VCA Capabilities per Device with FW 6.60

Technical Note

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1 Introduction

Different devices, whether cameras or encoders, offer a different amount of processing power for video content analysis (VCA). This has effects on the supported feature set and detection distance. All Bosch IP cameras & encoders can be clustered by their “Common Product Platform” (CPP), so the CPP version will be used to summarize the differences between the versions. Further differences are introduced because new features are often added with FW updates, because thermal camera videos have different visual properties than those of normal cameras, and because moving cameras (AUTODOME/MIC) sometimes need different handling. In this tech note, all of these differences are collected.

1.1 Overview of video content analysis algorithms

There are different types of video content analysis (VCA) algorithms available in different camera value levels. The camera value level is always part of the camera name, e.g. the DINION IP starlight **8000** MP has a value level of 8000. Here the overview of the VCA algorithms for FW 6.50:

	1000-3000	4000-6000	7000-9000	Description
Tamper detection	x	x	x	• Detect if camera is obscured or moved • Evaluate overall lighting level (too dark / bright) • Detect removed or placed objects in dedicated areas (reference image check)
MOTION+	x	x	x	• Change detection to trigger recording
Essential Video Analytics (CPP7/7.3 only)		x	x*	• Intrusion detection for smaller, controlled environments • Counting / queuing applications
Intelligent Video Analytics			x	• Mission critical perimeter protection • Outdoor environments with harsh weather conditions • Long detection ranges • Ship tracking • Exhibit protection • Counting / queuing applications
Intelligent Tracking (MIC/AUTODOME/ MP cameras only)			x	• AUTODOME / MIC automatically zoom to & follow a selected object • Megapixel cameras: “Virtual PTZ”, cutout stream follows selected object in the camera field of view

* Intelligent Video Analytics includes the full Essential Video Analytics feature set

1.2 Intelligent Video Analytics / Essential Video Analytics devices by common product platform (CPP)

Below is a table of Intelligent Video Analytics (IVA) capable devices from Bosch with respect to their Common Product Platform for CPP3, CPP-ENC, CPP4 and CPP6. For many of the devices listed there, IVA and non-IVA variants exist. From CPP7 onward, Intelligent Video Analytics is part of all 7000-9000 value level cameras, whereas Essential Video Analytics is part of all 4000-6000 value level cameras, therefore the devices are not listed explicitly there.

The CPP version of any device is part of the device type, which can be found on the device web page under system overview, or in the configuration manager under general -> device access -> camera identification.

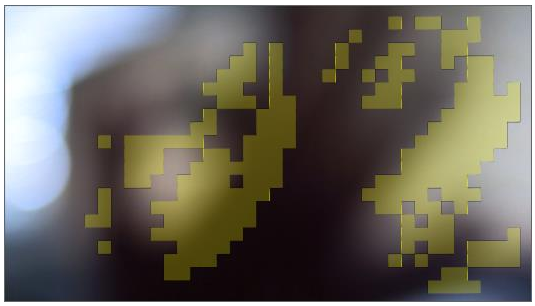
Note that though CPP3 is no longer supported and not included in FW 6.50, it is still listed in this tech note for completeness.

	Fixed Cameras	PTZ Cameras	Encoder
CPP3	DINION NBC-455-P IVA	AutoDome Easy II IP	VIP X1XF
	DINION NBC-498-P IVA	AutoDome Jr 800 HD	
	DINION NBN-921-P IVA	HD Converence Dome	
	FLEXIDOME NDC-455-P IVA	AutoDome Jr 800 HD Fixed	
	FLEXIDOME NDC-498-P IVA	VG4 AutoDome	
	FLEXIDOME NDC-921-P IVA	AutoDome 800 HD	
	VOT-320V IVA	AutoDome 700 IP	
	NEI-30 IR Imager IVA	MIC VIP	
CPP-ENC			VIP-X16000-XFM4
CPP4	DINION IP 7000 HD	AUTODOME IP 7000	
	DINION IP dynamic 7000 HD	AUTODOME IP 7000 HD	
	DINION IP starlight 7000 HD	AUTODOME IP starlight 7000 HD	
	FLEXIDOME IP 7000 RD	AUTODOME IP dynamic 7000 HD	
	FLEXIDOME IP dynamic 7000 RD	MIC IP starlight 7000 HD	
	FLEXIDOME IP starlight 7000 RD	MIP IP starlight 7000 XT	
	FLEXIDOME IP 7000 VR	MIC IP dynamic 7000 HD	
	FLEXIDOME IP dynamic 7000 VR	MIC IP dynamic 7000 XT	
	FLEXIDOME IP starlight 7000 VR		
	DINION IP imager 9000 HD		
	EXTEGRA IP starlight 9000 FX		
	EXTEGRA IP dynamic 9000 FX		
CPP6	DINION IP starlight 8000 MP		
	DINION IP ultra 8000 MP		
	FLEXIDOME IP panoramic 7000 MP		

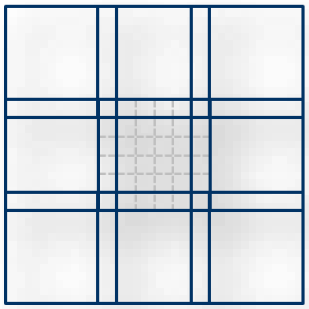
2 Resolution & minimal object sizes

2.1 MOTION+

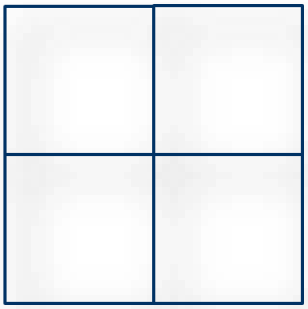
MOTION+ aggregates pixel information into processing blocks. These blocks are, in the internal resolution



MOTION+ blocks



6x6 block raster, 1 pixel overlap



8x8 block raster w/o

used for processing, either 6x6 pixel large with 1 pixel overlap to the next blocks, or 8x8 pixel with no overlap to neighbouring blocks, depending on whether the device was IVA capable until FW 6.10. From FW 6.10 onward, all devices now use the 8x8 pixel block raster. At the image border, there is an insensitive area with a width of approximately one block.

Internal resolution, block size and number of blocks used for MOTION+:

	Platform	Aspect Ratio	Internal Resolution		Block Size	Number of Blocks	
			x	Y		x	y
IVA capable or ≥ FW 6.10	CPP6/7/7.3	1:1	320	320	8x8	38	38
		4:3	320	240		38	28
		16:9	320	180		38	21
	CPP 3/4/ENC	16:9	320	180		38	21
		5:4	255	204		30	24
		4:3	240	180		28	21
		PAL	176	144		20	16
		NTSC	176	120		20	16
		VGA	320	240		38	28
Not IVA capable and < FW 6.10	CPP 3/4/ENC	16:9	160	90	6x6	29	15
		VGA	160	120		29	21
		PAL	176	144		33	26
		NTSC	176	120		33	21

2.2 Essential Video Analytics

Essential Video Analytics usually subsamples the video before processing it, resulting in the following internal processing resolutions:

Platform	Aspect Ratio / Format	IVA Resolution		Comment
		x	y	
CPP7/7.3	4:3	320	240	
	3:4	240	320	DINION / FLEXIDOME: 90° / 270° image rotation
	16:9	320	180	
	9:16	180	320	DINION / FLEXIDOME: 90° / 270° image rotation

Any object with an area of less than 10 square pixels in this internal resolution is discarded. A minimum object area of 20 square pixel is recommended for object detection.

2.3 Intelligent Video Analytics

Intelligent Video Analytics usually subsamples the video before processing it, resulting in the following internal processing resolutions, which depend on camera platform, firmware version and configuration of Intelligent Video Analytics:

Platform	Aspect Ratio / Format	IVA Resolution		Comment
		x	y	
CPP6/7/7.3 ≥FW 6.30 & double distance active	1:1	640	640	FLEXIDOME IP panoramic 7000 MP 360°
	4:3	640	480	
	3:4	480	640	DINION / FLEXIDOME: 90° / 270° image rotation
	16:9	640	360	
	9:16	360	640	DINION / FLEXIDOME: 90° / 270° image rotation
CPP6/7/7.3 ≥FW 6.30 & double detection inactive	1:1	320	320	FLEXIDOME IP panoramic 7000 MP 360°
	4:3	320	240	
	3:4	240	320	DINION / FLEXIDOME: 90° / 270° image rotation
	16:9	320	180	
	9:16	180	320	DINION / FLEXIDOME: 90° / 270° image rotation
CPP6/7/7.3 <FW 6.30	1:1	320	320	FLEXIDOME IP panoramic 7000 MP 360°
	4:3	320	240	
	16:9	320	180	
CPP3/4/ENC	16:9	320	180	
	4:3	240	180	
	PAL	176	144	
	NTSC	176	120	
	VGA	320	240	VOT-320

Double detection distance is active on CPP6/7/7.3 for the following configurations & objects:

- Tracking modes: 3D tracking, 3D people tracking
- Noise suppression: OFF, MEDIUM
- Object type: Moving, started, stopped

Any object with an area of less than 10 square pixels in the IVA resolution will be discarded. A minimum object area of 20 square pixel is recommended for object detection.

2.4 Intelligent Video Analytics FLOW

Intelligent Video Analytics FLOW aggregates pixel information into motion vectors per processing block. These blocks are, in the internal resolution used for processing, 8x8 pixel large with no overlap to neighbouring blocks. At the image border, there is an insensitive area with a width of approximately one block.

Platform	Aspect Ratio	Internal Resolution		Block Size	Number of Blocks	
		x	Y		x	y
CPP6/7/7.3	1:1	320	320	8x8	38	38
	4:3	320	240		38	28
	16:9	320	180		38	21
CPP 3/4/ENC	16:9	320	180		38	21
	5:4	255	204		30	24
	4:3	240	180		28	21
	PAL	176	144		20	16
	NTSC	176	120		20	16
	VGA	320	240		38	28

3 Frame rates

Intelligent Video Analytics, Intelligent Video Analytics FLOW, Essential Video Analytics and MOTION+ are always processed on the first stream. Depending on the maximal possible frame rate, or frames per second (fps) of this stream, they are processed with the following frame rates:

Maximal fps 1rst steam	Intelligent Video Analytics / Essential Video Analytics fps	MOTION+ fps
25 / 50	12,5	5
30 / 60	15	5
8,33	8,33	5

If the actually used frame rate of the first stream is lower, then the metadata and alarms are still generated with the frame rate specified here. If such a recording is viewed, then the displayed metadata will change faster than the video images themselves.

There are only two cases where the frame rate drops below:

- Exposure time is too large. This can be avoided by ensuring that minimal frame rate in automatic exposure mode is not smaller than the specified Intelligent Video Analytics / Intelligent Video Analytics FLOW / Essential Video Analytics / MOTION+ frame rate.
- Intelligent Video Analytics / Essential Video Analytics has to track too many objects simultaneously. This can happen with 3D person tracking mode in crowds. At the moment, ~10 objects can be tracked in real time with Intelligent Video Analytics on CPP4, ~20 objects with Intelligent Video Analytics on CPP6/7 and ~10 objects with Essential Video Analytics. Beyond that, frame drops may occur because processing took longer than available for the frame. Nevertheless, Intelligent Video Analytics / Essential Video Analytics will still continue to track the objects.

4 Moving camera (AUTODOME / MIC) & VCA

Many VCA algorithms are designed for non-moving cameras only, and will not work while the camera is moved. Therefore these algorithms are only available on predefined dome scenes. They will start the moment the scene is reached and be stopped on departure.

4.1 Profiles vs Scenes

On non-moving cameras, up to two VCA profiles are supported, which can be scheduled or switched via an internal or external trigger event. Moving cameras, however, are typically used different than non-moving cameras. They are typically configured to move to different scenes after a certain time span, in order to monitor more area than with a single camera. This would collide with any attempt to schedule the VCA on a single scene. Thus, while up to 16 scenes are supported with VCA, only a single VCA profile is available on each scene, and scheduling is not available.

4.2 Reference Image

Due to limited on-board storage and the fact that not only two but 16 reference images need to be stored on moving cameras, the VCA algorithms relying on a reference image, that is reference image check for tamper detection and crowd density estimation, have long not been supported and are only available from FW 6.20 onward on CPP4 and newer.

4.3 Detect “object in field” even during camera motion

Outside of prepositions and even while the PTZ camera is moving, whether on guard tours or manually, Intelligent Video Analytics can now detect and alarm on “object in field” on PTZ cameras. These alarm fields are defined globally across all potential PTZ views, and any part of those global fields currently within the cameras view becomes active. Thus, guard tours sweeping across the monitored areas in order to provide an intruder less time to slip by can now automatically alarm on those intruders as well. Geolocation of the tracked objects is now provided if the camera is calibrated and assigned a location in the corresponding coordinate system. This is only available on PTZ cameras of CPP 7.3 and newer. Not available on the thermal video of MIC IP fusion 9000i.

4.4 Intelligent Tracking

Moving cameras with Intelligent Video Analytics also have a special VCA algorithm called Intelligent Tracking. When triggered by an Intelligent Video Analytics or the manual selection of an Intelligent Video Analytics object by a user, the Intelligent Tracking steers the moving camera all by itself to zoom in on the object for most details and to follow this object. When the object stops, the Intelligent Tracking will monitor this region for a user specified time for further movement to be picked up and tracked. Afterwards, the moving camera will return to the scene it came from. Not available on the thermal video of MIC IP fusion 9000i.

5 Thermal camera & VCA

Thermal cameras like the DINION IP thermal 8000 or the older VOT-320 capture light not in the visible, colourful spectrum, but as heat emissions. Therefore, no colour information is available. Furthermore, areas and object with same temperature will have same thermal values, and thus distinct scene properties in the visible spectrum like fences, walls and bags may not be visible in the thermal image at all. Thus tamper detection and all reference image check based algorithms, that is reference image check and crowd density estimation, are not supported either, nor is the detection of idle / removed objects.

6 MIC IP fusion 9000i

The MIC IP fusion 9000i combines an optical PTZ camera with a thermal PT camera. Both sensors always have the same pan and tilt angles, and the optical camera can also zoom. On both video channels, a full Intelligent Video Analytics is running, and the results are made available on the other sensor as well.

Both moving object detection while the camera is moving as well as Intelligent Tracking are only available on the optical video channel, as the thermal sensor does not provide enough structure in the images for robust performance.

7 Video analytics features: Differences by device

	Feature list based on CPP3: FW 5.50 CPP4/6/7/7.3: FW 6.60	Intelligent Video Analytics CPP3 / ENC	Intelligent Video Analytics CPP3 VOT-320	Intelligent Video Analytics CPP3 PTZ	Intelligent Video Analytics CPP4	Intelligent Video Analytics CPP4 PTZ	Intelligent Video Analytics CPP6/7/7.3	Intelligent Video Analytics CPP7.3 PTZ	Intelligent Video Analytics CPP7 DINION IP thermal 8000	Intelligent Video Analytics CPP7 PTZ thermal channel	Essential Video Analytics CPP7/7.3	Essential Video Analytics CPP7/7.3 PTZ
	VCA scheduling	✓	✓	×	✓	×	✓	×	✓	×	✓	×
	Tamper detection	✓	×	✓	✓	✓	✓	✓	×	×	✓	✓
	Reference image check	✓	×	×	✓	✓	✓	✓	×	×	✓	✓
	MOTION+	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Intelligent Tracking	×	×	✓	×	✓	×	✓	×	×	×	×
	Object in field during PTZ camera motion	×	×	×	×	×	×	✓	×	×	×	×
Alarm Rules	Any object	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Object in field	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Line crossing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Enter / leave field	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Loitering	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Follow route	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Idle / removed object	✓	×	✓	✓	✓	✓	✓	×	×	✓	✓
	Counting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Occupancy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Crowd density estimation	✓	×	×	✓	✓	✓	✓	×	×	✓	✓
	Condition change	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Similarity search	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Flow / counter flow	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	×
Object Filter	Duration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Size	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Aspect ratio	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Speed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Direction	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Color	✓	×	✓	✓	✓	✓	✓	×	×	✓	✓
	Object class	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓
	Geolocation	×	×	×	✓	✓	✓	✓	✓	✓	✓	✓
Tracking Modes	Standard (2D) tracking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	3D tracking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	3D people tracking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Ship tracking	×	×	×	×	×	✓	✓	✓	✓	×	×
	Museum mode	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Masking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Face detection	×	×	×	✓	✓	✓	✓	×	×	×	×

8 Video analytics features by version

Here is an overview of which features were introduced by which Intelligent Video Analytics (IVA) version, starting with IVA 4.0 as the oldest IVA version supported by the devices listed here. The supported common product platforms of the FW / IVA release are added as well.

IVA Version	New Features	CPP-ENC	CPP3	CPP4	CPP6	CPP7	CPP7.3
4.0	IVA FLOW Head detection Improved calibration tool	x	x				
4.5	Crowd detection Improved object detection & tracking	x	x	x			
5.5	Counter People counter Assisted self-calibration wizard Improved object detection & tracking	x	x	x			
5.6	Best face detection (CPP4 only)			x			
6.0	Added CPP6 with full CPP4 feature set Object classification (replaces head detection) Improved configuration				x		
6.1	Object classification (replaces head detection) Improved configuration Ship tracking (CPP6 only) Geolocation Improved object detection & tracking (CPP6 only)			x	x		
6.2	Improved IVA Flow (CPP6 only) Improved robustness to shaking camera (CPP6 only) Scene-specific Object Detection (CPP6 only, via CBS) Reference image check & Crowd density estimation for moving cameras (CPP4 only)			x	x		
6.3	Added CPP7 with full CPP6 feature set Improved calibration: Focal length from lens motor position (CPP4-7), angles from gyrosensor (CPP7 only) or PTZ position (CPP4-7) Polylines for line crossing Alarm on foot points Alarm on number objects in field (now via GUI) Readded museum mode (CPP6/7)			x	x	x	
6.4	Improved calibration: Global calibration Detect “object in field” even during camera motion (CPP7.3) Improved Intelligent Tracking including Geolocation (CPP7.3) Alarm object visualization in JPEGs (CPP4-7.3)			x	x	x	x
6.6	Scenario defaults Multi-field crossing via task wizards Temporal states in VCA task script language			x	x	x	x

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