The integration of Rapidise's Security & Surveillance ecosystem into a unified edge-to-cloud architecture successfully connects specialized hardware for capture and initial processing with robust cloud services for management, storage, and advanced analytics.

This comprehensive stack is detailed across the hardware, connectivity, cloud infrastructure, and analytics layers:

1. Hardware and Edge Devices

Rapidise utilizes high-performance hardware platforms at the edge to manage IP camera input, perform local processing, and handle access control functionality.

A. IP Camera and AI Processing Hardware (Edge Computing)

- **Qualcomm QCS 6490 SoC:** This System on Module (SOM) is key to the edge architecture, powering products like the **Surveillance AI Camera** and the **Rapidise Edge AI Box**.
    - It features high computational power, including a Qualcomm Kryo 670 CPU, Adreno GPU 643L, and a dedicated Neural Processing Unit (NPU) with **12 TOPS** (Trillions of Operations Per Second) capability. This NPU enables **AI on Edge** processing.
    - The Surveillance AI Camera based on QCS 6490 supports three cameras, wired connections, and wireless connectivity (Wi-Fi, Cellular, and BLE) for streaming data.
    - The Edge AI Box ecosystem targets sectors including Security & Surveillance, where it performs tasks like **Intrusion Detection, Gun and Gunshot Detection, and Activity Tracking**.

B. Access Control Hardware

- **NXP i.MX 8M Plus (i.MX 8M Plus):** This processor is used in the **Multi-Tenant Access Control System**.
    - This system is designed with high-tech functionality and contemporary design, boasting a large color touchscreen.
    - Crucially, this access control system integrates external camera functionality, offering multiple photo views of visitors and **live streaming video at the gate**.
    - Connectivity for access control typically includes Cellular, Ethernet, and interfaces like the **Wiegand Interface** and **LoRaWan Gateway**.

2. Cloud Architecture and Data Pipeline

The edge devices utilize wireless and cellular connectivity to transmit data to the cloud, primarily leveraging **Amazon Web Services (AWS)**.

A. Cloud Infrastructure (AWS)

- Rapidise employs **Cloud Engineering** expertise spanning AWS, Azure, and GCP.
- For the Multi-Tenant Custom Cloud Video Management Portal, the cloud infrastructure is specifically hosted on **Amazon Web Services (AWS)**. AWS is also utilized for various other solutions and cloud development efforts.

B. Communication and Video Pipeline

- **MQTT Protocol:** Edge devices, such as the Surveillance AI Camera (QCS 6490) and the Unified Fall Detection System, use **MQTT** as the primary Communication Protocol to transmit data (including video metadata and alerts) to the cloud.
- **Video Encoding (FFmpeg):** Within the cloud portal, **FFmpeg** is used for **Video Encoding**, ensuring seamless management and distribution of video content.
- **Live Streaming (WebRTC):** For live streaming, Rapidise utilizes **WebRTC (Web Real-Time Communication)**, which minimizes cloud costs by facilitating peer-to-peer data and media exchange without intermediary software. AWS Native solutions like AWS Kinesis WebRTC are also employed.

3. AI Analytics and Video Management

Analytics are performed both at the edge (AI on Edge) and within the cloud environment, accessible via a **Multi-Tenant Video Management System (VMS)** portal.

A. AI on Edge and Core Expertise

- AI processing is a core expertise area. The high TOPS rating of the QCS 6490 SoC supports sophisticated local analysis.
- Rapidise offers the **Telep AI Model Library**, which provides hardware-agnostic, ready-to-use machine learning algorithms for various security applications.
- These AI applications include:
    - **Safety:** Intrusion detection, Gun Detection, Violence Detection, Human Activity Detection, Loitering Detection, and Facial Recognition System.
    - **Traffic Monitoring:** License Plate Recognition (ANPR), Vehicle Classification, Overspeed Detection, and Red Light Violation Detection.

- Specialized AI is also implemented in access control systems, such as **2.5D face recognition** (combining camera and Time-of-Flight sensors) for superior accuracy and security against spoofing.

B. Multi-Tenant VMS Portal

- Rapidise developed a **Multi-Tenant Custom Cloud Video Management Software** to replace existing third-party portals, offering a comprehensive platform for managing and distributing video content.
- The VMS portal offers robust features for video playback, customization, and analytics.
- **Multi-Tenancy:** The approach involves using a multi-tenant architecture strategy to reduce server infrastructure costs and provides completely isolated tenants, often managed using **Docker**.
- **Cloud Analytics Integration:** The cloud architecture supports event detection workflows that can leverage services like **Amazon Rekognition Video** to automatically identify objects, scenes, and activities in the video streams, providing searchable metadata.

In essence, the system functions like a distributed nervous system: High-performance hardware (QCS 6490 for cameras, i.MX 8M Plus for access control) acts as the sensory and local intelligence (the 'Edge'), utilizing onboard NPUs to run AI analytics (Telep library). This intelligence is communicated over protocols like **MQTT** to the central brain (the 'Cloud,' hosted on **AWS**), where video streams are managed and encoded (**FFmpeg**), and a comprehensive **Multi-Tenant VMS Portal** provides a centralized, analytical dashboard for users to view, manage, and distribute video feeds and access control events.