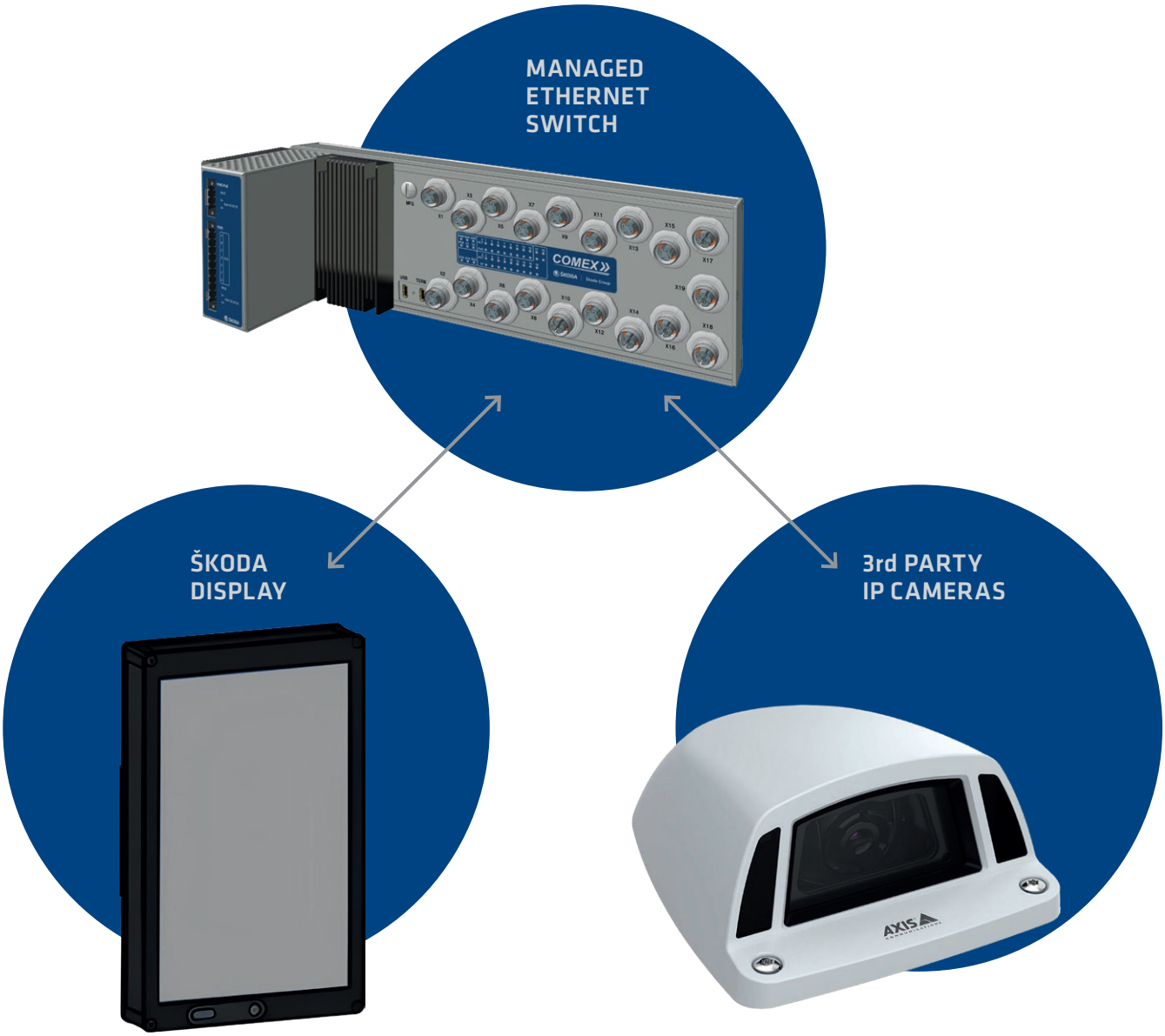
STEMS – SIL 2
ELECTRONIC MIRROR SYSTEM



DESCRIPTION

STEMS is a certified SIL 2 Electronic Mirror System designed for railway vehicles. It replaces conventional optical mirrors with high-resolution IP cameras and dedicated in-cab displays. Video streams are transmitted via managed Ethernet PoE switch withlow latency (< 300 ms). The system provides low latency, uncorrupted, freeze-free, smooth video streaming and full railway-grade diagnostics.

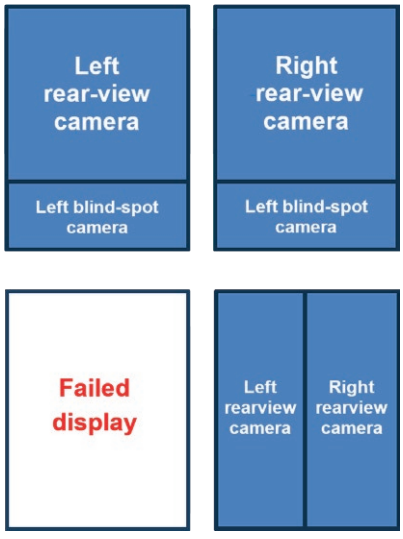
STEMS – SIL 2 ELECTRONIC MIRROR SYSTEM

KEY FEATURES

- SIL 2 certified for true image capture, transmission and rendering
- Low latency < 300 ms
- Portrait display optimized for polarized sunglasses
- Multiple display layouts (Full, Split, PiP, Degraded)
- Two types of exterior cameras – standard and low profile
- PoE cameras + managed switch
- Integrated diagnostics and safety functions
- 20-years design lifetime

STANDARDS

- System complies with EN 50121-1, EN 50121-3-2, EN 50124-1, EN 50155, EN 61373, EN 45545-2, EN 50125-1, EN 60529, EN 50126, EN 50129, EN 50159, EN 50657



TECHNICAL SPECIFICATIONS

ENVIRONMENTAL CONDITIONS	Operating temperature	Cameras –25°C to +55°C; Display –15°C to +55°C.
	Humidity	0–100% non-condensing
	Altitude	up to 1,400 m
SYSTEM ARCHITECTURE	The system consists of: - IP cameras (rear-view & blind-spot) - SIL2 display units - Managed PoE Ethernet switch.	All components per cab form a closed VLAN segment integrated with vehicle ECN network via firewall-controlled router.
MODULES – CAMERAS	EXTCAM-4	AXIS P3925-R in custom housing, heated, IP66 for blind-spot and rear-view monitoring
	AXIS P3925-LRE	heated IP66/67 camera for blind-spot and rear-view monitoring
MODULES – DISPLAY	DPC-S2-12.1" portrait display, 1280×800, SIL2 safety module, M12 Ethernet, 24V DC power, external watchdog, multiple layouts including degraded mode.	
MODULES – SWITCH	CMX.ESW10	Managed PoE switch, port-based DHCP, VLAN isolation, Class of Service, EN 50155 compliant.
SAFETY FUNCTIONS	SF01 Low-latency video streaming	The delay of the video stream from any camera shown on the display does not exceed 300ms compared to real-time.
	SF02 Uncorrupted video streaming	The video stream shall be free of any dangerous artifacts, disordered image parts, significantly shifted colours, or missing parts of the image.
	SF03 Freeze-free video streaming	System shall only display live video streams, i.e. video streams that are not frozen.
	SF04 Image mirroring	System shall mirror the captured video streams of rear-view cameras to correctly reproduce the real scene as if it were reflected by a classic rear-view mirror.
	SF05 Rendering of correct video stream in correct tile	System shall display the video streams in a predefined part of the screen.
	SF06 Smooth video streaming	The displayed video stream shall not be jerky, i.e. it shall be smooth enough withou a noticeable delay between consecutive frames.
NETWORK INTEGRATION	Dedicated STEMS VLAN, ECN router firewall (deny-by-default), TRDP communication for display/camera status and cab occupancy