Common Product Platform 14 (CPP14)
Technical Whitepaper

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1 Common Product Platform 14 (CPP14)

1.1 Introduction

Bosch Building Technologies continues to invest in new product platforms to stay ahead of the continuously changing and ever increasing requirements of video surveillance users. Based on the desire to benefit from the newest technologies like Deep Neural Network (DNN) based Video Analytics, Bosch introduces its newest Common Product Platform: CPP14. As with CPP13, CPP14 supports DNN Video Analytics to enable new customer use cases. The new platform includes a full suite of data security features enabling the next generation of secure intelligent IP cameras. Additionally, CPP14 offers advanced image processing (e.g. local tone mapping, dynamic range, and noise filtering), Electronic Image Stabilization (EIS) on selected cameras, and a hardware accelerator to support DNN Video and Audio analytics. With the powerful capabilities of CPP14, Bosch will be able to expand its product portfolio with a new range of bullet and dome cameras as well as multi-imager cameras.

1.2 What is a common product platform?

Bosch Building Technology uses a Common Product Platform (CPP) to offer a unique combination of advanced analytics, high quality imaging, and the best data security through its entire range of products. A CPP provides a foundation for building upon with different sensor and lens combinations, and/or a different housing to shape a new camera. As the foundation remains the same, VMS and recording solution integrations with the new and old cameras remain the same. Each product benefits from the features provided by the platform and can also be extended with its own product specific advanced functionality. Each new CPP builds upon previous CPPs and adds improvements while still assuring products from different CPPs can be used jointly in one system. Alternatively, a CPP can also be created with specific requirements in mind, i.e. CPP13 was designed according to fully open principles to create the first security camera with an open Operating System (OS). Now, together with CPP13, Bosch brings CPP14 for the next generation of secure intelligent IP cameras. In 2021, Bosch will add its first CPP14 products to the camera portfolio.
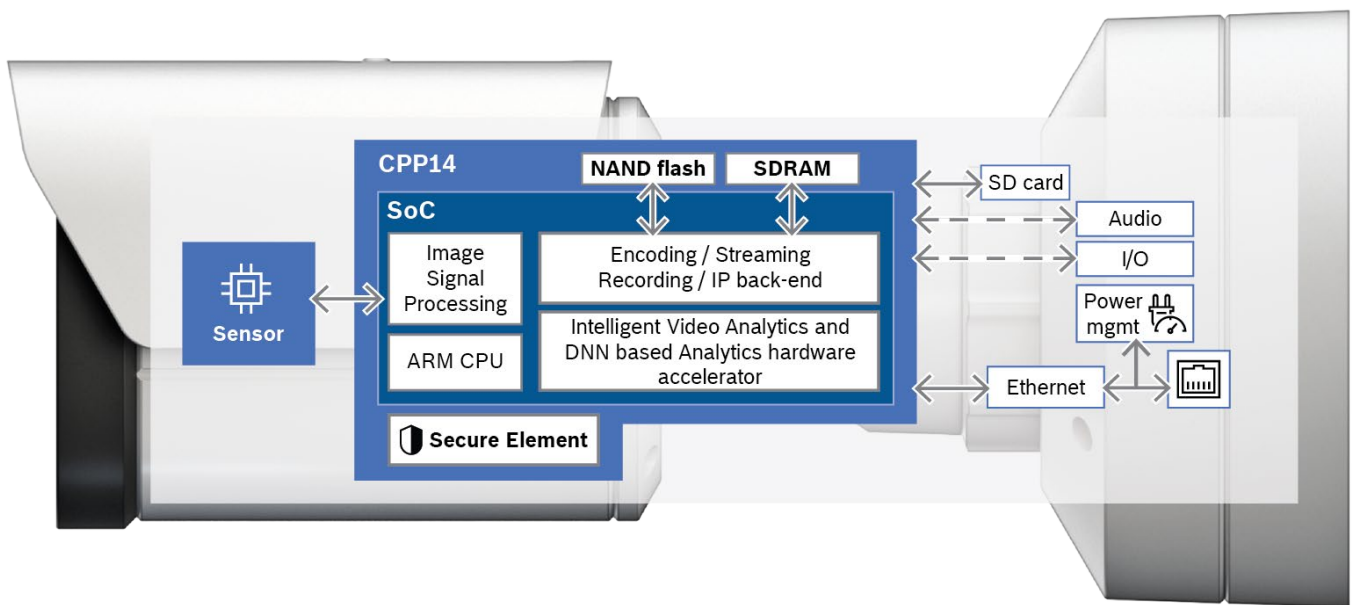

Figure 1: Schematic of Common Product Platform 14

1.3 The introduction of CPP14

CPP14 is an innovative platform to drive the next generation of intelligent security cameras. It combines a quad-core CPU, advanced image processing, a full suite of advanced data security features, and a built-in hardware accelerator to support Intelligent Video Analytics and DNN based Video Analytics. It is designed for both high-performance cameras such as multi-imager cameras, as well as being optimized for standard intelligent surveillance cameras with advanced imaging and DNN-based object-classification capabilities.

Advanced image processing is enabled by the next-generation image signal processor (ISP). It provides superb imaging in low-light conditions. Better low-light performance is achieved by more effective motion detection with temporal noise filtering. What does this mean? Noise commonly appears in images in low-light conditions due to an increased gain. By applying temporal noise filtering, the noise is being reduced from frame to frame in order to create a useful image. In CPP14 this algorithm is improved, reducing motion blur for moving objects in dark scenes. Besides better low-light performance, CPP14 also improves multi-exposure high dynamic range (HDR) processing. It has a streamlined HDR related front-end that supports blending of multiple exposures either on the fly by the ISP or already by the sensor. Together with CPP7.3, CPP14 also offers the new HDR X technology to capture maximum detail in high contrast scenes. HDR X is the next generation motion optimized HDR imaging available on selected cameras (as it is dependent on the image sensor used). It captures much more detail of moving objects without artefacts / blurring and also performs better at lower light levels during dusk and dawn.

CPP14 also includes improved local tone mapping. Local tone mapping allows the camera to process pixels according to their spatial characteristics. This yields an image more pleasing to the eye with more contrast and more visible detail, while preventing halo artefacts. CPP14 supports up to six independent sensor inputs, meaning it can also be used for multi-imager cameras. Also, its video codec offers advanced streaming capabilities, allowing the user to set-up three or in some cases even four H.264 / H.265 streams simultaneously.

The versatile platform also has a more advanced warping engine. This allows for higher quality lens distortion correction, better dewarping of panoramic images, and 3-axis Electronic Image Stabilization (EIS). EIS will be available on selected cameras and is an effective image compensation method for shaking cameras in windy environments or installation on shaky poles. As CPP14 EIS uses the camera's integrated gyrosensor, it provides accurate compensation for shaky movements.

By means of a built-in hardware accelerator to support DNN Video Analytics, CPP14 cameras enjoy a higher granularity when classifying persons and objects, meeting strict requirements of certain ITS applications. The combination of classic Intelligent Video Analytics (IVA) and new DNN Video Analytics provides a powerful tool to bring this technology to life. The camera benefits from robust IVA performance which provides superior detection and tracking of objects in surveillance applications and low false alarm rates due to intelligent filtering. By deploying Deep Learning models, CPP14 based cameras can detect and track many objects in complex scenes with lots of occlusions, challenging light conditions, and shadows. It can be trained to distinguish more object classes, and detect and track objects at different scales, under rotation, and with various deformations. For example, it can differentiate a person from a shadow or detect a boat on waving water. Some Deep Learning models can recognize behaviour of objects. These capabilities will increase the number of use cases where cameras can effectively support surveillance operators. And they will enable the use of cameras in diverse fields as intelligent incident detection on highways and in tunnels, traffic detection and classification at intersections, people counting and crowd surveillance. The Deep Learning models are under constant development at Bosch R&D using hundreds of hours of collected video footage. The deployment of these models on cameras is done through licensed firmware updates. The configuration of these sophisticated analytics is much easier than IVA. Planned functionality includes classification and 3D tracking of traffic (pedestrian, car, truck, bus, bike, etc.), license plate recognition, and face recognition.

CPP14 includes a full suite of advanced data security features to implement advanced on-device physical security. Because video data is often highly critical and sensitive, Bosch is driving a systematic approach to maximize data security by considering physical safety and cybersecurity simultaneously. On both CPP13 and CPP14 additional special measures are put in place to ensure the best security for device access and data transport.
- The cameras have built-in Secure Element (SE) hardware providing main Trusted Platform Module (TPM) functionality to ensure the highest levels of data security and privacy protection.
- The new SE supports RSA encryption with a key length of up to 4096 bits, which today is considered safe far beyond 2030.
- It also supports a secure boot mechanism which only allows Bosch-signed firmware to load and run on the camera.

To learn more about data security and how Bosch protects this, please refer to the Bosch website Video Systems section.

In summary, key features of CPP14 include:
- Increased low light performance via improved temporal and spatial noise filter
- Improved multi-exposure HDR algorithm with HDR and HDR X support
- Improved local tone mapping for enhanced detail and contrast

- Better multi-streaming flexibility
- Electronic Image Stabilization (EIS) on selected devices
- Analytics based on DNN object-classification capabilities
- Full suite of advanced data security features

As CPP14 is a solid innovative platform, Bosch will continue to develop new features and possibilities based on CPP14. This will allow the user to benefit even after purchase of a CPP14 camera. Developments are ongoing to enable app support within the CPP14 closed platform for special needs and applications. Also, it will continue to receive updates to continuously improve DNN-based Analytics for person and object detection / classification.

1.4 History of Bosch CPPs

Bosch's first CPP that was broadly applied in cameras was CPP3, introduced in 2008 / 2009. Its successor, CPP4, was introduced in August 2011 and was the first full HD platform optimized for the complete camera product portfolio from entry level cameras (value level 2000), up to the most high-end products (value level 9000). It integrated a low latency image pipeline, H.264 multi-streaming with digital PTZ functionality. CPP4 also brought better 3D noise reduction to support intelligent Dynamic Noise Reduction and it supported automatic exposure to bring intelligent Auto Exposure into the 7000 range cameras with IVA capability. At the time of introduction, it pushed the performance boundary and introduced a platform for innovative high-end IP cameras.

As CPP5 was an encoder-only platform, the successors for CPP4 were CPP6, CPP7, and CPP7.3 introduced in 2014 and 2015. CPP6 doubled the encoding performance, enabling the introduction of the first 4K Ultra HD camera and 360 degree panoramic camera with edge dewarping capability. CPP7 brought the first HDR camera with true 120dB HDR and CPP7.3 enabled improved noise reduction. Both CPP7 and CPP7.3 offered the ability to run at higher frame rates (60fps) and introduced more advanced video analytics in the midrange (Essential Video Analytics) and high-end (Intelligent Video Analytics). On top of this, CPP7.3 introduced Video Analytics as a standard and H.265 encoding for superb compression while ensuring high-quality video at a much lower bitrate. The latest introduction was done in 2020: CPP13 with INTEOX open camera platform. Designed according to fully open principles, it combines built-in Intelligent Video Analytics from Bosch, a commonly used open Operating System (OS) provided by Security and Safety Things, and the ability to securely add software apps at a later date. Application developers can simply develop apps based on a common language. This makes INTEOX the only platform that is accessible to anyone who wants to imagine, create, and deploy customer-specific solutions.

	CPP6	CPP7	CPP7.3	CPP13	CPP14
Apps	No			3rd party (S&ST)	Bosch qualified
Video Analytics	Optional		Essential Video Analytics Intelligent Video Analytics	Intelligent Video Analytics	Intelligent Video Analytics
Machine Learning	Camera Trainer for ≥7000			Camera Trainer	
DNN-based Analytics	No			Yes	
Audio Analytics	Threshold and frequency detection				Audio AI
Image signal processing	Bosch			Standard	Bosch
Encoding	H.264			H.264 H.265	
HDR	HDR	HDR	HDR, HDR X	HDR	HDR, HDR X
Data security	SE with TPM functionality			SE with TPM functionality RSA encryption key lengths up to 4096 bits	
Available form factors	Fixed, panoramic	Fixed	Fixed, moving		Fixed, moving, panoramic, multi-imager

A new CPP is expected every 12 to 18 months. Apart from implementing the latest state-of-the art image processing capabilities, improvements can be expected in terms of throughput rate (allowing higher resolutions as well as more advanced multi-sensor cameras) and lower power consumption. But mostly, they will increase processing power for DNN-based analytics allowing faster, even more accurate, and more complex AI algorithms.