CCTV and Video Surveillance System Design: Cameras, IP Networks, VMS and Storage

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Introduction:

CCTV and video surveillance systems often disappoint when cameras are bought by count rather than by purpose: faces are too small to identify, night scenes wash out, networks choke on video streams and recordings are overwritten before anyone asks for them. This Core Concept course gives security systems engineers, security managers and facility and IT staff a practitioner method for turning an operational requirement into a camera, network, recording and control room design that can be installed, tested and maintained. Participants build a CCTV System Design Specification with a camera schedule, storage calculation and acceptance test plan.

Course Objectives:

- Write an operational requirement that states the purpose, target, activity and viewing conditions for each camera view on a site
- Select camera types, lenses and fields of view that reach the pixel density and DORI target set for each view in daylight and at night
- Design the IP video network, Power over Ethernet budget, bandwidth and storage capacity for a multi-camera system
- Specify NVR or VMS architecture, ONVIF interoperability, video analytics and control room monitoring arrangements that operators can sustain
- Set recording retention, evidential export, privacy safeguards and cyber hardening measures for surveillance data
- Plan installation, site acceptance testing and preventive maintenance so that image quality holds over the system life

Target Audience:

- Security systems engineers responsible for designing and specifying camera and recording systems
- Security managers responsible for surveillance coverage, control rooms and incident footage
- Facility and building services staff responsible for installing, powering and maintaining cameras on site
- IT and network staff responsible for carrying, storing and securing video traffic
- Project and technical staff responsible for tendering, supervising and commissioning surveillance works
- Control room supervisors responsible for operator workload, monitoring procedures and evidence requests

Course Outline:

Day 1: Surveillance Foundations, Operational Requirements and Current-State Survey

- CCTV System Chain: Cameras, Transmission, Recording, Display and Operators
- Analogue, HD-over-Coax and IP Camera Generations Compared
- Operational Requirement Statement: Purpose, Target, Activity and Viewing Conditions
- Risk-Based Camera Coverage Priorities Linked to the Site Threat Register
- Existing CCTV Estate Audit: Camera Inventory, Blind Spots and Image Quality Log

Day 2: Camera Technology, Optics, Lighting and Image Quality Targets

- Fixed, Varifocal, PTZ, Multi-Sensor, Fisheye and Thermal Camera Selection
- Image Sensor Size, Focal Length and Horizontal Field of View Calculation
- Pixel Density per Metre and DORI Targets: Detection, Observation, Recognition and Identification
- Wide Dynamic Range, Low-Light Sensitivity and Infrared Illuminator Range
- Scene Lighting Assessment: Backlight, Glare, Vehicle Headlights and Colour Rendering

Day 3: IP Video Network, Recording and VMS Architecture

- Video Compression, Frame Rate, Resolution and Bit Rate Trade-Offs per Camera
- Surveillance Network Design: VLAN Segmentation, Switch Uplinks and Multicast Streams
- Power over Ethernet Budget per Switch and UPS Autonomy for Camera Loads
- NVR Versus Server-Based VMS: Multi-Server Scaling, Failover and ONVIF Profiles S, G, T and M
- Storage Sizing Calculation: Bit Rate, Recording Mode, Retention Days and RAID Overhead

Day 4: Control Room Operation, Video Analytics, Evidence and Cyber Hardening

- Control Room Monitoring: Operator Camera Load, Video Wall Layout and Workstation Ergonomics
- Video Analytics at Overview: Line Crossing, Loitering, Object Classification and Licence Plate Recognition
- Retention Schedule and Evidential Export with Hash Values, Watermarking and Audit Trail
- Privacy by Design: Purpose Limitation, Privacy Masking, Signage and Viewing Request Handling
- Camera and VMS Hardening: Default Credentials, Firmware Updates and TLS Encrypted Streams

Day 5: Design Build, Acceptance Testing and CCTV System Design Specification

- Camera Schedule and Site Layout Build for a Multi-Building Campus Case
- Bandwidth and Storage Calculator Build with Peer Check of Assumptions
- Installation Checklist: Mounting Height, Cable Routes, Weatherproofing and Labelling
- Site Acceptance Test Script: Image Test Targets, Failover Trials and Export Checks
- Preventive Maintenance Plan, Health Monitoring and Design Specification Presentation

Skills You Will Gain:

- Operational Requirement Writing
- Camera and Lens Selection
- Field of View Calculation
- Surveillance Network Design
- Video Storage Sizing
- VMS Architecture Planning
- Evidential Video Handling
- Surveillance Acceptance Testing

Why Attend This Course:

- Return with a CCTV System Design Specification, camera schedule and storage calculation for a site you are responsible for
- Stop buying cameras that record scenes but cannot identify people or vehicles when an incident is investigated
- Challenge supplier proposals on bandwidth, storage, lens choice and night performance with your own calculations
- Compare surveillance practice with peers from industrial, commercial, healthcare, logistics and public-facing sites

Conclusion:

A surveillance system earns its cost only when every camera view answers a stated operational need and the footage survives long enough, in a usable form, to support decisions and investigations. The one week move from operational requirements and camera technology, through optics, lighting, network, recording and VMS architecture, to control room practice, analytics, evidence handling, privacy and cyber hardening. The final day builds a camera schedule, bandwidth and storage model, acceptance test script and maintenance plan, assembled into a CCTV System Design Specification ready for use at work.