The Civil Infrastructure Platform

CIVIL
INFRASTRUCTURE
PLATFORM

Overview

Civil infrastructure systems are at the very heart of modern societies. Technical systems are ubiquitously responsible for supervision, control, and management of infrastructure that supports an array of human activities. Examples include electric power generation and transport, water and wastewater management, communication, transportation, healthcare and others.

These networks deliver essential services, provide shelter and support social interactions and economic development. As requirements for reliability, connectivity and feature-richness increase, the amount of software needed to implement and maintain such systems has grown to unprecedented levels.

The Civil Infrastructure Platform (CIP) Initiative, hosted by the Linux Foundation and driven by the world's leading manufacturers of civil infrastructure systems, aims at providing a base layer – a set of industrial grade core open source software components, tools and methods to create Linux-based embedded systems that meet the requirements of modern societal infrastructure.

Software-intensive, complex base systems that do not create differentiating value for products, yet need to be provided by each and every manufacturer, are jointly developed, extended and maintained. The results of this collaborative development are provided as open source software (OSS). CIP focuses on providing a basis for the implementation of safety-critical systems using standard Linux components, and on delivering super long-term support (envisioned duration: 15+ years) of selected versions of the Linux kernel. Of course, these very ambitious goals can only be fully realised if many companies and organisations join the effort!

CIP believes that sharing efforts, working closely with the upstream community, and contributing back to projects is essential to ensure the success of the initiative.

Base Platform Requirements

Several of our requirements are unique to the considered fields and usually do not play any substantial role in consumer or server products. A bug in a mobile phone that unexpectedly ends a phone call or requires a reboot is a nuisance to the user. A similar bug in a brake control system, a signal-box or a light-signalling system can cause severe harm to people, including loss of life. CIP thus needs to ensure that its base layer is trusted software of the highest industrial quality, which necessitates:

- **Reliability:** Uninterrupted operation over extended periods of time is the rule, not the exception.
- **Functional safety:** Civil infrastructure systems are often cyber-physical in that they interact with the external world, sometimes using very heavy machinery. The platform must provide an appropriate basis so that higher layers can ensure that people will not be harmed. This is only possible when the base components are combined into appropriate software architectures.
- **Security:** The increasing use of IT technologies in industrial systems, together with a strong trend towards more and more connectivity in IoT components, increases the possible attack surfaces for criminals. Information security, identification and backporting of relevant fixes, and sound security update mechanisms are among the core concerns of CIP.
- **Real-time capabilities:** Automation and control tasks appear abundantly in industrial settings, and deterministic response times are often required. CIP will not develop individual solutions, but will ensure cooperation with or provide sponsorship for the existing approaches to real-time enhanced Linux.

Sustainability

Infrastructure products face product life-cycles of 10 to 60 years and software components need to keep up with such life-cycles. The CIP project helps to build sustainable systems at sustainable costs by reducing overall development costs. By using CIP's base platform, maintenance costs become predictable (and small) by minimising the number of regression problems by extensive, central testing and by providing components prepared for further certification. CIP's solid, conservative update strategy gives advice on when firmware updates are unavoidable, and provides software architectures that prevent the need for constant updates as much as possible.

Platform

CIP aims to build and maintain a pre-production base layer of industrial quality that all members can share to implement commercial products. Building a civil infrastructure platform requires more than just a kernel. It also requires:

- **Key software components:** Linux kernel, bootloader, shell, utilities and key libraries are included in the CIP base layer and will be provided with appropriate updates and backports over the platform's lifetime.

- **Reproducibility and traceability:** It is not possible to maintain a system without also maintaining those key tools that are used to produce that system from scratch, together with the associated metadata. Among other things, a complete toolchain that continues to work for decades is crucial. Achieving traceability requires CIP to produce the platform through a transparent process in which inputs, outcomes, tools and states are kept for inspection, ensuring that CIP software and processes can be trusted in the future.

- **Debugging and maintenance:** Regardless of how old a system is, new bugs will crop up. Packages to debug the system and perform basic maintenance actions are need to be provided. For an industrial quality base layer, maintainability is a core factor at every stage of its design and production. CIP understands that this effort is shared with upstream communities.

CIP will publish the selected software packages and tools that form the Civil Infrastructure Platform, and commits to following open source development and delivery practices using OSS licenses and an upstream first policy. All components will be verified to work on selected industrial hardware reference platforms. This enables interested parties to establish complete hardware/software solutions in minimal time that can be used as a basis for vendor-specific product innovation.

More Information

The project's website, www.cip-project.org, provides more information and also describes options for corporate membership and community participation.