

11<sup>th</sup> Central and Eastern European Software Engineering  
Conference in Russia - CEE-SECR 2015

October 22 - 24, Moscow



# Experience of developing Cloud service for Video Surveillance

**Andrey Konovalov**  
MERA Software Services

# 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

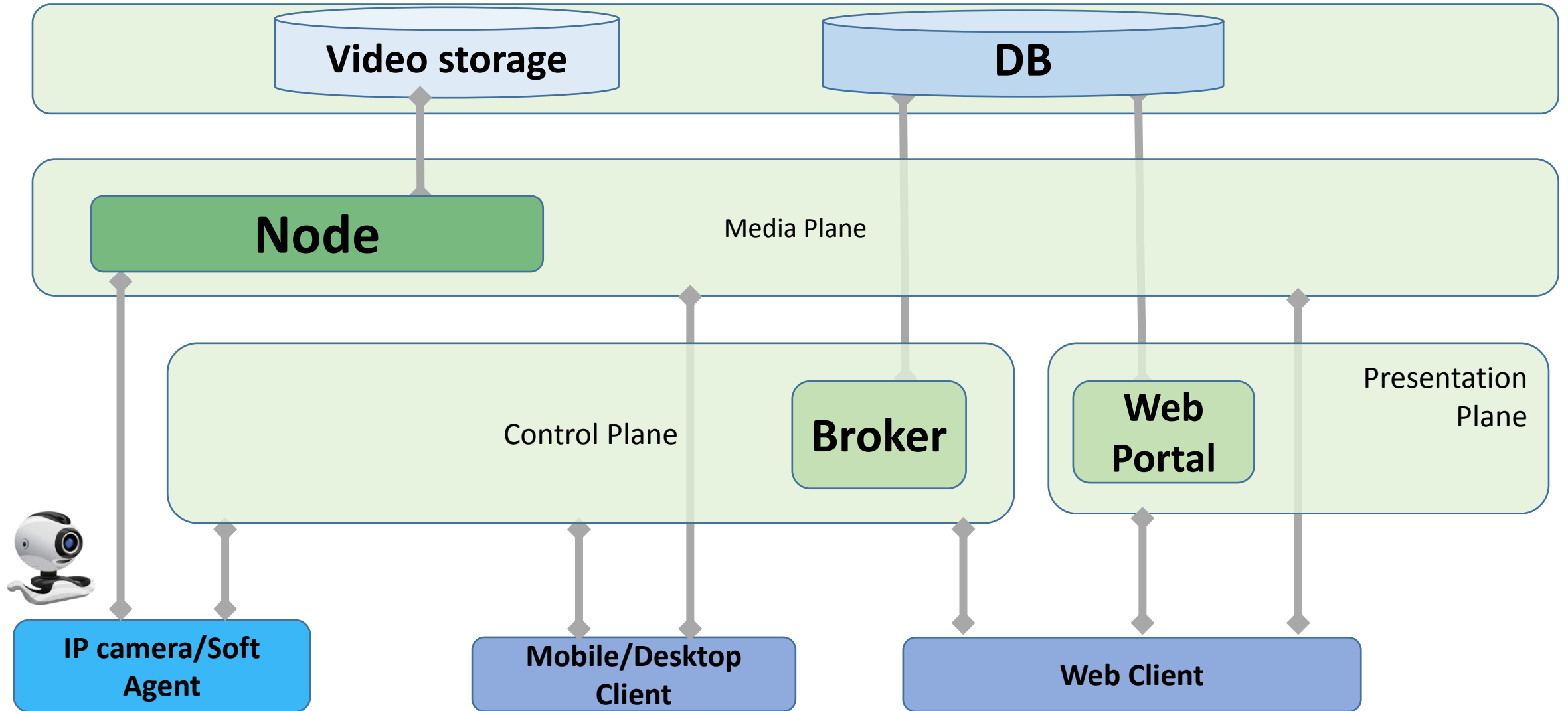
**Storage Plane**

**Media Plane**

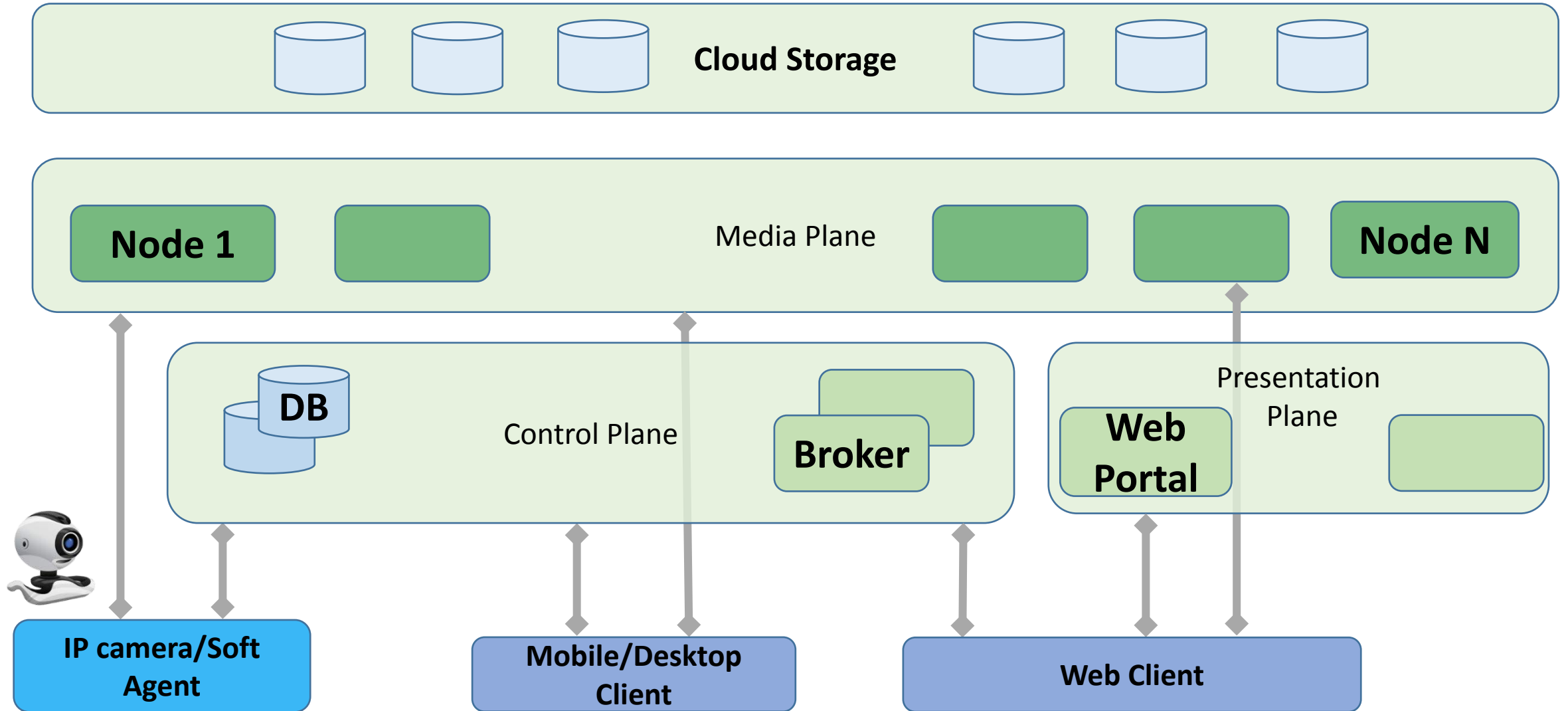
**Control/Signaling Plane**

**Presentation Plane**

# Architecture – players



# Architecture – make it Cloud ready



## **Communication barriers**



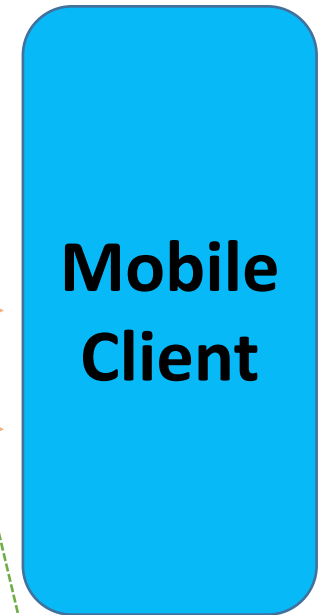
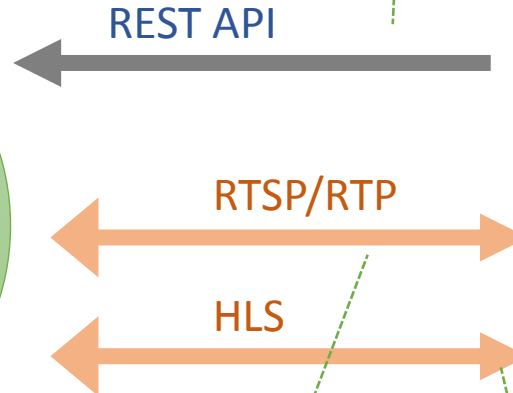
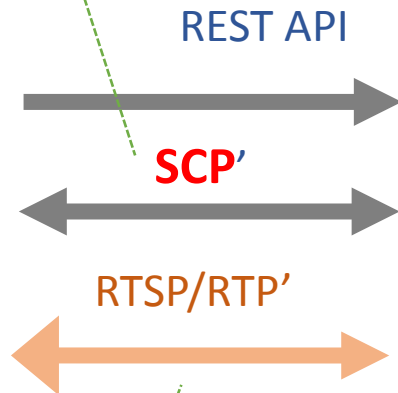
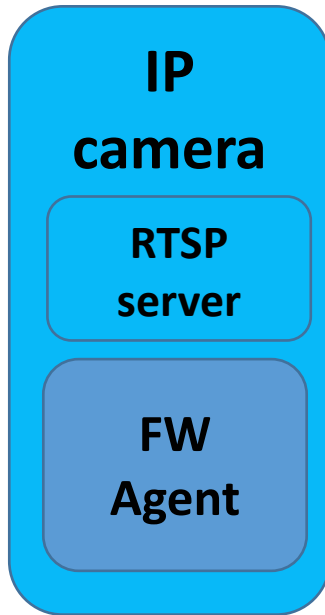
# Connectivity/Transport issues - Protocols – Outer space

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

Because of integration!

“Everywhere” and “Intuitive”

“Everywhere”



Smart TCP bridges

delay < 5 sec

iOS

# 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?

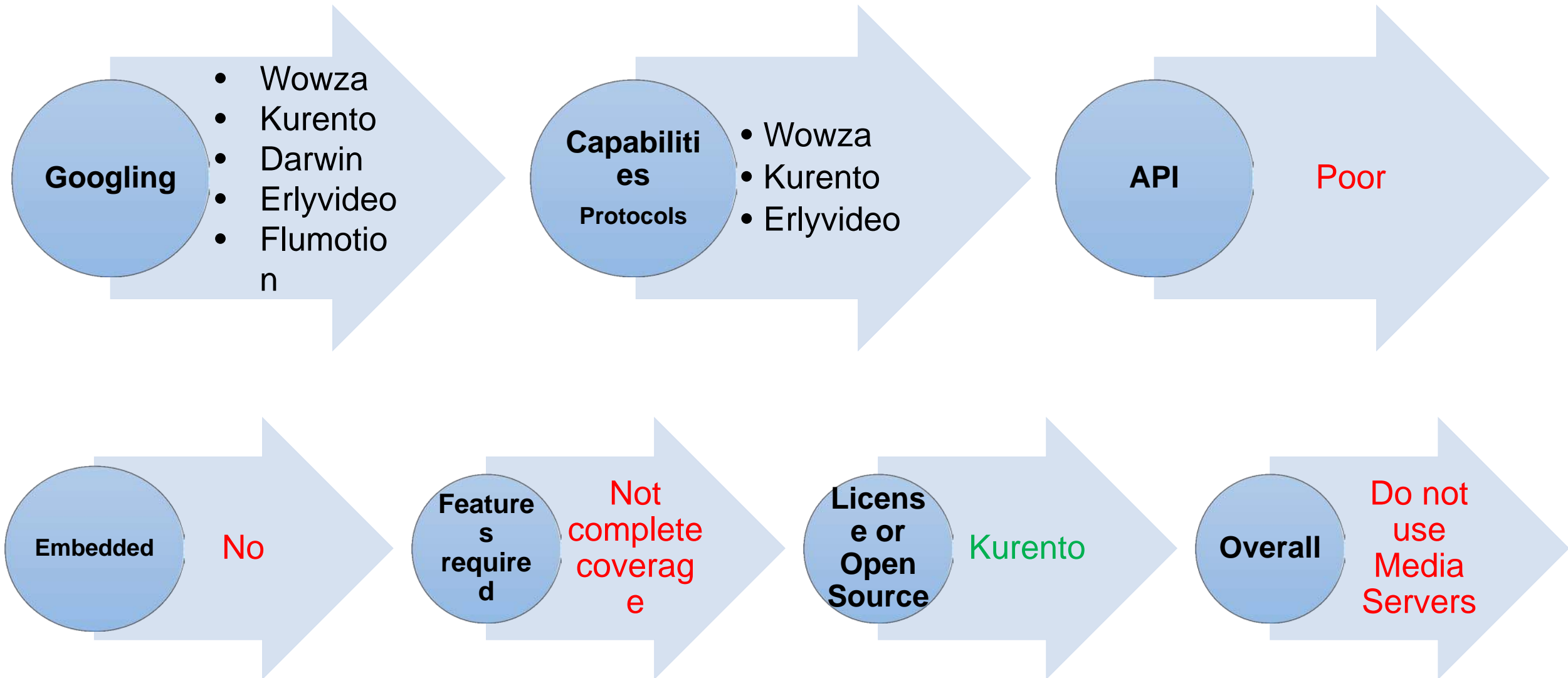
# Media delivery

- **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 approach



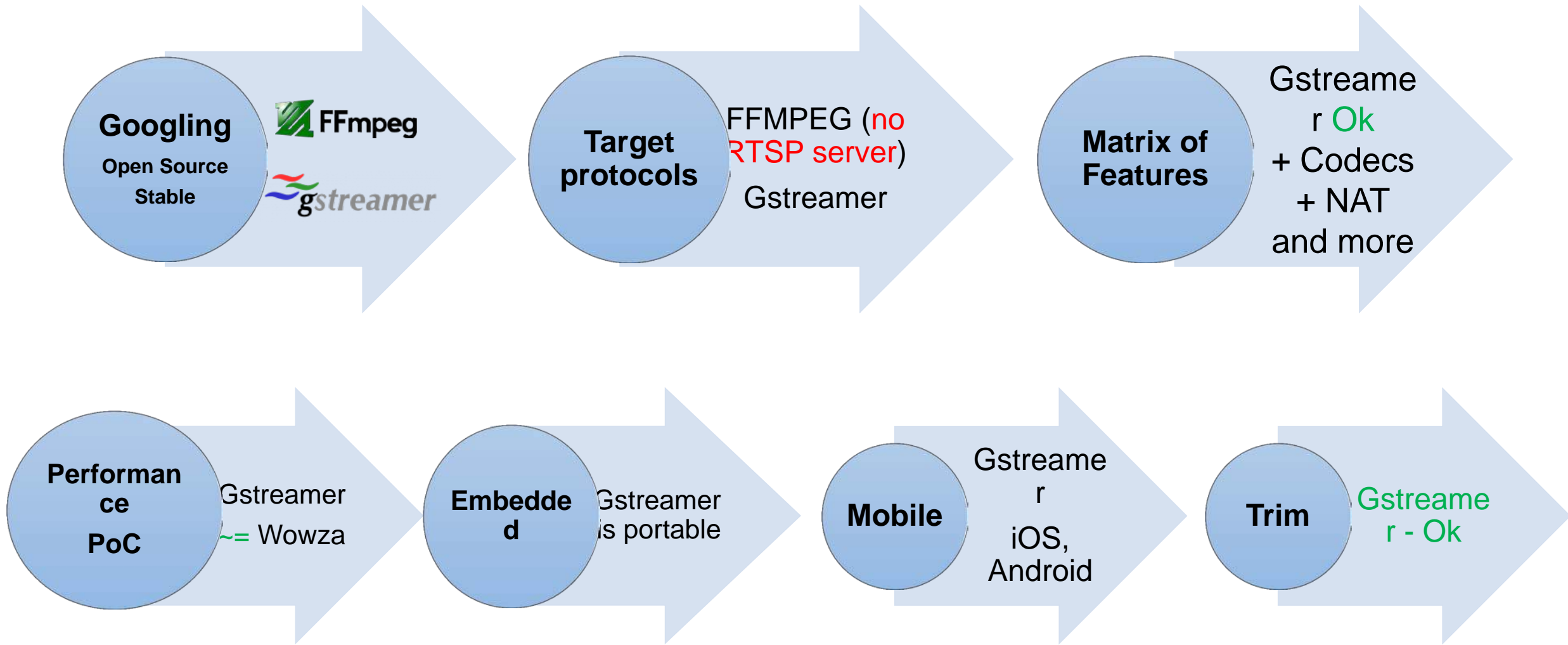
## **Media manipulations**

# Option 1 for media processing - Media Servers



**Problem: what to use for the Media processing?**

# Option 2 for media processing - Media Frameworks



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**



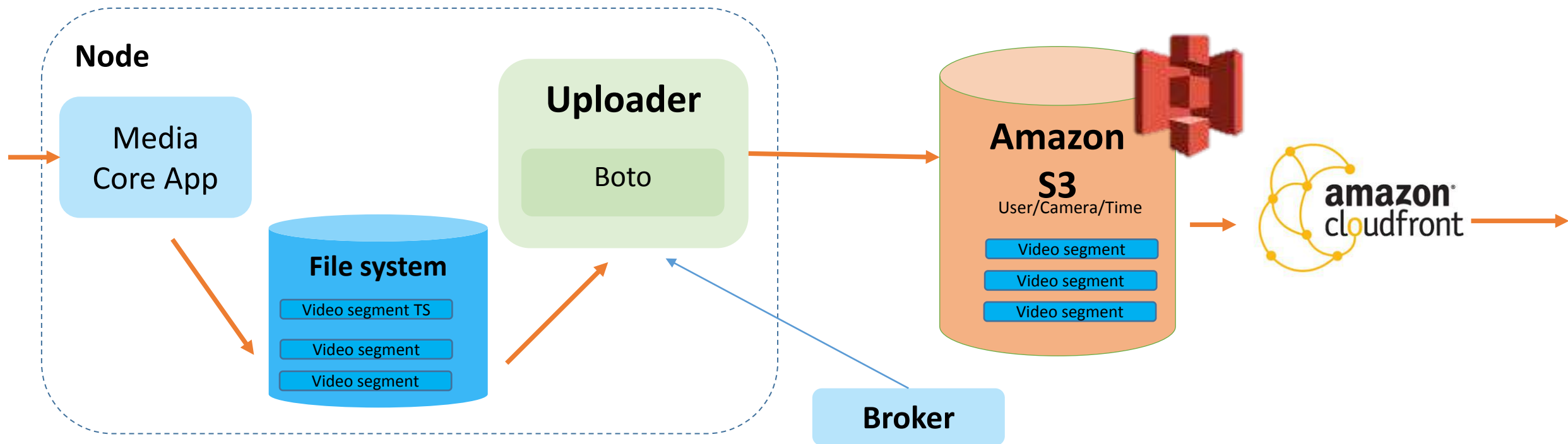
OpenWebRTC

# 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-storage

- **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

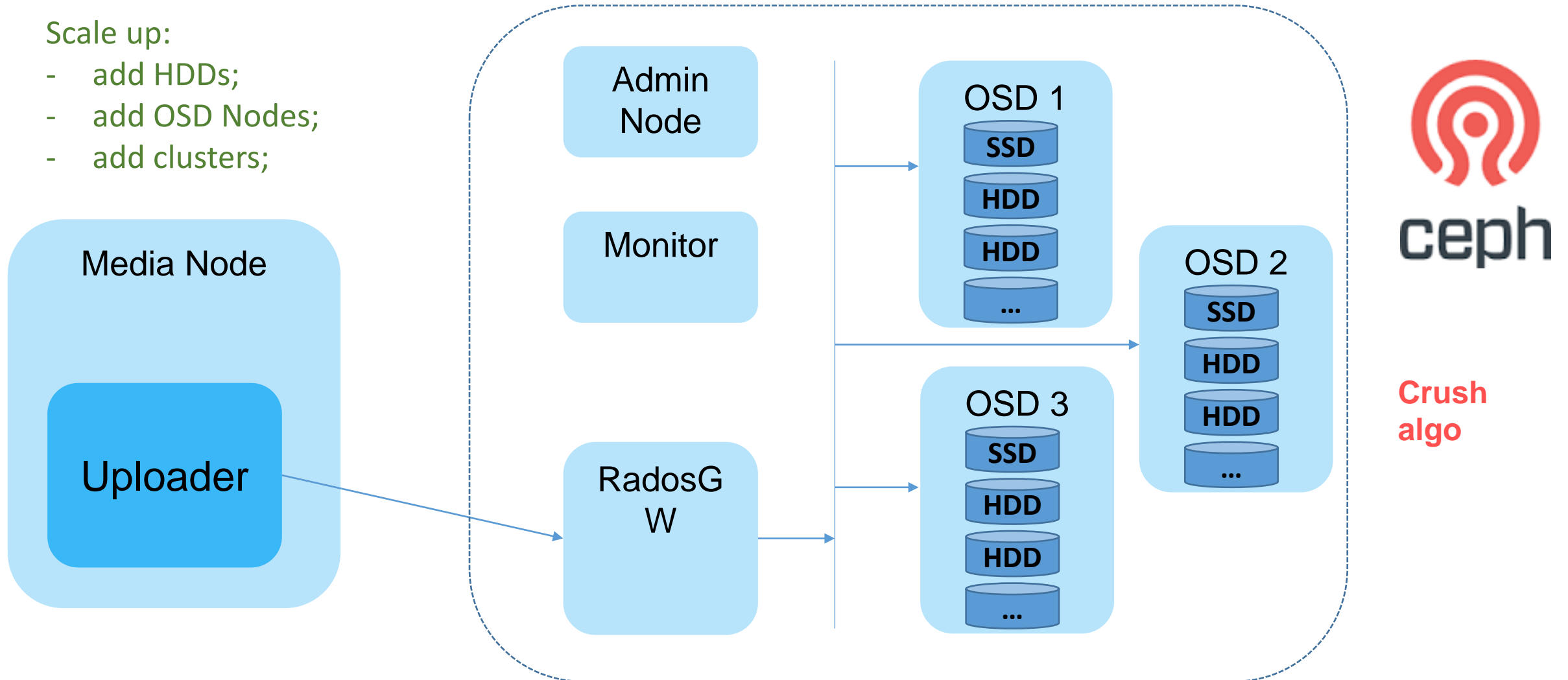


Almost no changes in our code  
moving from S3 to Ceph

# Private Storage – typical Ceph configuration for Mera Watch

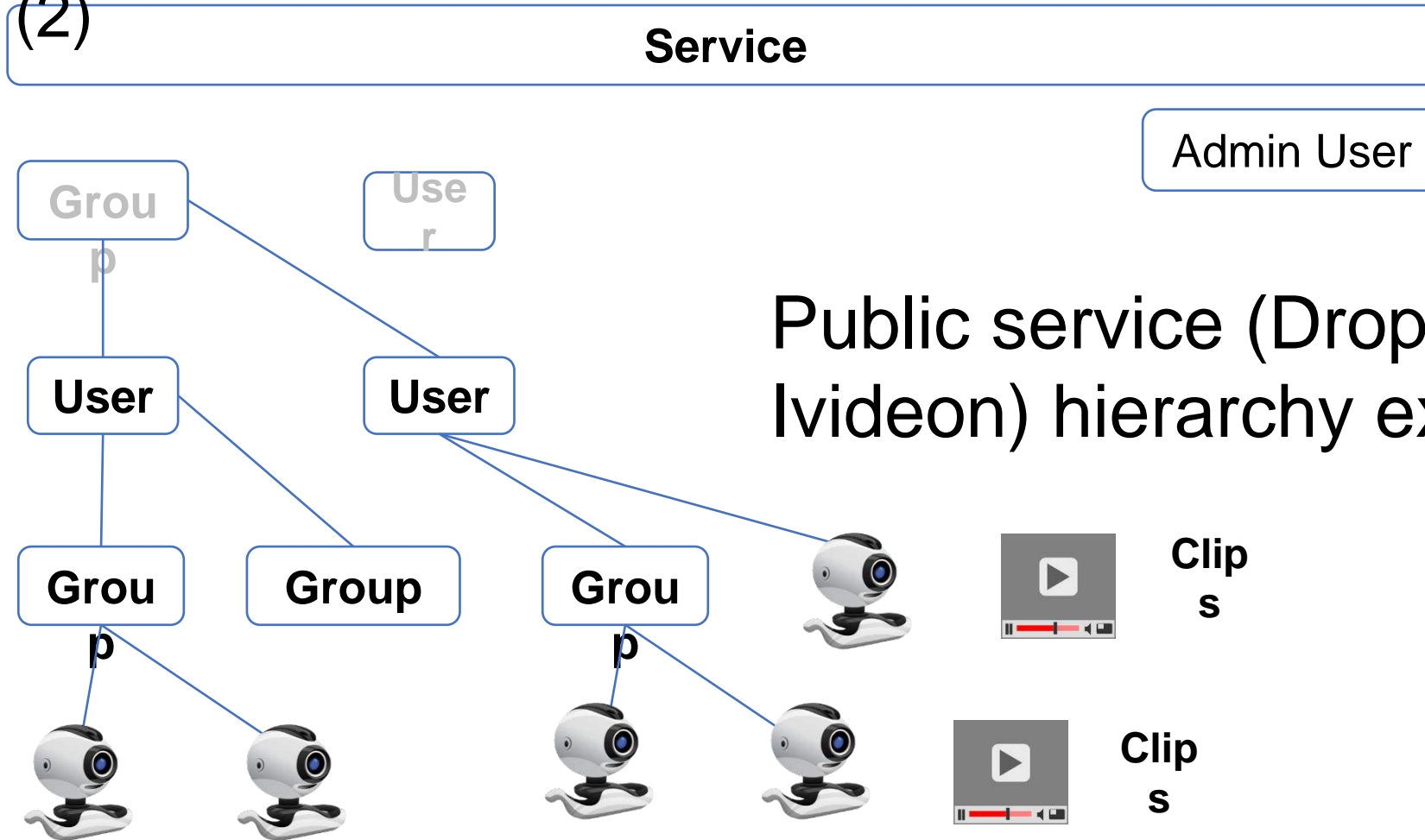
Scale up:

- add HDDs;
- add OSD Nodes;
- add clusters;



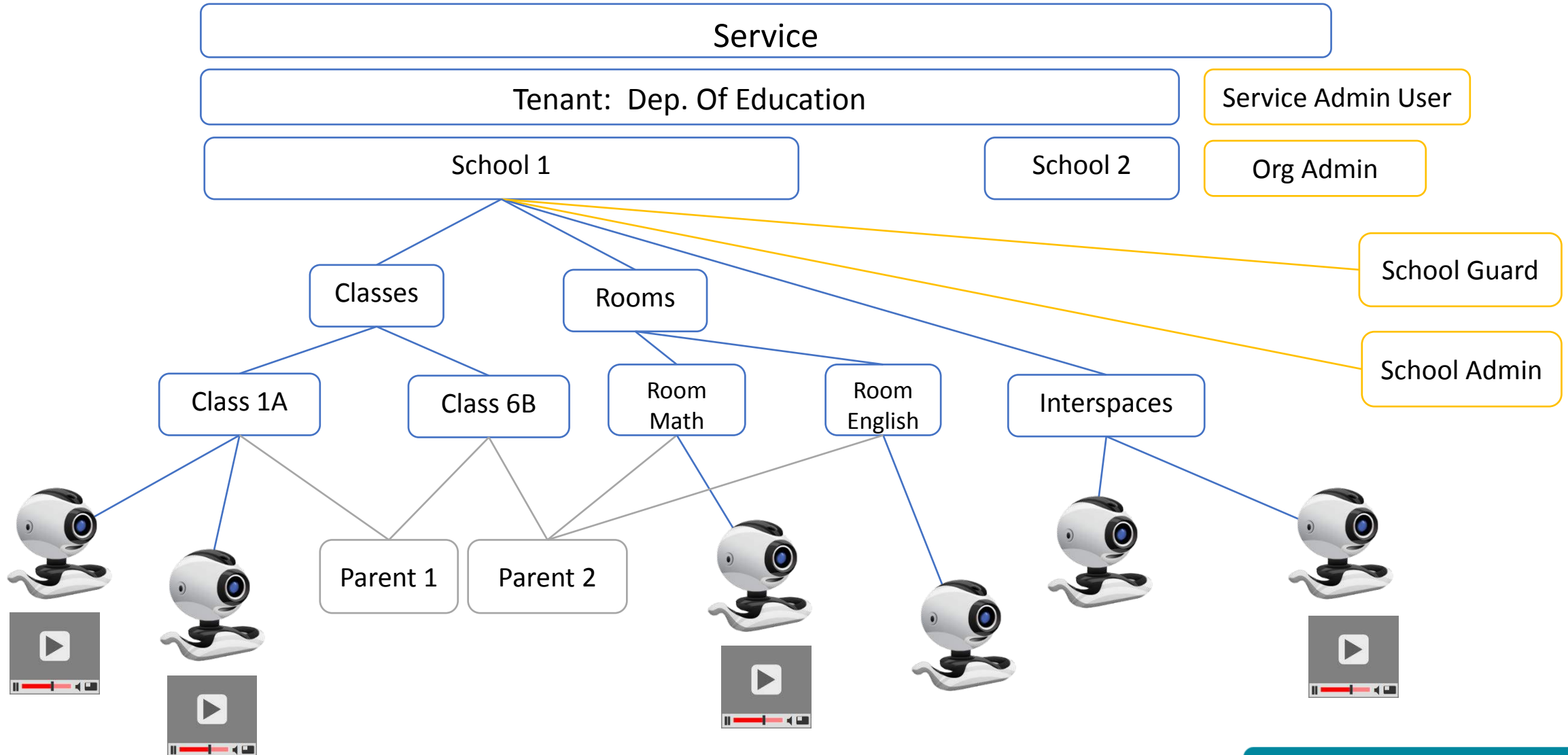
# Access control and grouping

**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

- **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

- **Frameworks**

- **Apache Shiro**

- <http://shiro.apache.org/index.html>
- Complete security and “permissions” concept
- Integrated with Spring



- **Spring Security**

- Looks complicated



- **Code wise**

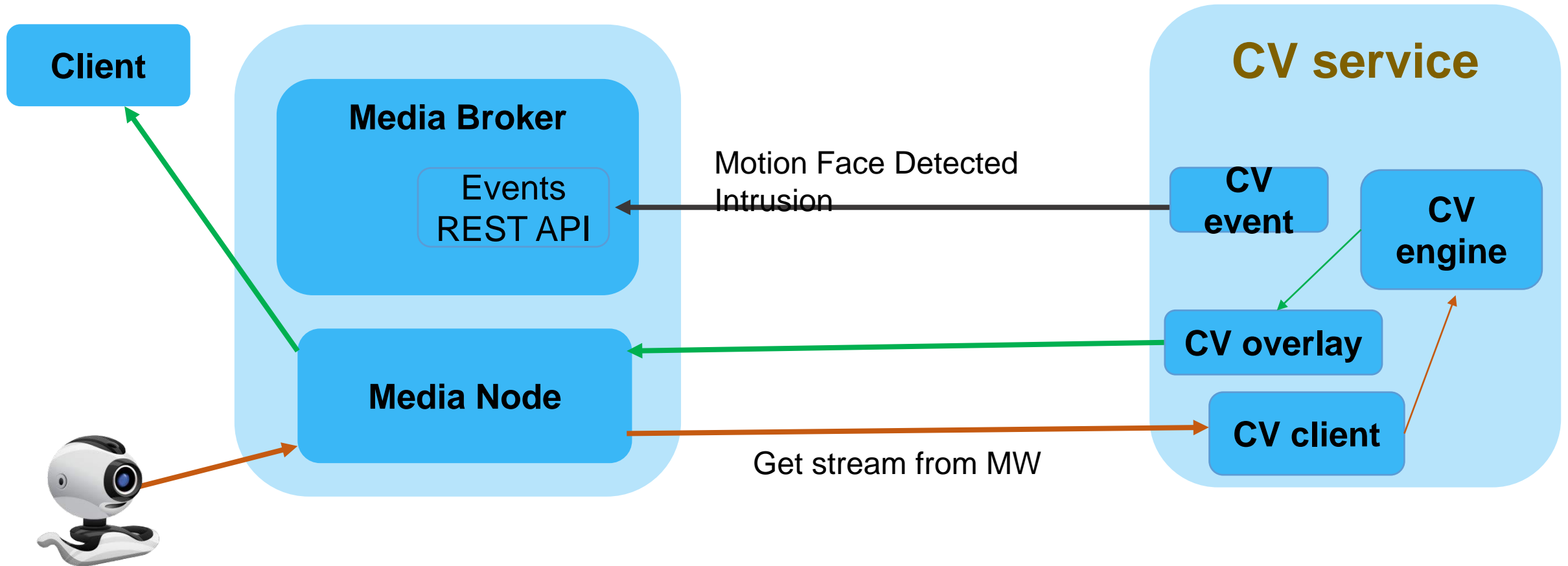
- Need Role-Permissions evaluator procedures
- `isPermitted(resource, action, attributes)`
- `getListofResourcesPermitted(action)`



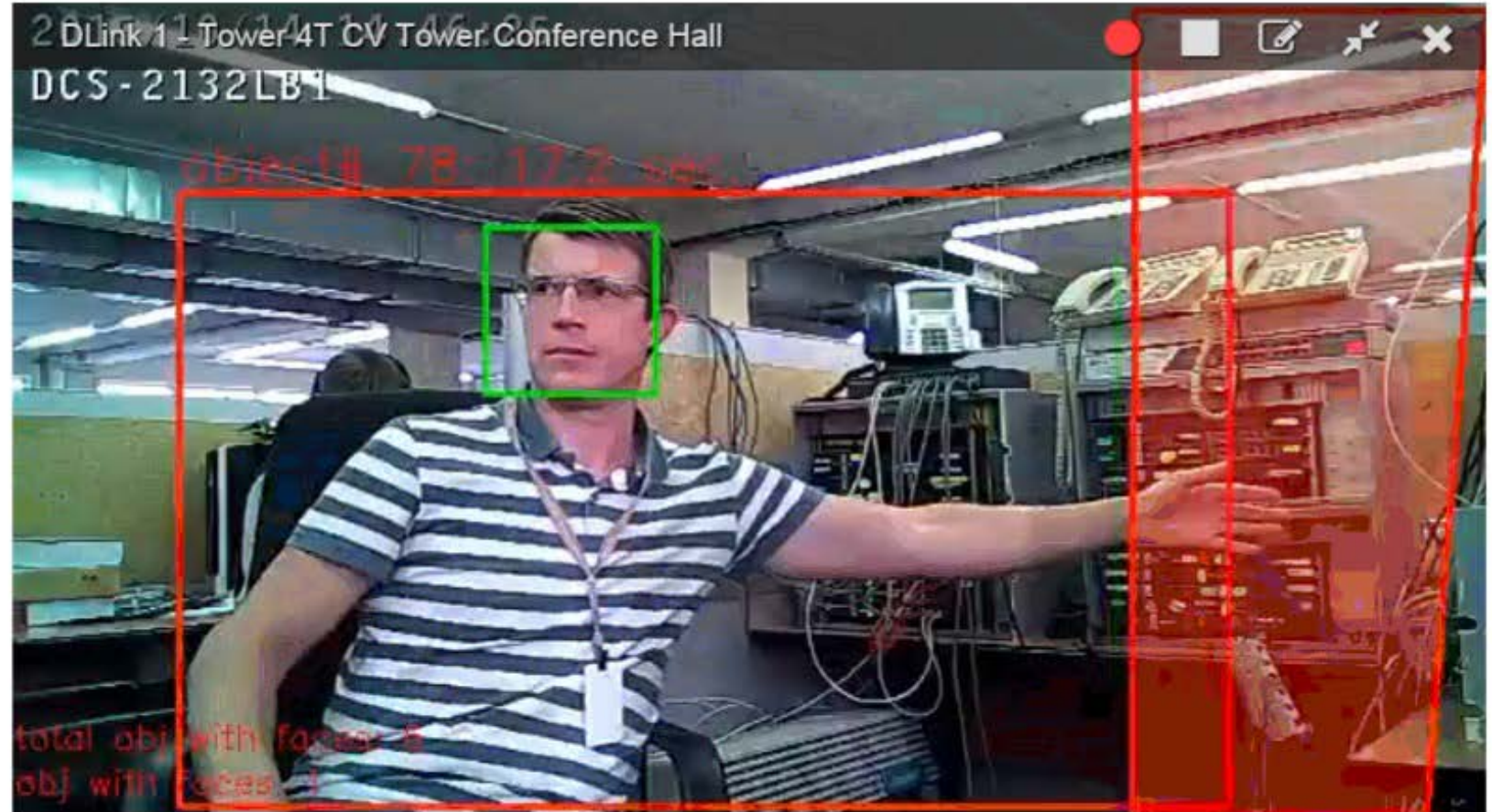
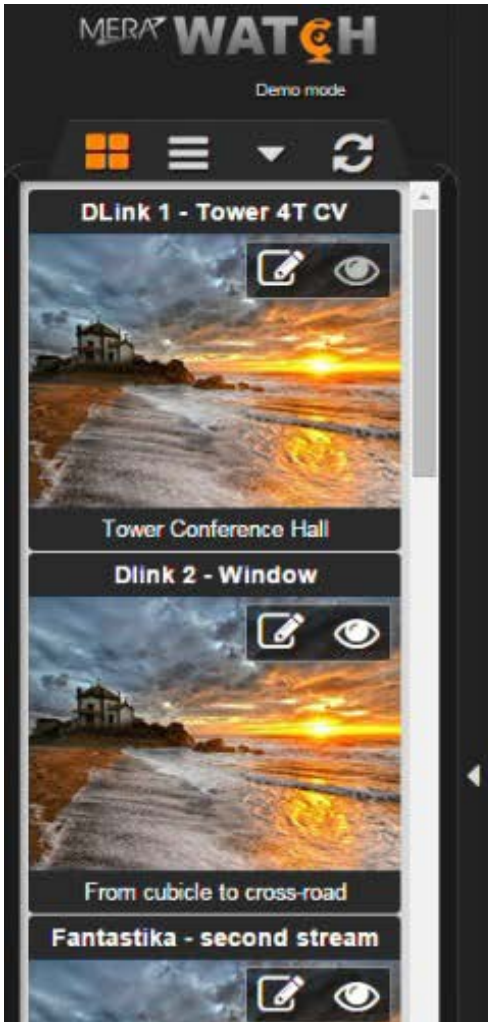
# Video analytics integration

- **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



Much more left to talk about ...

# Contacts

**Andrey Kononov**

MERA Software Services

Unified Communication solutions architect

[aknv@mera.ru](mailto:aknv@mera.ru)

[andrey.kononov.nn@gmail.com](mailto:andrey.kononov.nn@gmail.com)

