VCA Capabilities per Device with FW 8.40

Technical Note

Table of contents

1 Introduction 3

1.1 Overview of video content analysis algorithms 3

2 Resolution & minimal object sizes 4

2.1 MOTION+ 4

2.2 Essential Video Analytics....5

2.3 Intelligent Video Analytics....5

2.4 Intelligent Video Analytics FLOW 6

2.5 Camera Trainer....6

2.6 Traffic Detector 6

3 Frame rates 7

4 Moving camera (AUTODOME / MIC) & VCA 7

4.1 Profiles vs Scenes....7

4.2 Reference Image....7

4.3 Detect “object in field” even during camera motion....8

4.4 Intelligent Tracking....8

5 Thermal camera & VCA 8

6 MIC IP fusion 9000i 8

7 Video analytics features: Differences by device 9

8 Video analytics features by version 10

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

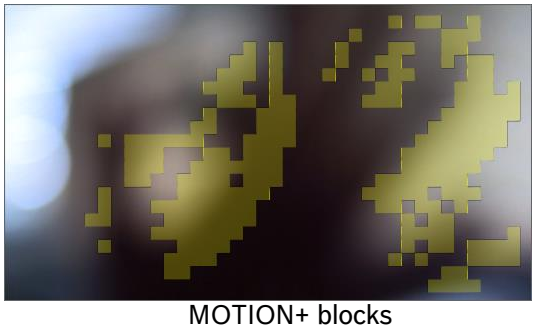
There are different types of video content analysis (VCA) algorithms available:

	Description
Tamper detection	• 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+	• Change detection to trigger recording
Essential Video Analytics	• Intrusion detection for smaller, controlled environments • Simple counting / queuing applications
Intelligent Video Analytics	• Mission critical perimeter protection • Outdoor environments with harsh weather conditions • Long detection ranges • Ship tracking • Exhibit protection • Counting / queuing applications • Camera Trainer • Intelligent Video Analytics includes the full Essential Video Analytics feature set
Intelligent Tracking (MIC/AUTODOME/ MP cameras only)	• AUTODOME / MIC automatically zoom to & follow a selected object • Megapixel cameras: “Virtual PTZ”, cutout stream follows selected object in the camera field of view
Camera Trainer	• Self-train detectors for simple, rigid objects. • Camera Trainer is an extension of Intelligent Video Analytics
Traffic Detector (INTEOX only)	• Traffic monitoring up to high traffic density, as well as parked cars and pedestrians. Includes classification of car, bus, truck, bicycle, motorbike and persons. • Traffic Detector is an extension of Intelligent Video Analytics

2 Resolution & minimal object sizes

2.1 MOTION+

MOTION+ aggregates pixel information into processing blocks. These blocks are, in the internal resolution used for processing, 8x8 pixel with no overlap to neighbouring blocks from FW 6.10 onward. At the image border, there is an insensitive area with a width of approximately one block.



MOTION+ blocks

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

Aspect Ratio	Internal Resolution		Block Size	Number of Blocks	
	x	Y		x	y
1:1	320	320	8x8	38	38
4:3	320	240		38	28
16:9	320	180		38	21

2.2 Essential Video Analytics

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

Aspect Ratio / Format	IVA Resolution		Comment
	x	y	
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	
CPP6/7/7.3/13/14 ≥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
CPP6/7/7.3/13/14 ≥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
FLEXIDOME panoramic 5000i & double detection distance active	1:1	480	480	
FLEXIDOME panoramic 5000i & double detection distance inactive	1:1	240	240	
FLEXIDOME multi 7000i & double detection distance active	4:3	320	240	
	16:9	320	180	
FLEXIDOME multi 7000i & double detection distance inactive	4:3	160	120	
	16:9	160	90	

Double detection distance is active 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.

Aspect Ratio	Internal Resolution		Block Size	Number of Blocks	
	x	Y		x	y
1:1	320	320	8x8	38	38
4:3	320	240		38	28
16:9	320	180		38	21

2.5 Camera Trainer

When Camera Trainer is available, it uses the following resolutions and a minimal object size of 32x32 pixel. All Camera Trainer objects have a size which is a multitude of 8x8 pixel blocks, or 16x16 pixel blocks for larger objects.

Platform	Aspect Ratio / Format	IVA Resolution		Comment
		x	y	
CPP6/7/7.3/13/14	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
FLEXIDOME panoramic 5000i	1:1	480	480	
FLEXIDOME multi 7000i	4:3	320	240	
	16:9	320	180	

2.6 Traffic Detector

If Traffic Detector is available, it uses the following resolution and a minimum object size of 16x16 pixel.

Platform	Aspect Ratio / Format	IVA Resolution		Comment
		x	y	
CPP 13	4:3	640	480	
	16:9	640	360	

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

Exception is the FLEXIDOME multi 7000i, where Intelligent Video Analytics runs with 7.5 fps.

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 a few 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.
- Camera Trainer: Due to larger image size in the panoramic cameras, Camera Trainer results may not be available every frame, causing outlines and alarms to flicker.

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 CPP6/7/7.3: FW 7.10 CPP13: FW 8.4 CPP14: FW 8.3	Intelligent Video Analytics CPP6/7/7.3	Intelligent Video Analytics CPP7.3 PTZ	Intelligent Video Analytics CPP7 DINION IP thermal 8000	Intelligent Video Analytics CPP7.3 PTZ thermal channel	Intelligent Video Analytics CPP13	Intelligent Video Analytics CPP13 PTZ	Intelligent Video Analytics CPP14	Essential Video Analytics	Essential Video Analytics 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	✓	✓	×	×	×	×	×	×	×
	Camera Trainer	✓	✓	×	×	✓	✓	✓	×	×
	Traffic Detector	×	×	×	×	✓	✓	×	×	×

8 Video analytics features by version

Here is an overview of which features were introduced by which Intelligent Video Analytics (IVA) and Essential Video Analytics (EVA) version, starting with IVA 6.0 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 / EVA Version	New Features	CPP6	CPP7	CPP7.3	CPP13	CPP14
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				
6.2	Improved IVA Flow (CPP6 only) Improved robustness to shaking camera (CPP6 only) Reference image check & Crowd density estimation for moving cameras (CPP4 only)	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			
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		
6.6	Scenario defaults Multi-field crossing via task wizards Temporal states in VCA task script language	x	x	x		
7.1	Camera Trainer	x	x	x		
7.6	Object filter width & height Tamper detection: Camera moved	x	x	x		
7.75	CPP13 initial release, no Intelligent Tracking Traffic Detector: Vehicles, 2D tracking				x	
8.0	CPP14 initial release					x
8.1	Traffic Detector: Added car, bus, truck, bicycle, motorbike subclasses. Added persons. Added 3D traffic tracking.				x	
8.4	Intelligent Tracking on CPP 13				x	

Bosch Sicherheitssysteme GmbH
Robert-Bosch-Ring 5
85630 Grasbrunn
Germany
www.boschsecurity.com