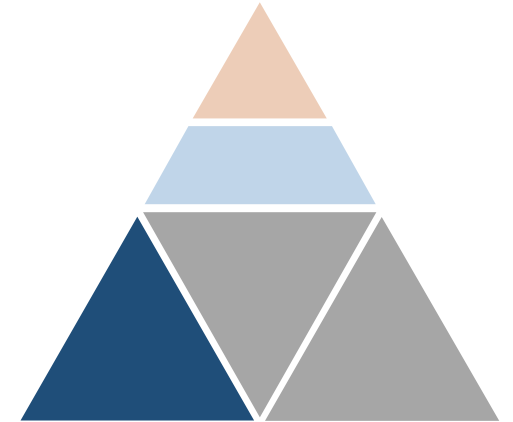
picture taken from Pinterest
https://www.pinterest.de/pin/554646510344033382/

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:

company-specific middleware and applications

scope of a typical Linux distribution

additional
packages
(hundreds)

CIP Core packages
(tens)

base layer

CIP kernel
(10+ years maintenance, based on LTS kernels)
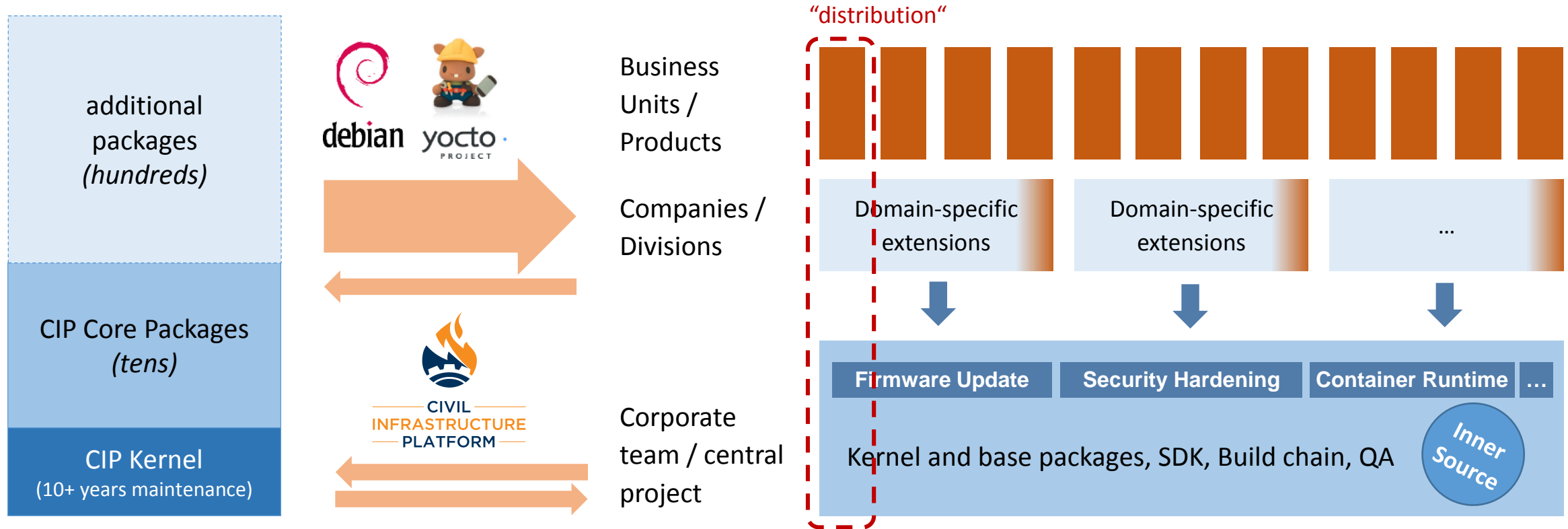
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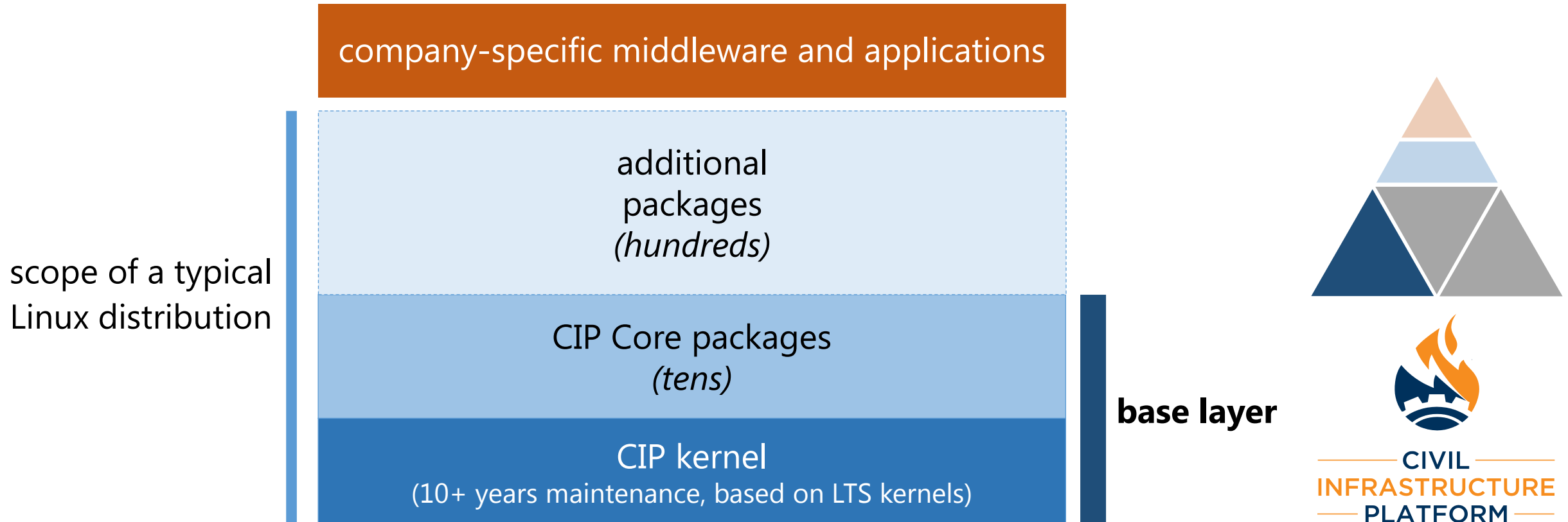
Mapping CIP into the company

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

"distribution"

additional packages *(hundreds)*

CIP Core Packages *(tens)*

CIP Kernel *(10+ years maintenance)*

debian   yocto PROJECT

CIVIL INFRASTRUCTURE PLATFORM

Business Units / Products

Companies / Divisions

Corporate team / central project

Domain-specific extensions

Domain-specific extensions

...

Firmware Update   Security Hardening   Container Runtime   ...

Kernel and base packages, SDK, Build chain, QA

Inner Source

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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The backbone of CIP are the member companies
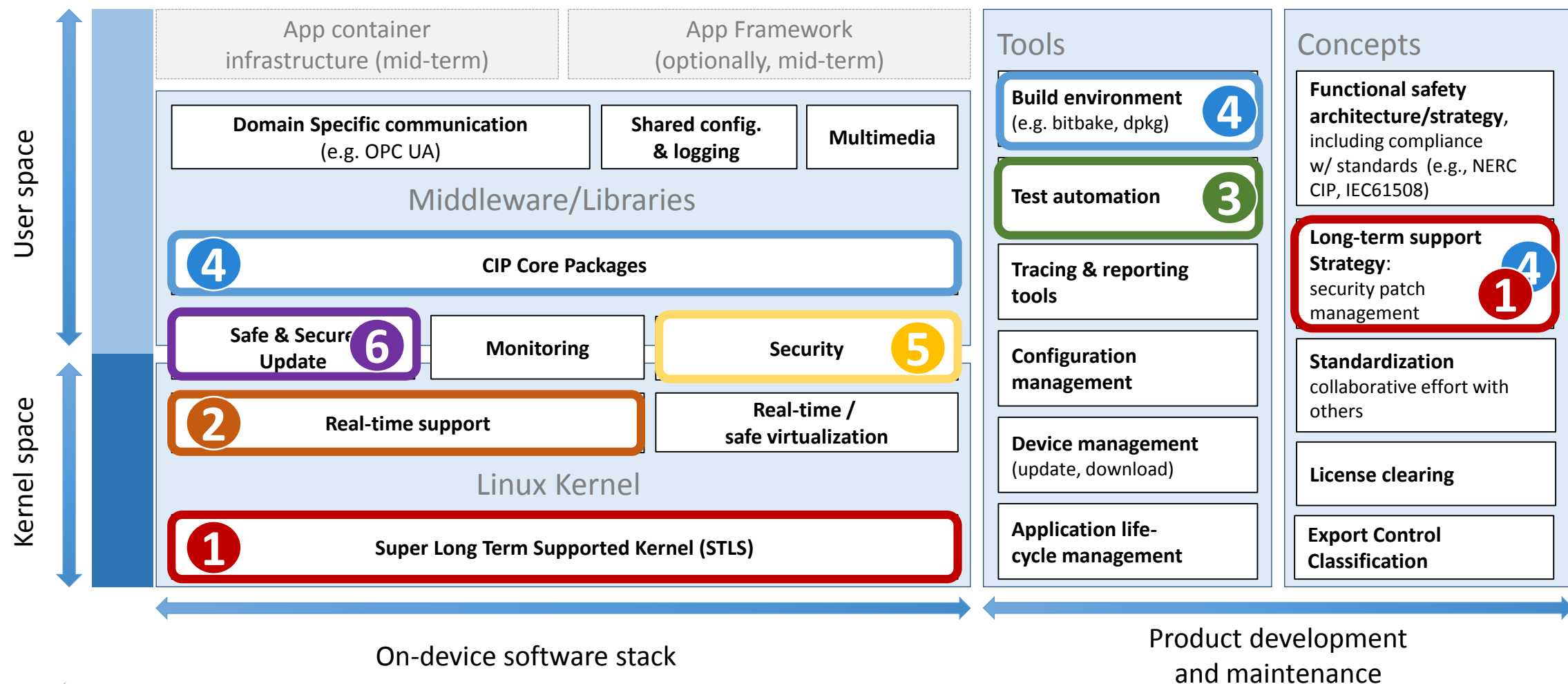

Open Source Summit China 2019
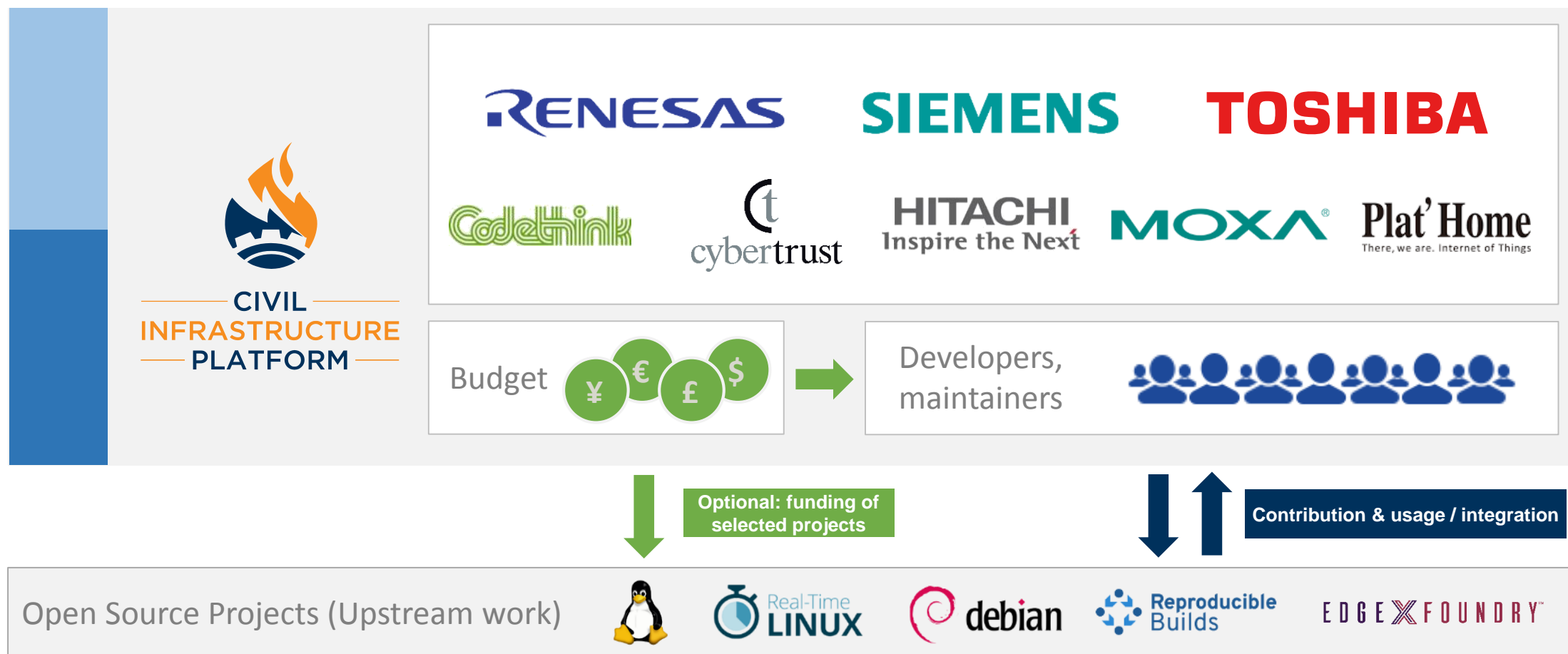
CIP lays the Foundation for Sustainable Smart Cities

Scope of activities

CIP governance structure and projects

Governing Board (GB)

Technical Steering Committee (TSC)

❶ SLTS kernel	❷ Real-time	❸ Testing	❹ CIP Core	❺ Security WG(*)	❻ Software update WG	
✔	✔	✔	✔	✔	✔	Industrial grade
✔		✔	✔		✔	Sustainability
✔		✔	✔	✔	✔	Security

(*): Workgroup

CIP Projects and its scopes
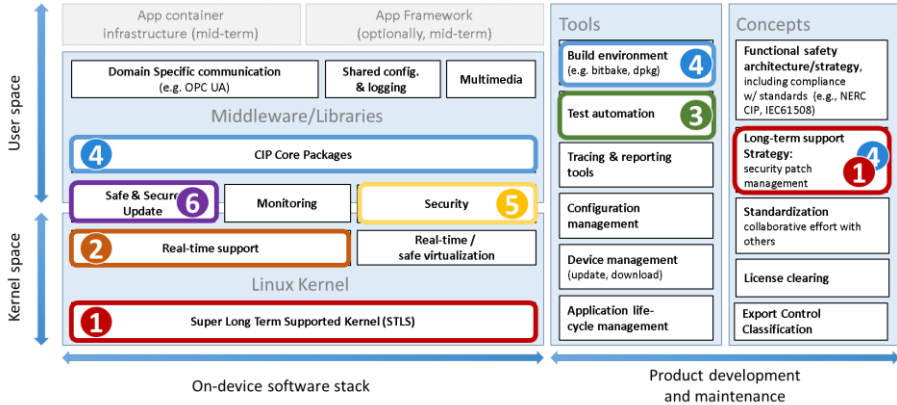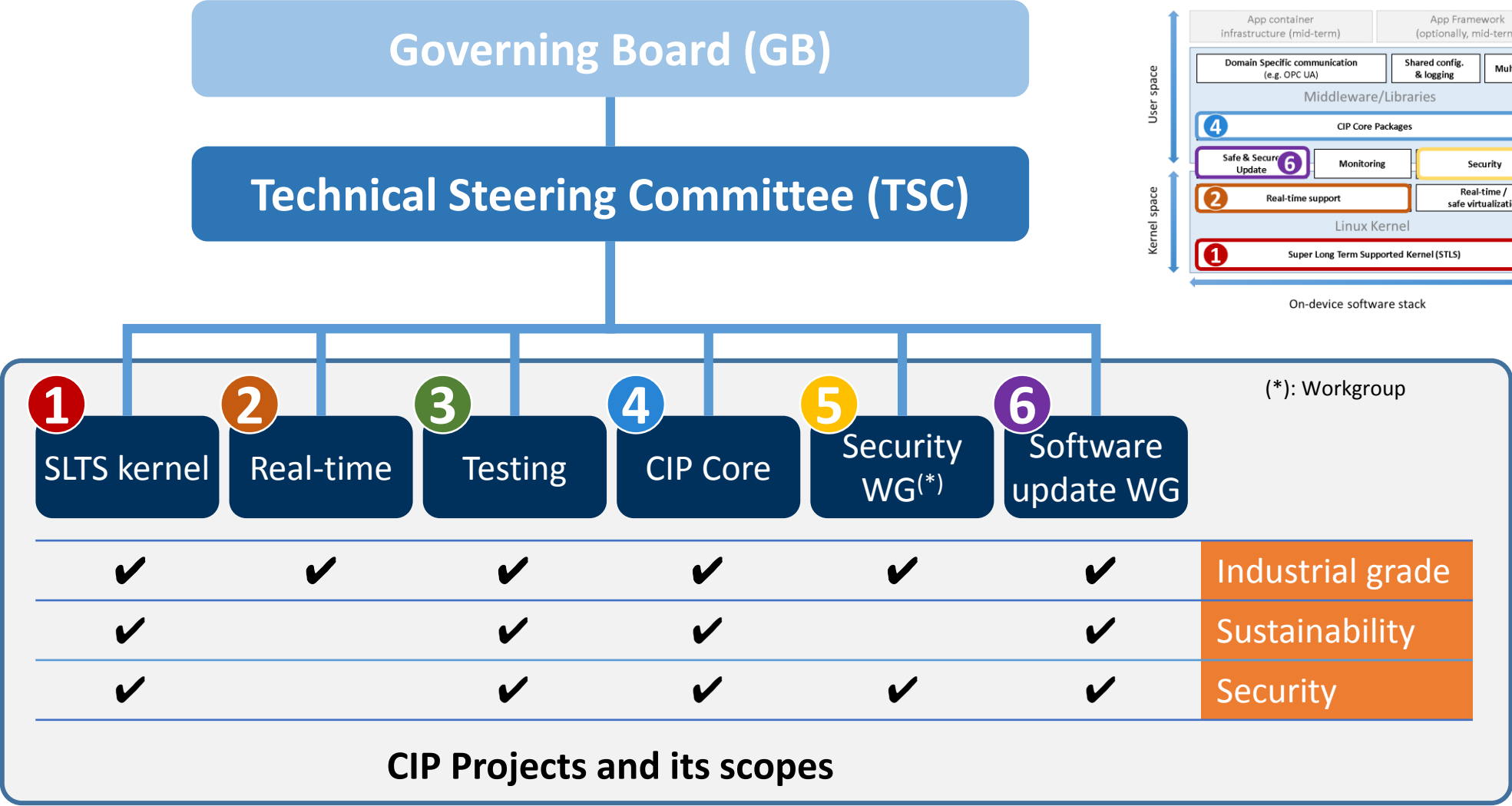
Collaborative development with other OSS projects

Contribute, Collaborate and use by CIP

Upstream Projects

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

① **Upstream first**

② **Use the upstream code**

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① **Upstream first**

③ Integrate

CIP Open Source Base Layer (OSBL)
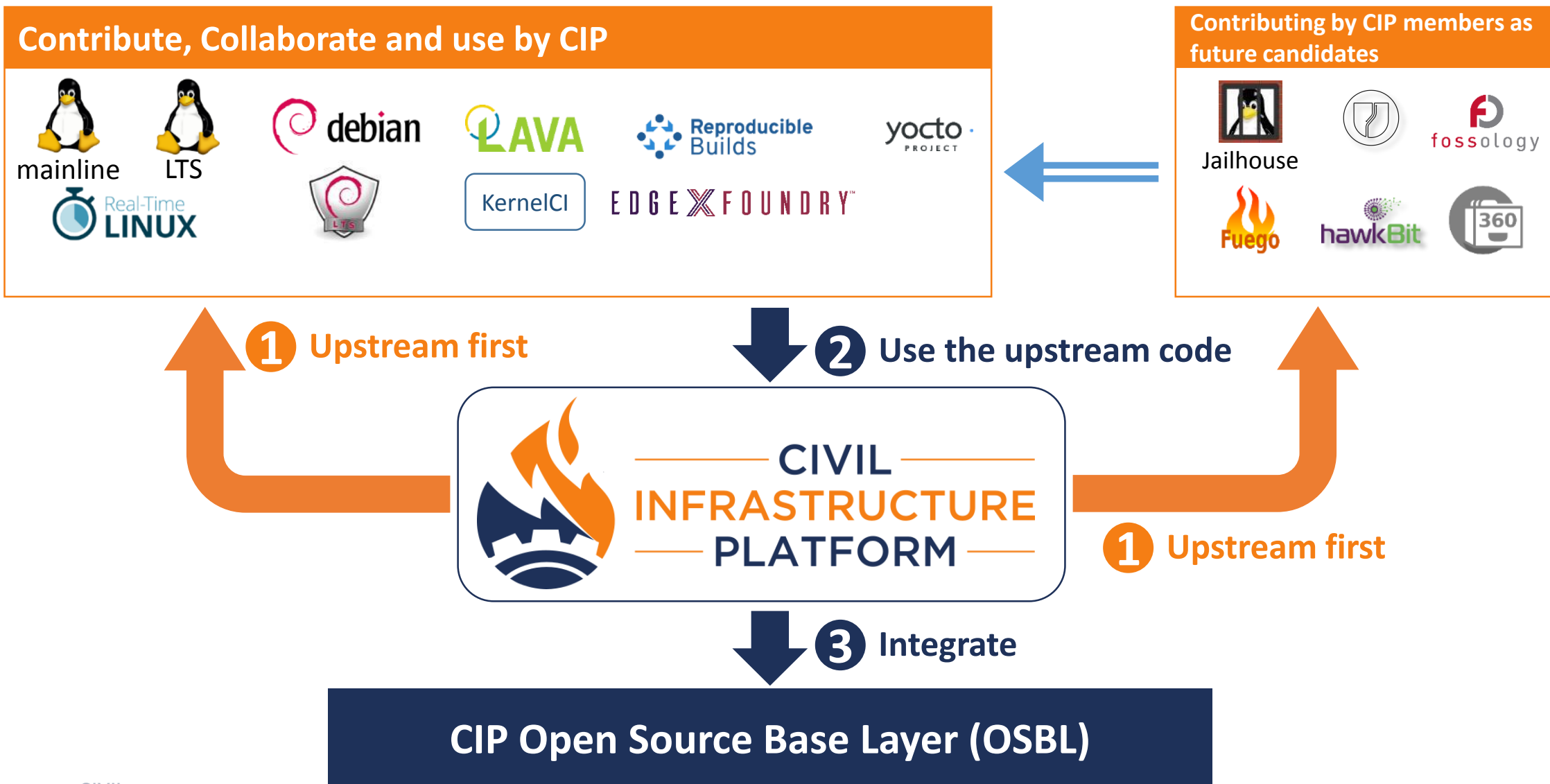
- Goal
  - Providing CIP kernels with more than 10 years maintenance period
    - Super Long Time Stable kernel

- Status
  - CIP SLTS kernels has been released
    - Linux 4.4.166-cip29
    - Linux 4.19.13-cip1
    - https://git.kernel.org/pub/scm/linux/kernel/git/cip
  - CIP kernel team participate into LTS review process

❶ up-streaming ❷ use ❸ integrate

- Goal
  - Provide CIP SLTS kernel with real-time enhancement (RT_path)
  - Work with Real-time Linux Project to standardize Real-time enhancement

- Status
  - CIP SLTS RT kernels has been released
    - Linux 4.4.166-cip29-rt21
    - Linux 4.19.13-cip1-rt
    - https://git.kernel.org/pub/scm/linux/kernel/git/cip
  - Test results are available on CI-RT
    - https://ci-rt.linutronix.de/RT-Test/

Mainline / LTS

Stable kernel

① RT patch mainlining

②

Real-Time LINUX

RT patch

Stable-rt

②

① Funding

① Join as maintainer and also developer

②

Mentor / Maintainer

③ CIP SLTS RT kernel

CIP kernel team

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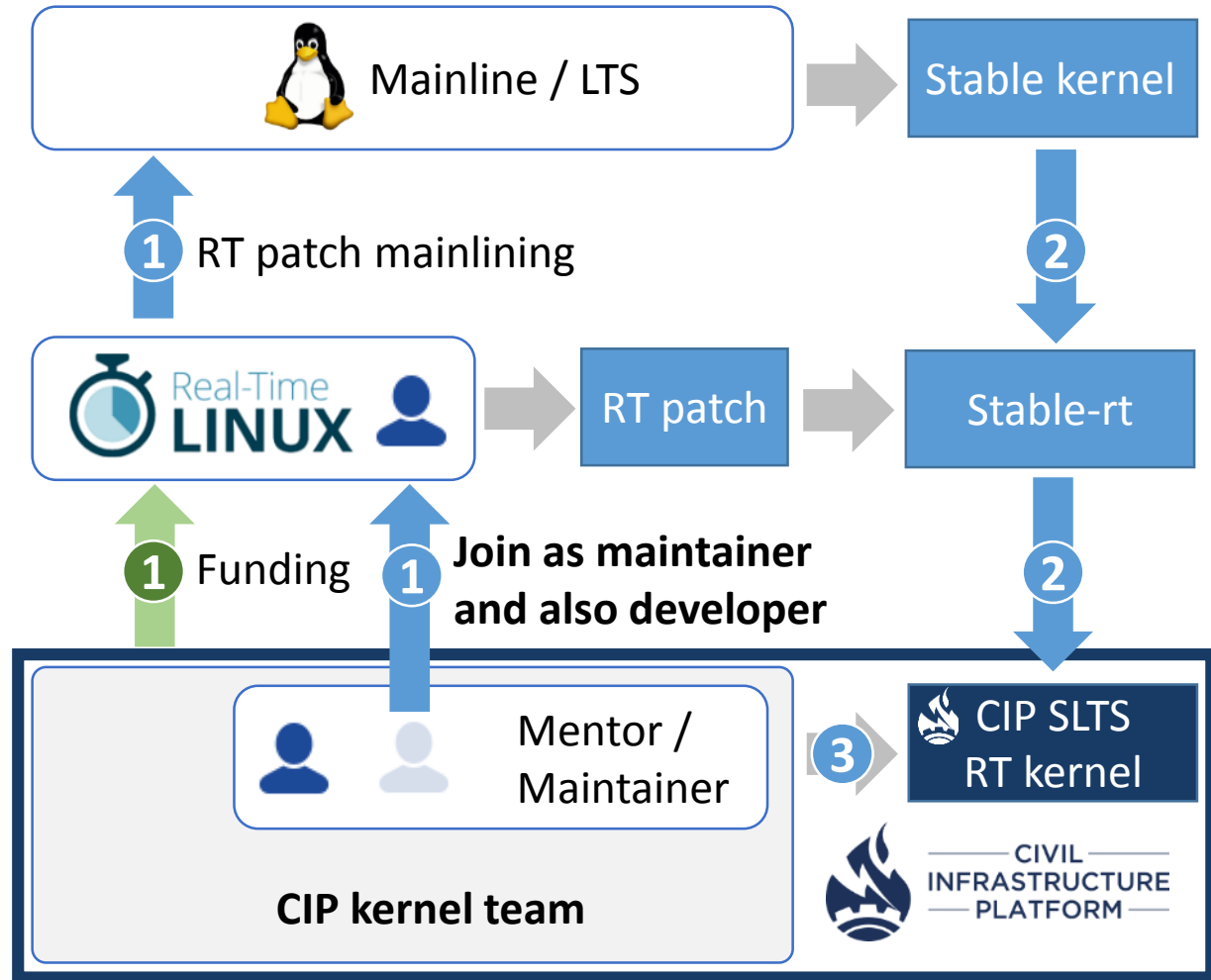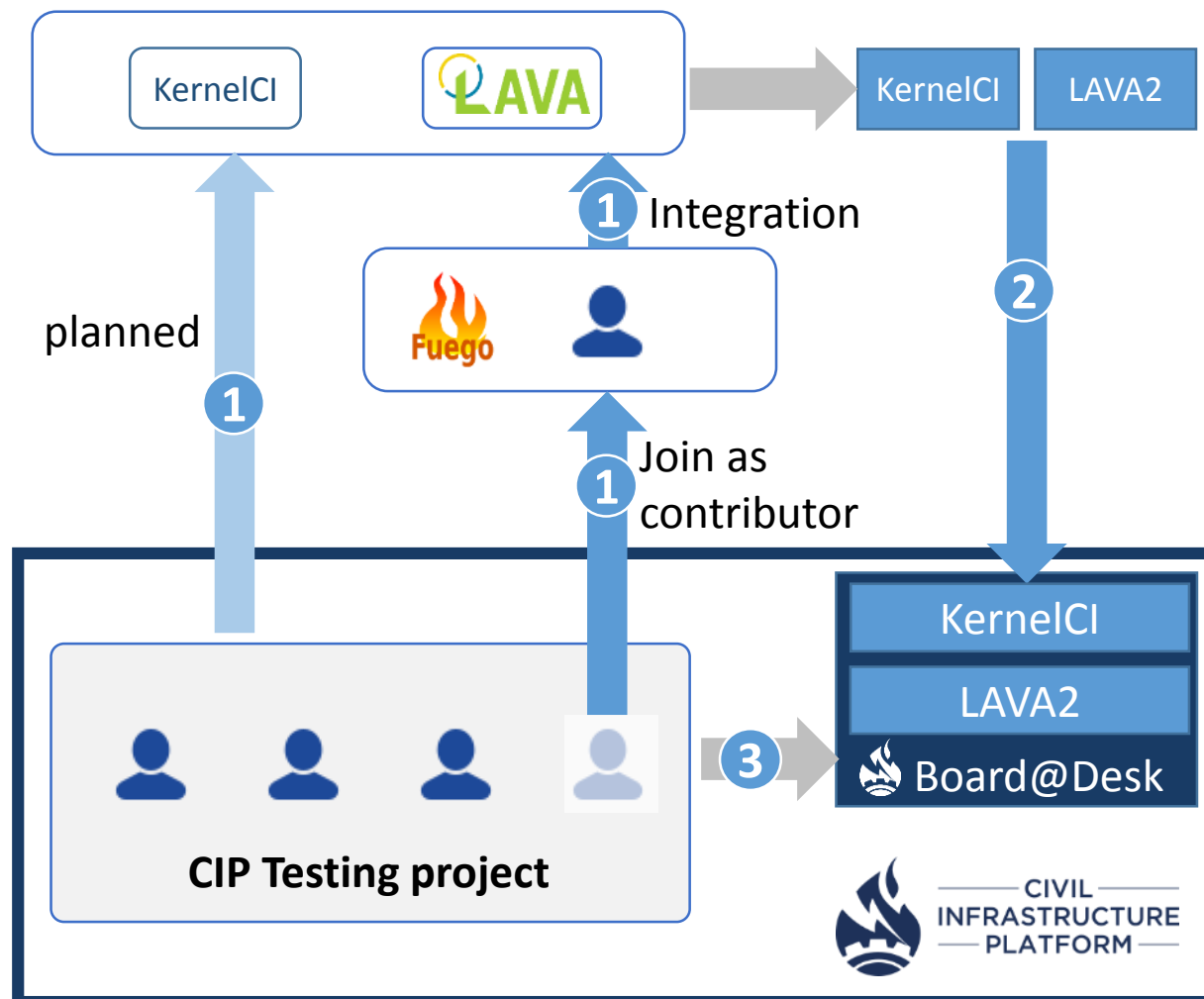
① up-streaming ② use ③ integrate

❸ CIP Testing

- Goal
  - Providing a test environment to test the CIP kernel and more
  - Single developer can test at their desk

- Current status
  - The first version B@D already released
  - https://gitlab.com/cip-project/board-at-desk-single-dev

KernelCI   LAVA   →   KernelCI   LAVA2

planned

1 Integration

Fuego   **1** Join as contributor

2

CIP Testing project   **3** →   KernelCI / LAVA2 / Board@Desk

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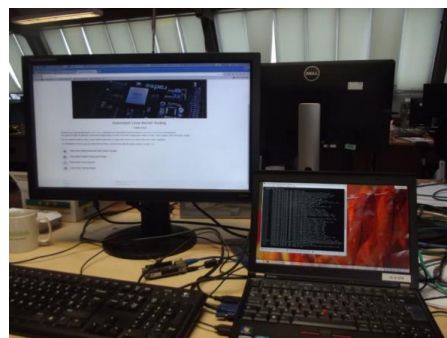
1 up-streaming   **2** use   **3** integrate

❹ CIP Core

- Goal
  - Provide a reference implementation with CIP core packages for testing
  - Following implementations will be provided
    - Tiny profile
      - eg. Small IoT devices
    - Debian profile
      - eg. IoT gateways

- Status
  - CIP Core Tiny profile has been released
    - https://gitlab.com/cip-project/cip-core
  - PoC implementation is available for Debian profile
    - https://gitlab.com/cip-playground/isar-cip-core

Debian-cross

Debian packages | Debian sources

① Funding to Debian-LTS

① Contribute cross compiling patches

②

ISAR | ELBE

yocto PROJECT | Deby as meta-debian

Build tool

Debian | meta-*

②

① Contribution

Debian profile
Tiny profile
CIP Core

CIVIL INFRASTRUCTURE PLATFORM

CIP Core project

③

① up-streaming ② use ③ integrate
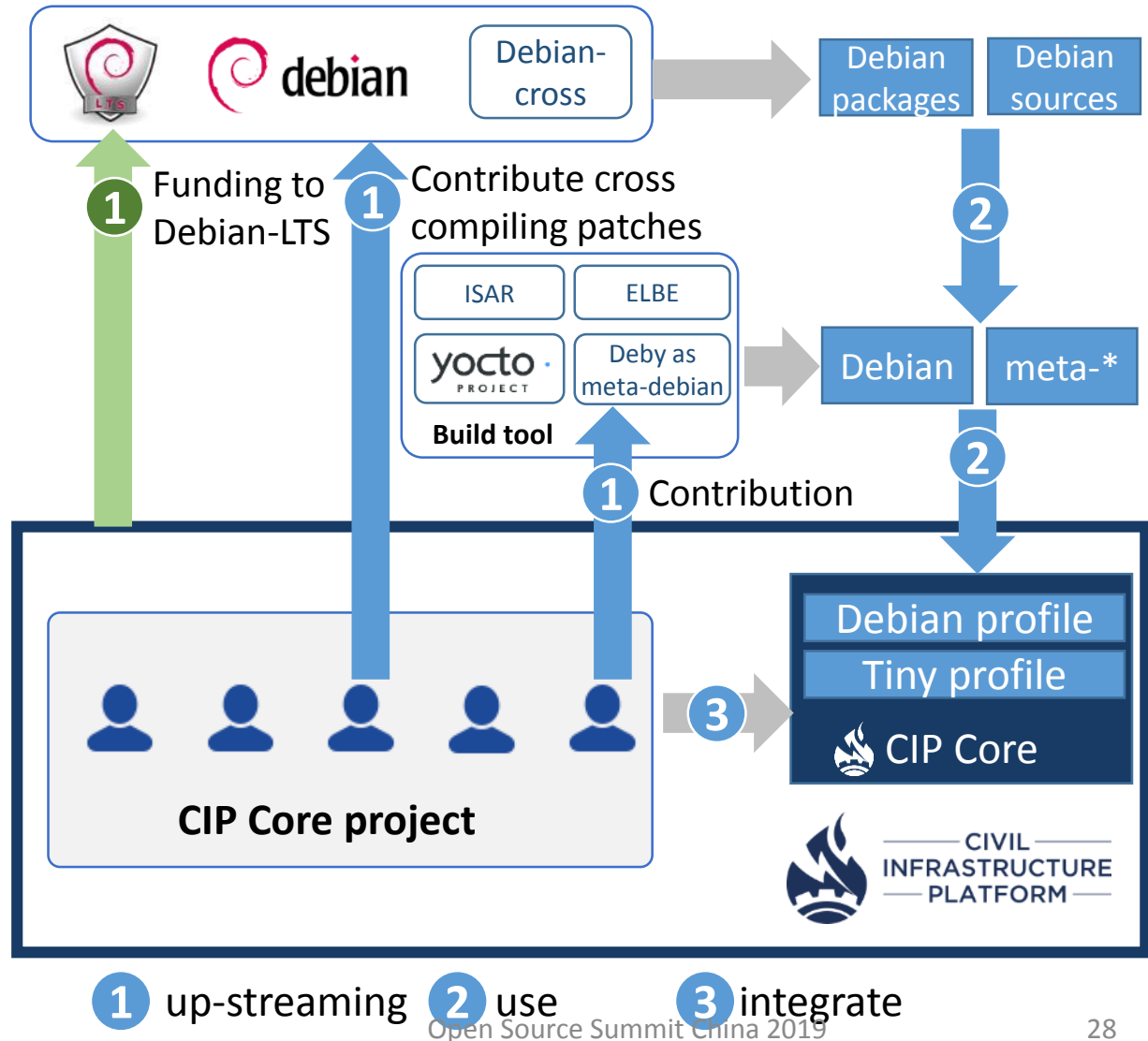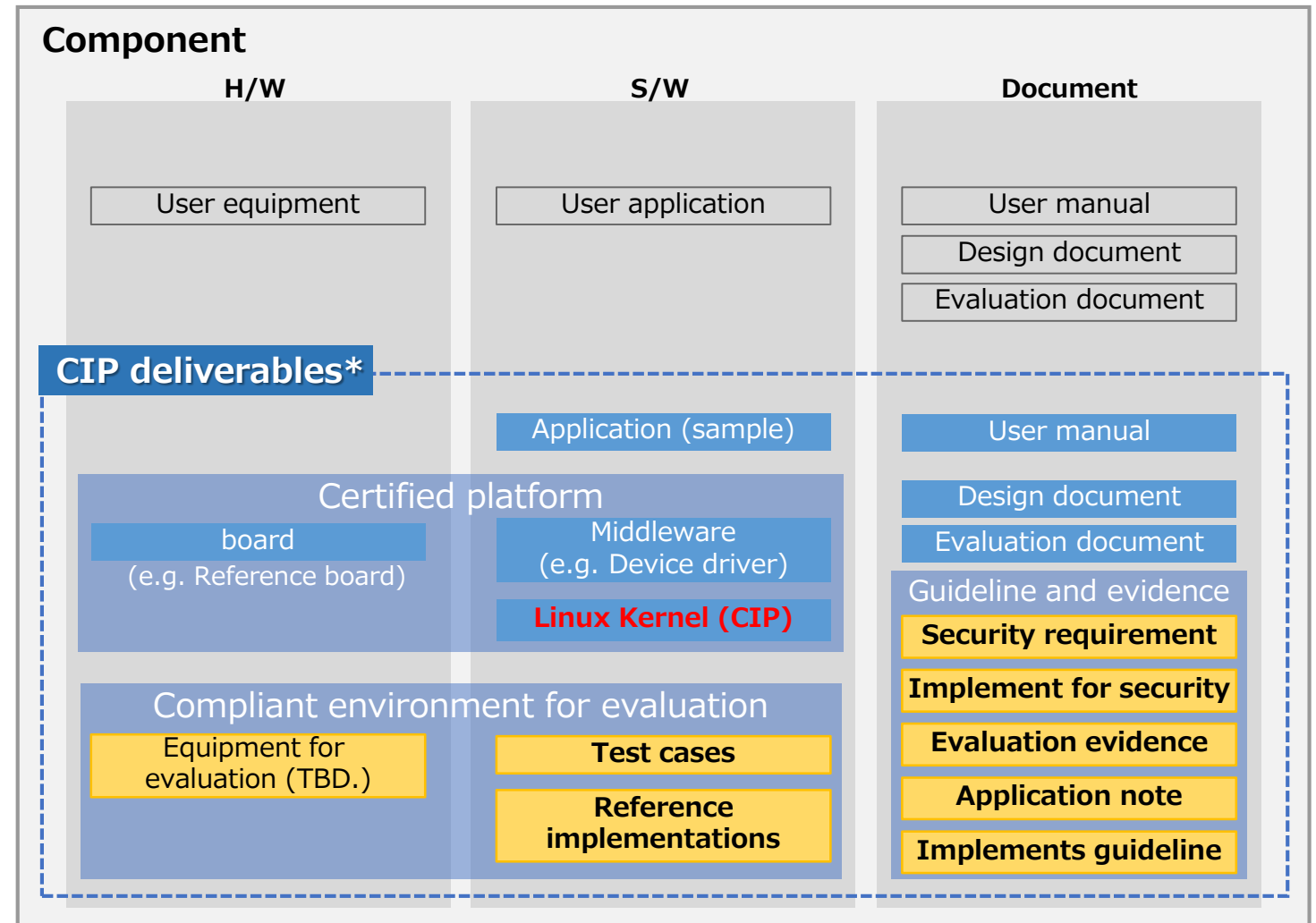
❺ Security working group

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

- **Status**
  - Started for feasibility study
  - A demonstration scheduled at OSS Japan in July

Component

	H/W	S/W	Document
	User equipment	User application	User manual
			Design document
			Evaluation document

CIP deliverables*

		S/W	Document
		Application (sample)	User manual

Certified platform

board (e.g. Reference board)	Middleware (e.g. Device driver)	Design document
	Linux Kernel (CIP)	Evaluation document

Guideline and evidence

- **Security requirement**
- **Implement for security**
- **Evaluation evidence**
- **Application note**
- **Implements guideline**

Compliant environment for evaluation

Equipment for evaluation (TBD.)	**Test cases**
	Reference implementations

*: Noted that this image is under planning and for only illustrative purposes.

❻ Software update working group
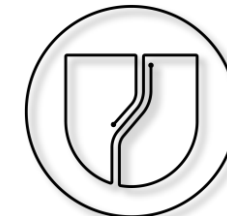
- **Goal**
  - Incorporate a common solution for software updates into CIP core

- **Status**
  - Just started

Eclipse IoT hawkBit

https://www.eclipse.org/hawkbit/

SWUpdate / Suricatta

SWUpdate

https://github.com/sbabic/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, Reproducble 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, PREEMPT_RT, KernelCI, …)
  - Providing suitable tool chains
  - Ensuring in-depth tests
- **Contribution and collaboration with upstream projects are the key CIP activities**

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Join us

CIP for sustainable Smart Cities with Open Source Software

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

Question?

Thanks for your attention!