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Experience of developing Cloud service for Video Surveillance

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Starter

Agenda

- Intro
- Architecture and decomposition
- Main problems solved
  - Communication barriers
  - Media processing
  - Public Cloudification
    - Cloud Recording
    - Access control and grouping
- Integration – Video Analytics

“Evolution, not revolution”

“lessons learned”

Beginning: MERA Watch Initial Requirements

- **Public** service, **Consumer** market, **iOS** first, **integrated Camera**
- **Amazon** AWS, **Integrate** with existing *Home Automation service*
- Functional:
  - Interact (HD! Intuitive! Secure! Everywhere! From any device! Minimal delay!)
  - Aware (Analyze this! Alert me! Pull the trigger!)
  - Back in time (Action! Stop! Cut! Everything! No tape waste!)
- Numbers: **720p30**, **H264**, 2 Mbps, **10K+ cams, 5 seconds**

Architecture - layers

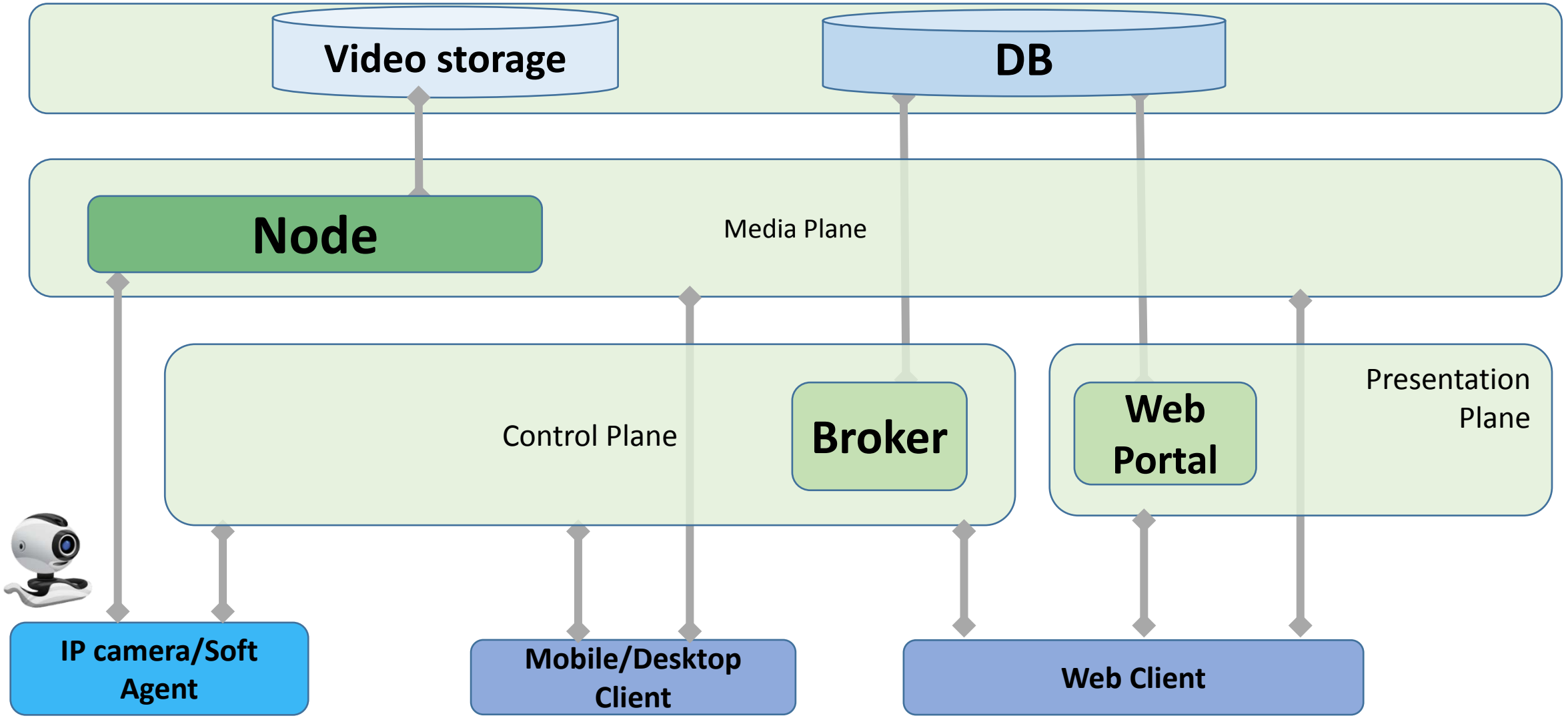
Storage Plane

Media Plane

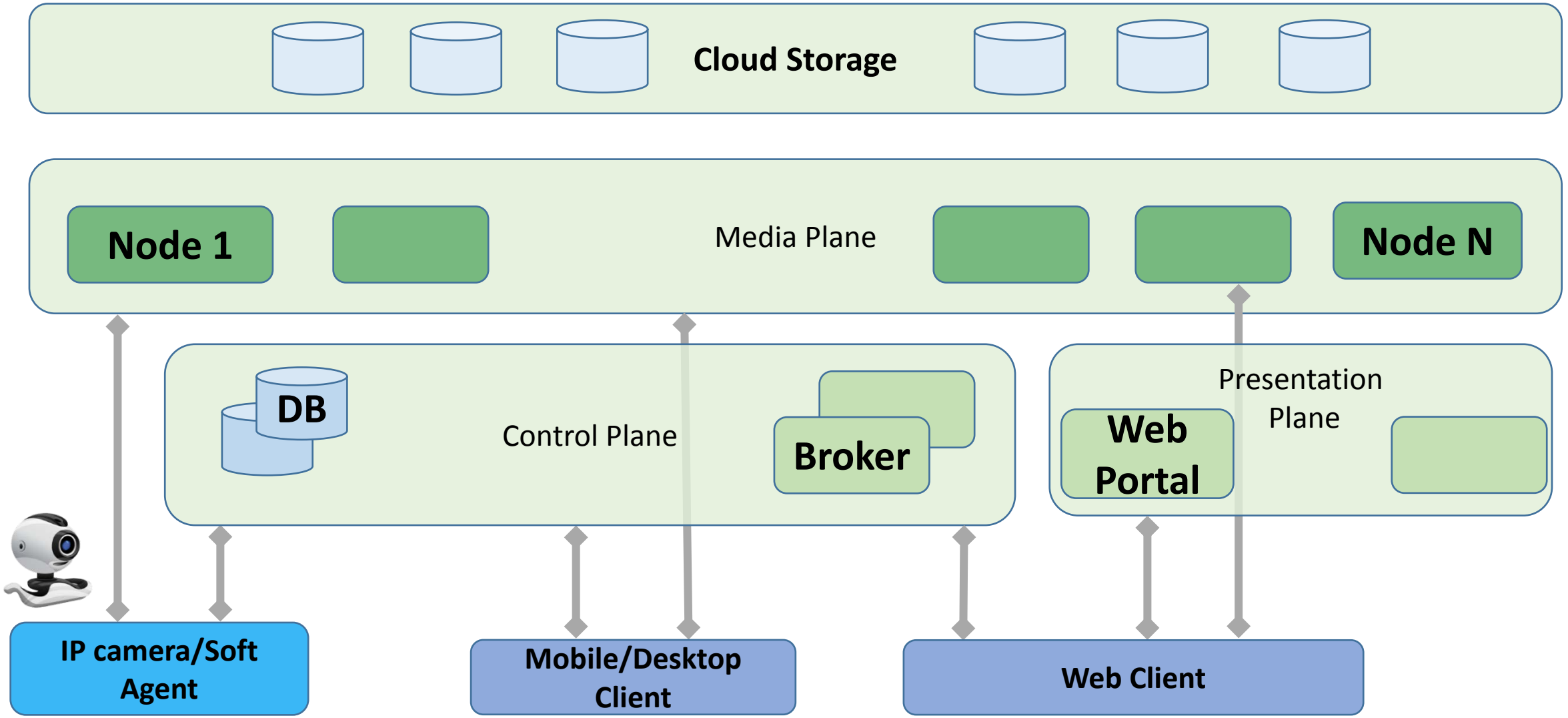
Control/Signaling Plane

Presentation Plane

Architecture – players



Architecture – make it Cloud ready



Communication barriers

Connectivity/Transport issues - Protocols – Outer space

SCP (Smart Control Protocol): **UDP**, Duplex, ICE-style NAT traversal (STUN, TURN …).

Because of integration!

IP camera

RTSP server

FW Agent

REST API

SCP'

RTSP/RTP'

Smart TCP bridges

"Everywhere" and "Intuitive"

Service

"Everywhere"

REST API

RTSP/RTP

HLS

delay < 5 sec

iOS

Mobile Client

Connectivity/Transport issues – Control Security

- **Problem:** How to secure UDP control protocol?
  - DTLS

    No support in the ICE libs (libnice, ice4j) , Cloud side - complicated
  - Encrypt payload of packets

    Inventing a wheel
  - **Solution**: HTTP, duplex, **long-polling technique**. Security – **TLS**

    Cons? - Yes, they are. Some delay and server resources

Final? Web sockets? MQTT? Transport agnostic?

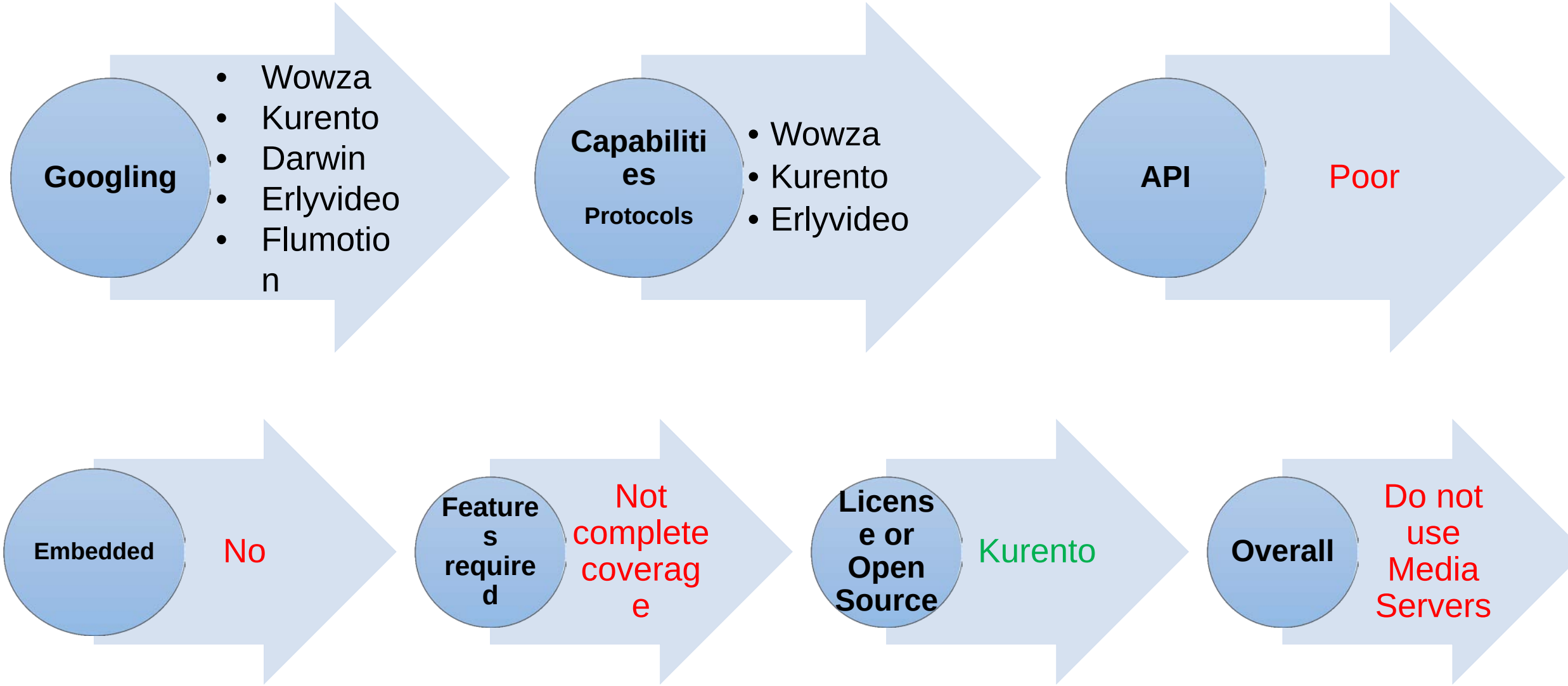
Media delivery

- **Problem:** How to get media from Camera behind NAT/FW/…
  - Push – HTTP push, RTP
  - Pull – HTTP live streaming
  - **Solution:** Mixed/Overlay – RTSP/RTP over TCP
    - NAT, FW, Proxy? - TCP bridge

- **Problem:** Web client and real time media
  - **Solution:** WebRTC , RTMP
- Conclusion: No silver bullet, fallback appro

Media manipulations

Option 1 for media processing - Media Servers



Problem: what to use for the Media processing?

Option 2 for media processing - Media Frameworks

Googling
Open Source
Stable

FFmpeg

gstreamer

Target protocols

FFMPEG (no RTSP server)

Gstreamer

Matrix of Features

Gstreamer Ok
+ Codecs
+ NAT
and more

Performance PoC

Gstreamer
~= Wowza

Embedded

Gstreamer is portable

Mobile

Gstreamer
iOS, Android

Trim

Gstreamer - Ok

And the winner is gstreamer

....

Sample streaming difficulties

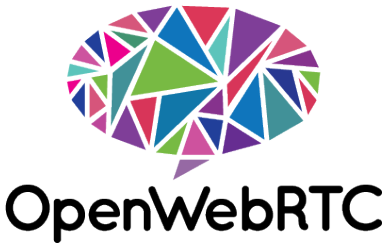
- **Problem: One camera – several clients**
  - Same protocols, different protocols
    - Easy for RTSP, HLS, RTMP but not for WebRTC
  - **Solution**: Gstreamer helped (“tee” elements/RTSP server).

- **Problem: Transcoding**

  Incoming: H264/G.711;

  Outgoing: VP8 or H264 (i.e. profile changed), audio - AAC
  - **Solution**: Gstreamer – Dynamically attached transcoding

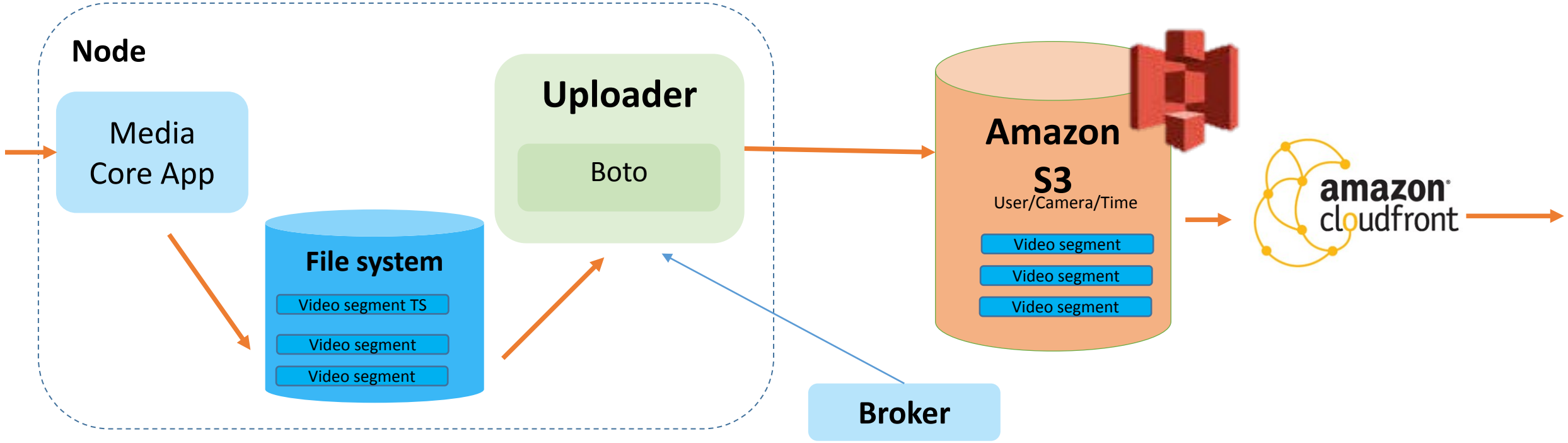
- **Problem: Security for Webrtc**
  - DTLS-SRTP plugin from OpenWebRTC



Private Cloudification

Recording in Mera Watch in AWS

- **Solution**: Record in HLS (MPEG TS) format varying segment length
- **Storage**: Amazon S3



Private Storage – problem and requirements

- **Problem: Substitute S3 to deploy in Private Cloud**
- **Requirements: “Usual” Cloud Storage**
  - Scalable, Robust – replication is a must have
  - Fast enough for video recording of N cameras streams
  - Regular hardware
  - Easy to integrate with

- **No PoC time for evaluation** so the decision was based on
  - Features/API
  - Recommendations and feedback, open source
  - Community design activity

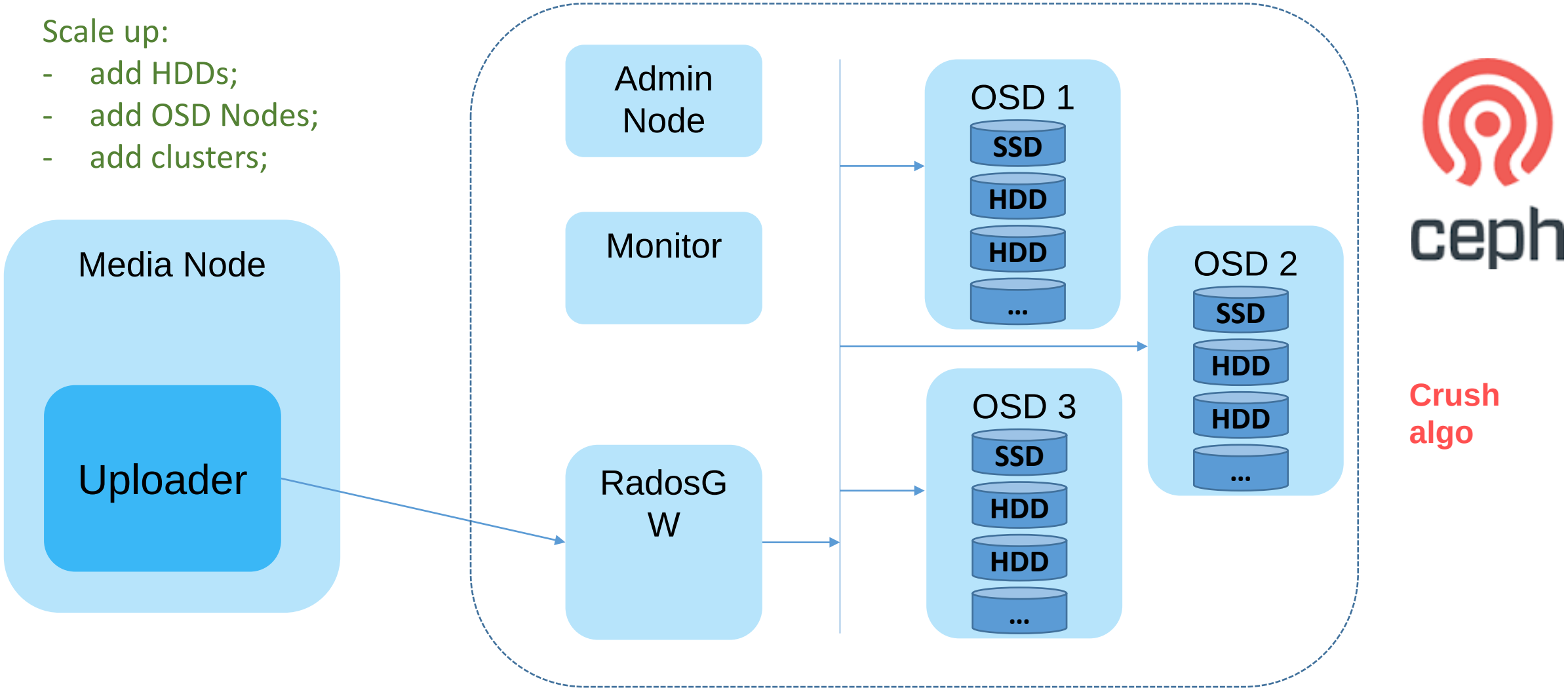
Private Storage – decision

- **Options considered**
  - Distributed file system: GlusterFS, Ceph
  - Object storage: Ceph, OpenStack Swift , Sheepdog, riak-cloud-stora
- **Decision: Ceph**
- **Why Ceph?** (http://ceph.com/)
  - "Ceph is **open source** and freely-available, and **it always will be**"
  - All three types of storage – Object, Block and File System
  - **Production ready**
    - 2Gis, Yahoo, Redhat Cloud storage selection
      - http://www.theplatform.net/2015/04/16/inside-the-ceph-exascale-storage-at-yahoo/
  - **S3 API** for Object storage

Almost no changes in our code moving from S3 to Ceph

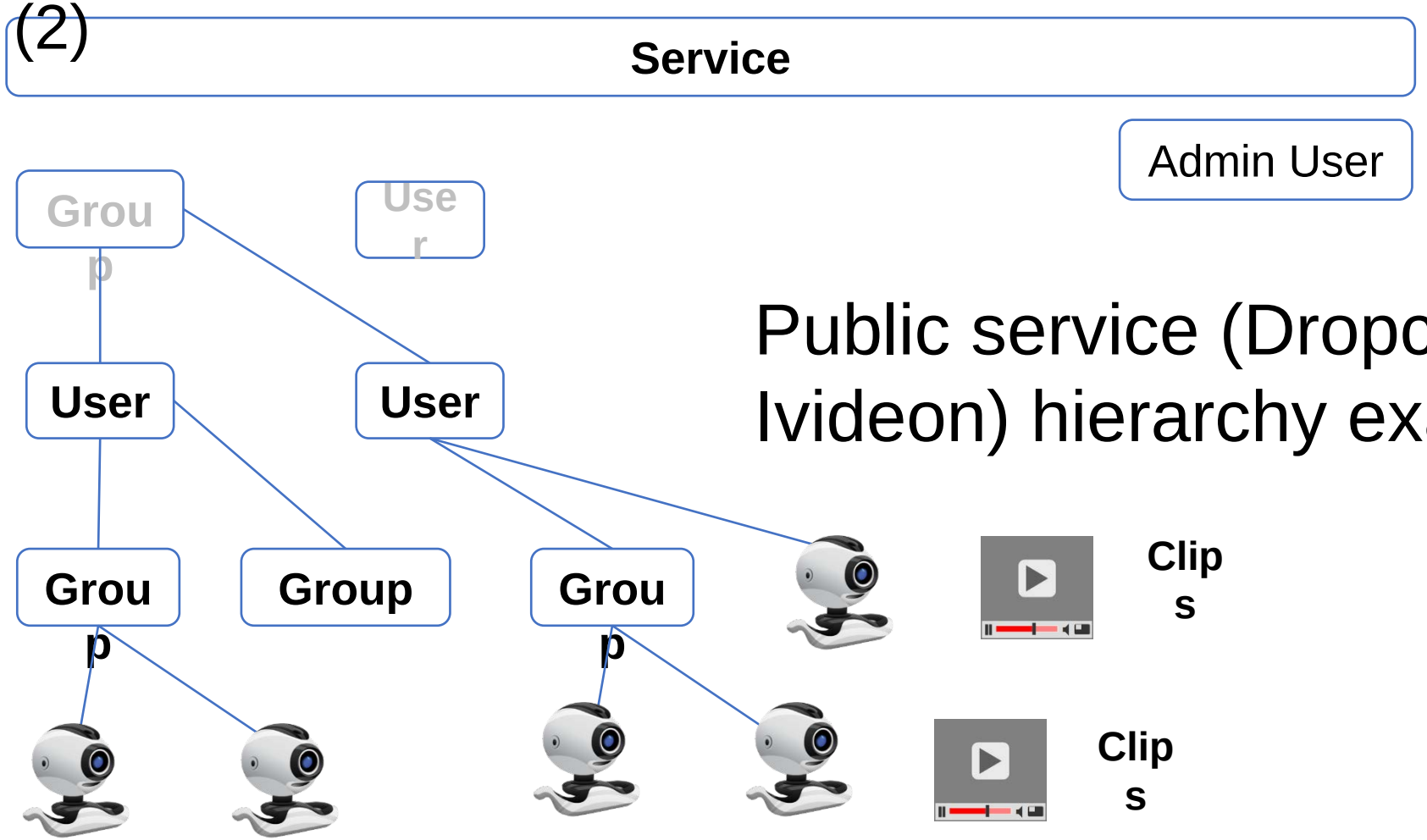
Private Storage – typical Ceph configuration for Mera Watch

Scale up:
- add HDDs;
- add OSD Nodes;
- add clusters;



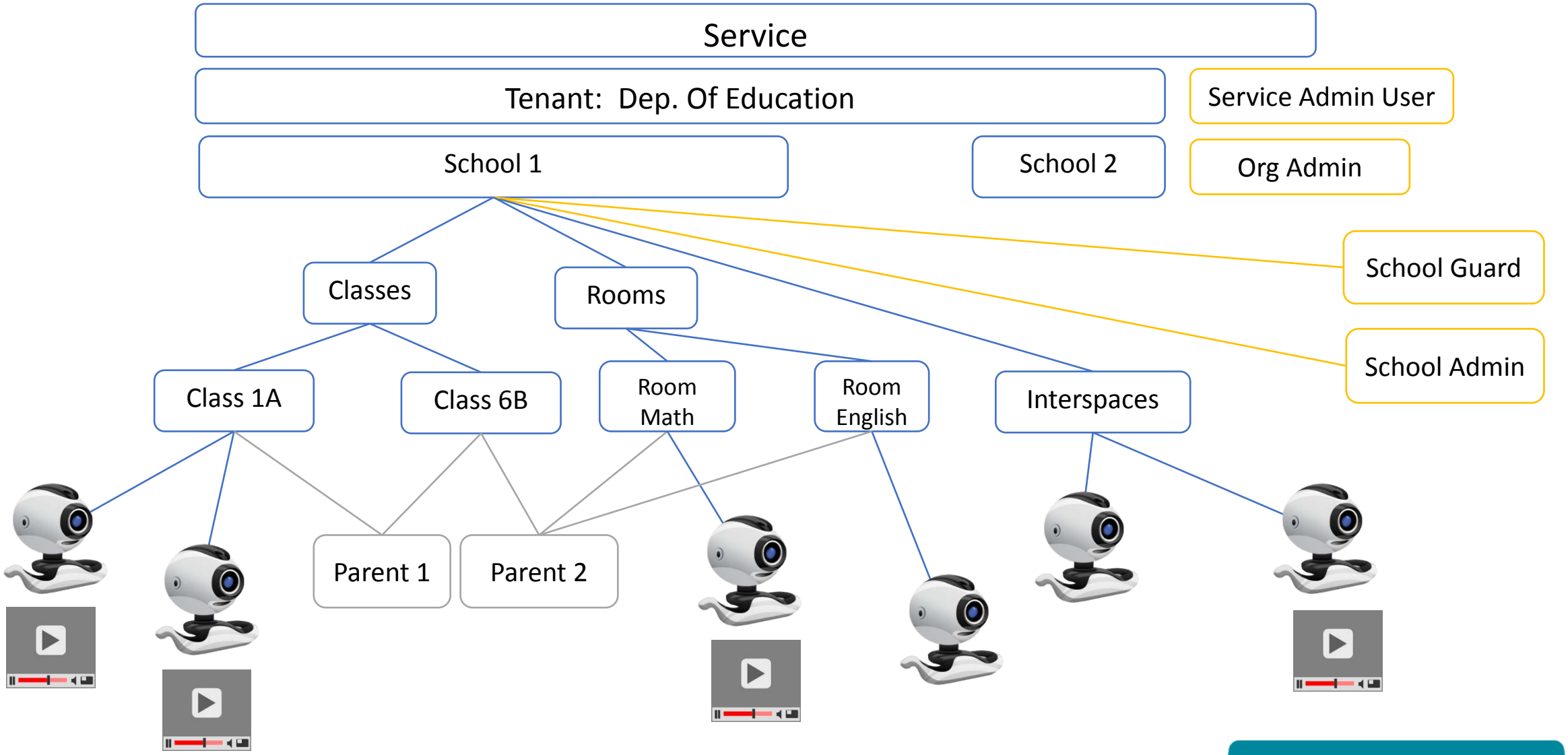
Access control and grouping

Problems: Control permissions for users (1) and structure cameras (2)



Public service (Dropcam, Ivideon) hierarchy example

Private service example: Municipal VSaaS – Schools



Access Control and Grouping – Access Control Decision details

- **Access Control**
  - Many approaches (RBAC, ACL, ABAC, Domains, Rules …)
  - **Solution:** Hybrid (Core RBAC + Attributes) but RBAC first
  - Roles
    - Assigned to Users and Groups (User can have several Roles)
    - Role contains a list of permissions made of actions on resources
  - **Why do we need attributes?**
    - Example: View in particular time (e.g. parent view a camera in particular class room in particular lesson time)
- **Grouping**
  - Main point: Groups are used to include both Devices and Users!

Access Control and Grouping – Access Control Decision details

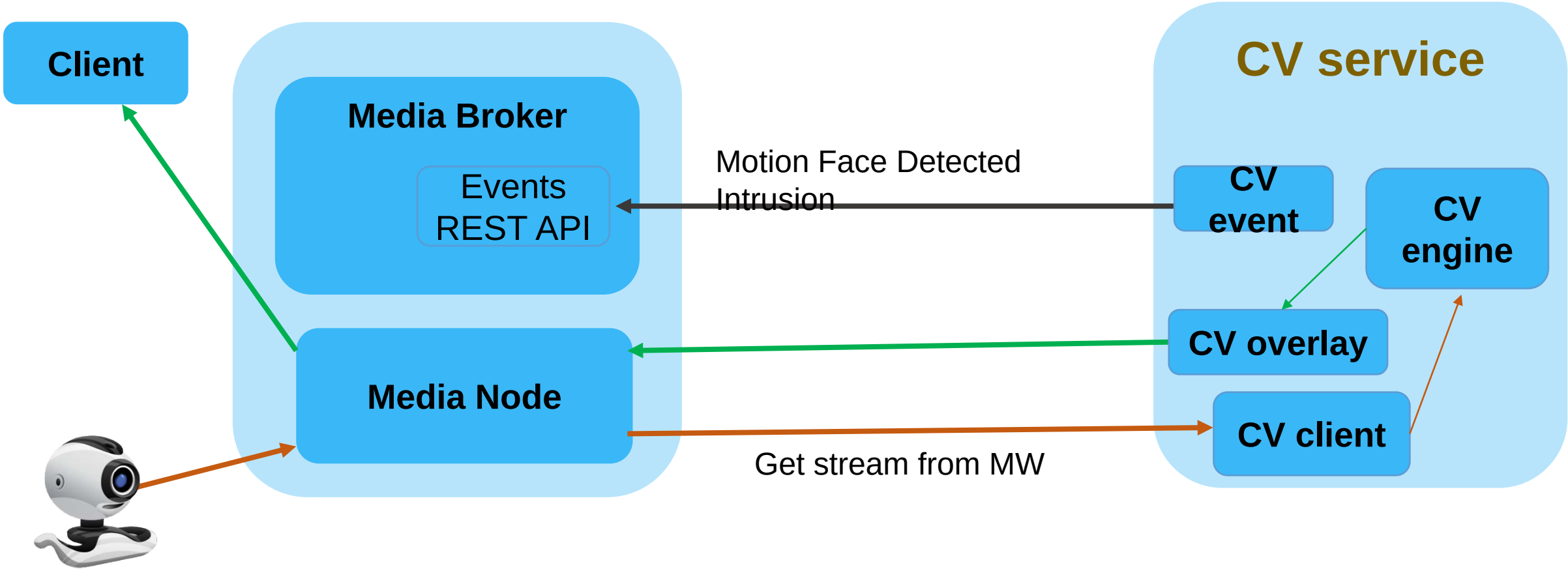
- **Frameworks**
  - **Apache Shiro**
    - http://shiro.apache.org/index.html
    - Complete security and “permissions” concept
    - Integrated with Spring
  - **Spring Security**
    - Looks complicated
- **Code wise**
  - Need Role-Permissions evaluator procedures
  - isPermitted(resource, action, attributes)
  - getListofResourcesPermitted(action)

Video analytics integration

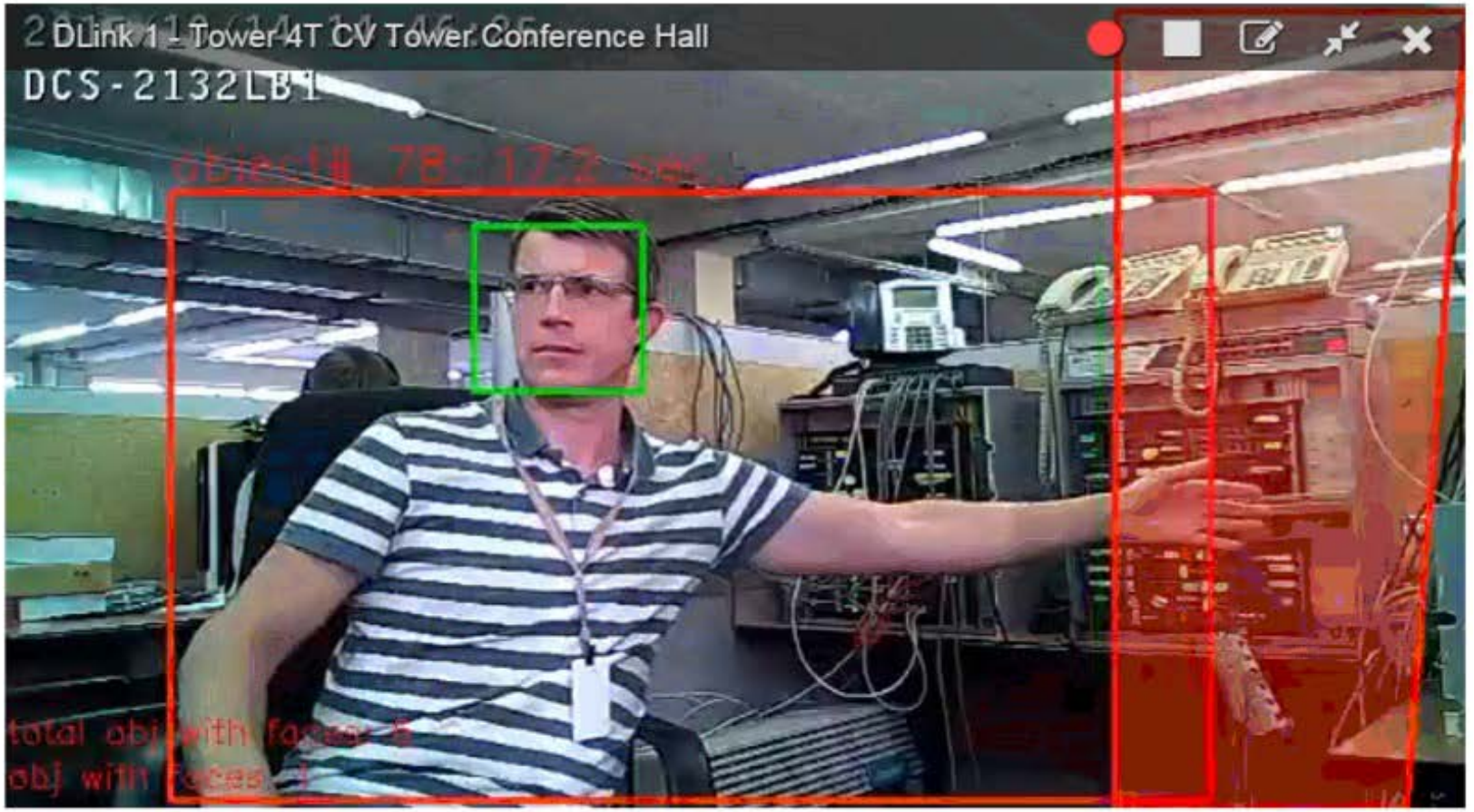
- **Integration API**
  - Must have
  - Examples: Home automation, Social services, SIP, billing, etc.

- **Video analytics**
  - Regular feature of Video Surveillance services
  - **Service integration model** as opposite to built-in feature
    - Loose coupling
    - Win in scalability, loose in performance, a bit
  - **Features**: Motion detection, Face detection, Intrusion area

Video analytics integration - flows



Video analytics integration - example



Q&A time

Much more left to talk about …

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