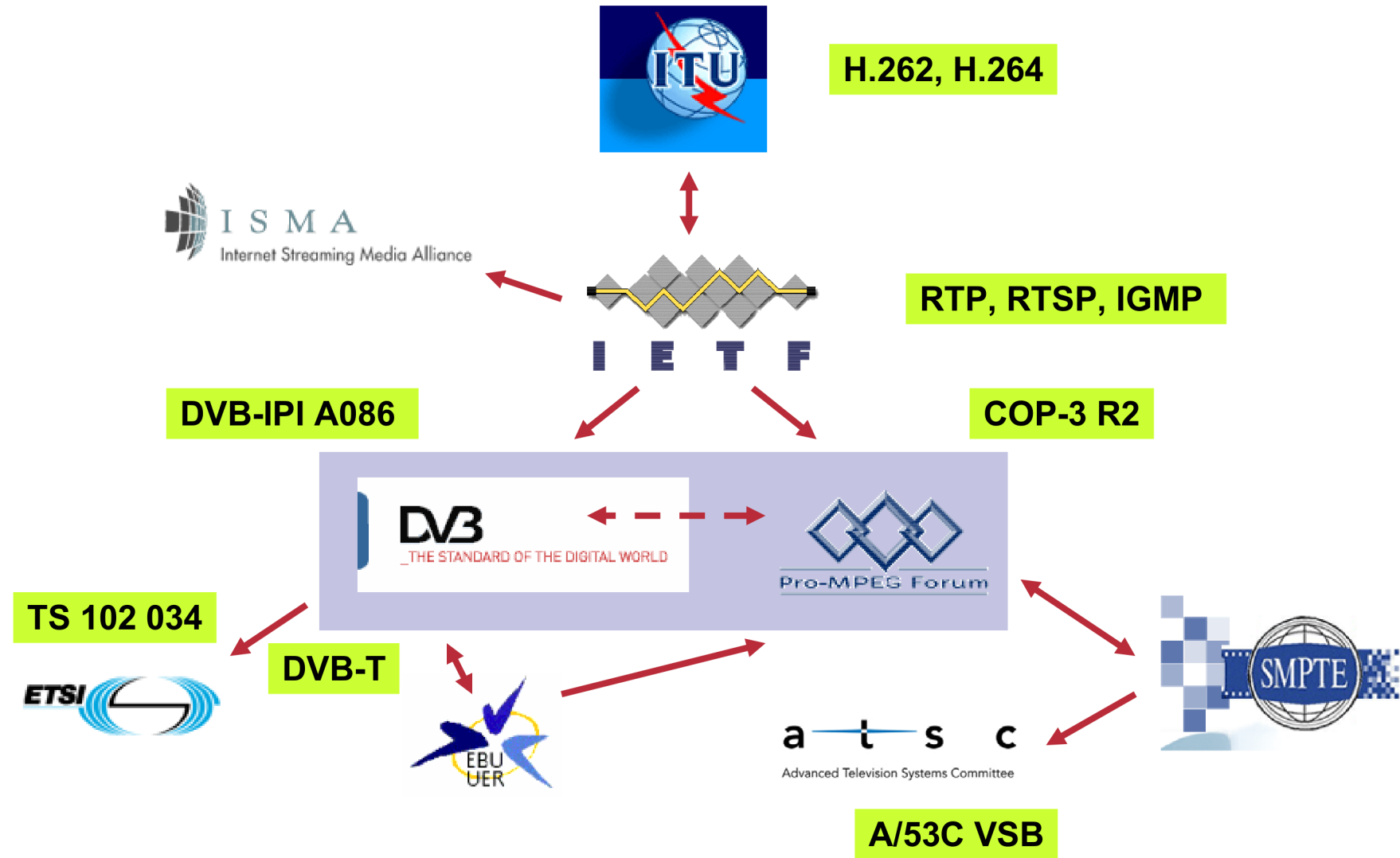




IPTV

<http://bobek.cz>

<http://nangu.tv>



- Multicast-based services
 - ◆ RFC 3376 – IGMPv3
 - ◆ However, IGMPv2 is by far the most common signaling protocol used today

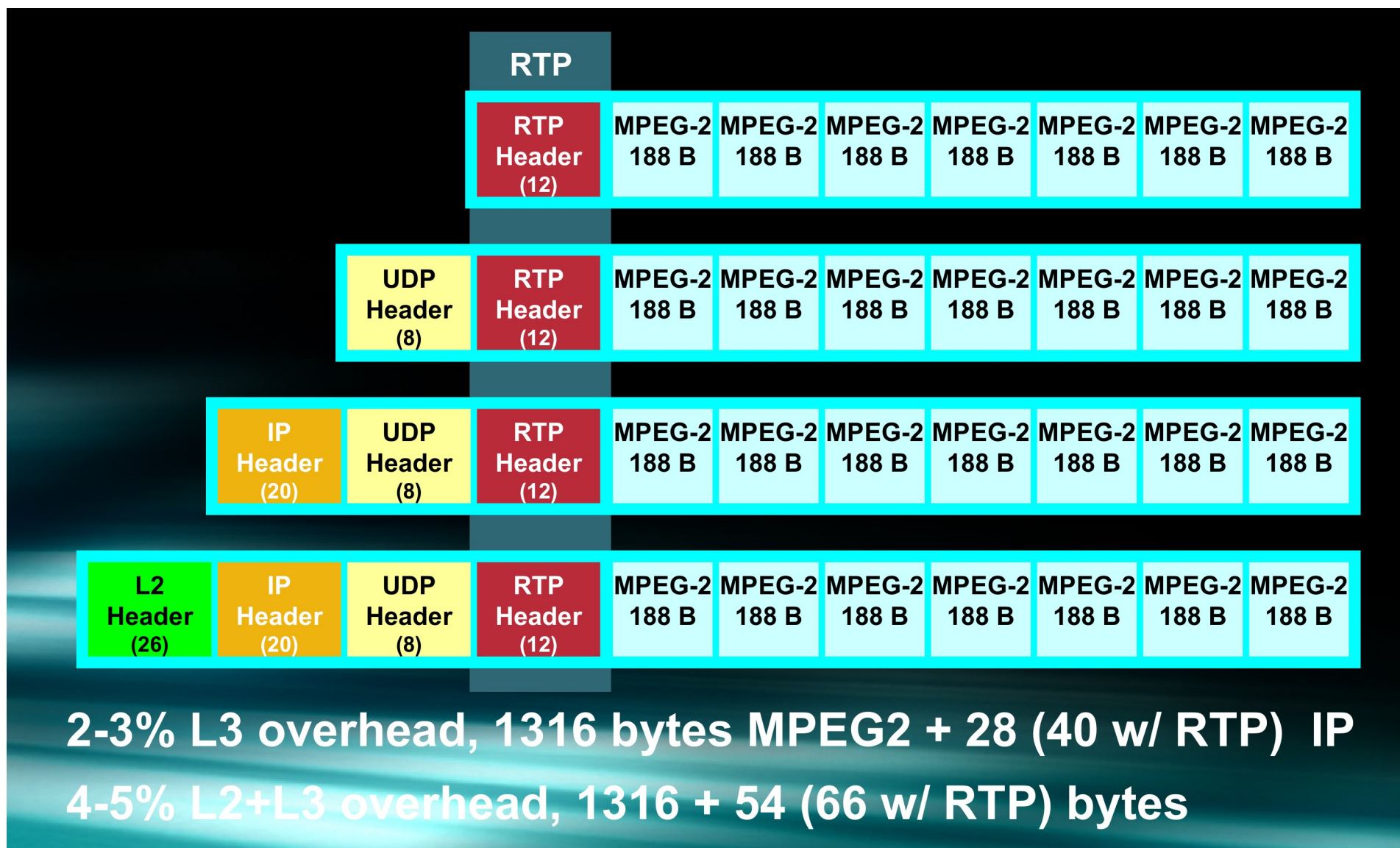
- On-demand services
 - ◆ RFC 2326 – RTSP

- Other IETF standards like DNS, DHCP, ...

- Transport jointly provided by
 - ◆ UDP – checksum and multiplexing
 - ◆ RTP – sequencing and timestamping

- RFC 2250 – RTP Payload for MPEG-1/2 Streams
 - ◆ Section 2 – MPEG TS encapsulation
 - ◆ Section 3 – MPEG ES encapsulation

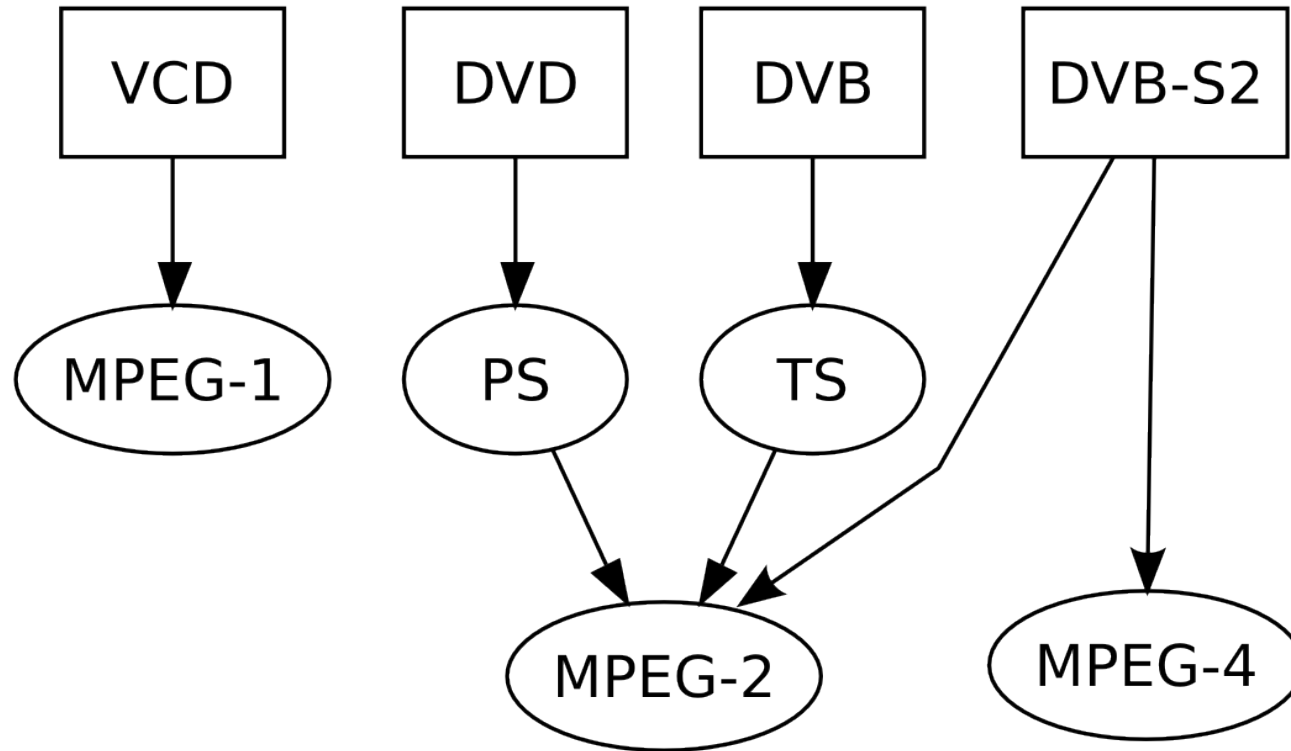
- However, industry keeps on using the MPEG-TS/UDP encapsulation



- containers
 - ◆ MPEG2-TS
 - ◆ RTP

- codecs
 - ◆ MPEG2v or h.264 (MPEG4 Part 10)
 - ◆ MPEG2L2/L3 or AAC

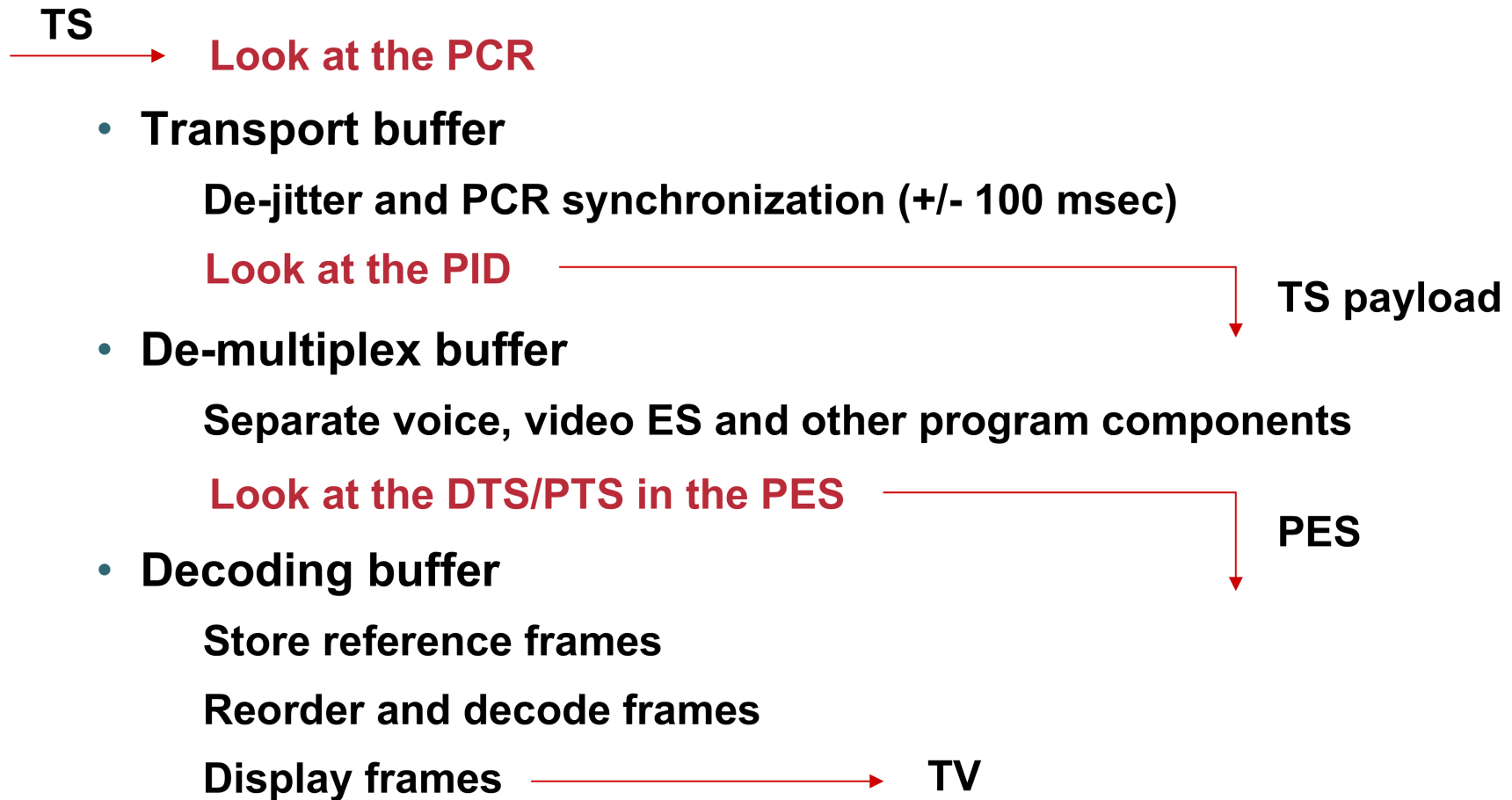
- management
 - ◆ http/https
 - ◆ Infocast (service messages over multicast)
 - ◆ TR-069
 - ◆ SNMP



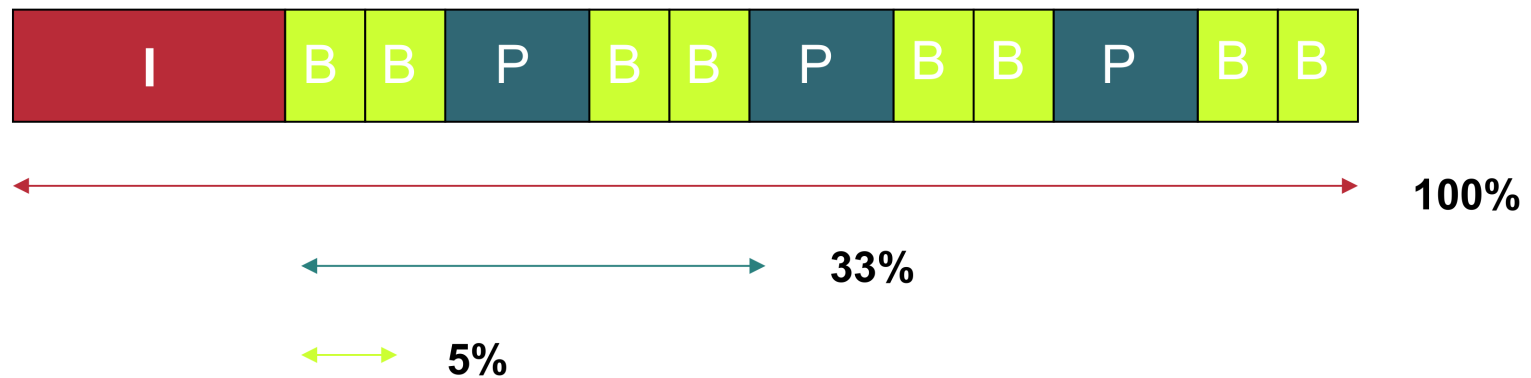
- MPEG-2 is a standard for “the generic coding of moving picture and associated audio information”
- It is not MP2 = MPEG-1 Audio Layer II
- Transport Stream + Program Stream
 - ◆ Defined in Part 1, H.222.0
- Lossy video codec
 - ◆ Defined in Part 2, H.262
 - ◆ Similar to MPEG-1 with support for interlaced video
- Lossy audio codec
 - ◆ Defined in Part 3
 - Enhanced MPEG-1 with support for multichannel (up to 5.1)
 - Additional bitrates for MPEG-1 audio -> Layer I, II and III
 - ◆ Defined in Part 7
 - non-backwards-compatible
 - AAC = Advanced Audio Coding
 - Also defined in Part 3 of MPEG-4

- Container format
- Encapsulates packetized elementary streams
- Layers
 - ◆ Composition of various programs
 - ◆ Packetized Elementary Stream (PES) identified by PID
 - ◆ Elementary Stream (ES)
 - ◆ Group of Pictures (GOP)
 - ◆ Slice
 - ◆ Macroblock (6-12 DCT blocks)
 - ◆ Encoding block or block (DCT encoding block, 8x8px)
- Tables
 - ◆ Program Association Table (PAT)
 - ◆ Program Map Table (PMT)
 - ◆ Network Information Table (NIT) – *not in MPEG2*
 - ◆ Conditional Access Table (CAT) – *not in MPEG2*

- Program Stream
- Other container format for encapsulating video and audio
- Combination of one or multiple PES with common timebase



- Each GOP is independent
- Usually not more than 15 frames
- The longer GOP the more efficient but less robust
- I Frame
 - ◆ Intra-coded, avg. reduction 7:1
 - ◆ Like JPEG, blocks 8x8px of Y, R-Y, B-Y
 - ◆ Blocks are grouped into macroblocks of 16x16px
 - ◆ Macroblocks are grouped horizontally into slices
 - ◆ Multiple slices form a frame -> I-Frame
- P Frame
 - ◆ Predicted based on prior I or P
 - ◆ Avg. reduction 20:1
- B Frame
 - ◆ Bidirectionally predicted
 - ◆ Avg. reduction 50:1

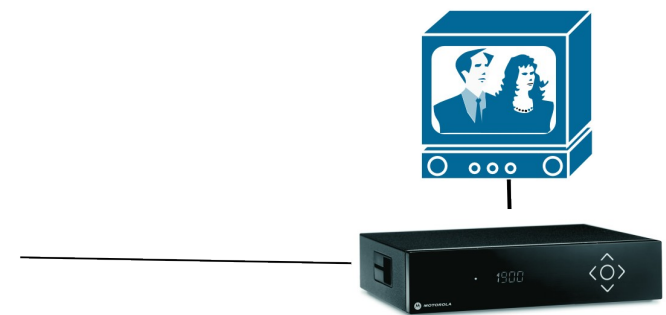


MPEG-2 GOP of size 12 => 480 msec (25 fps)

- Hitting an I-frame (> 20% probability) affects the whole GOP
- < 300 msec should cause a single-GOP loss, i.e. minor glitch

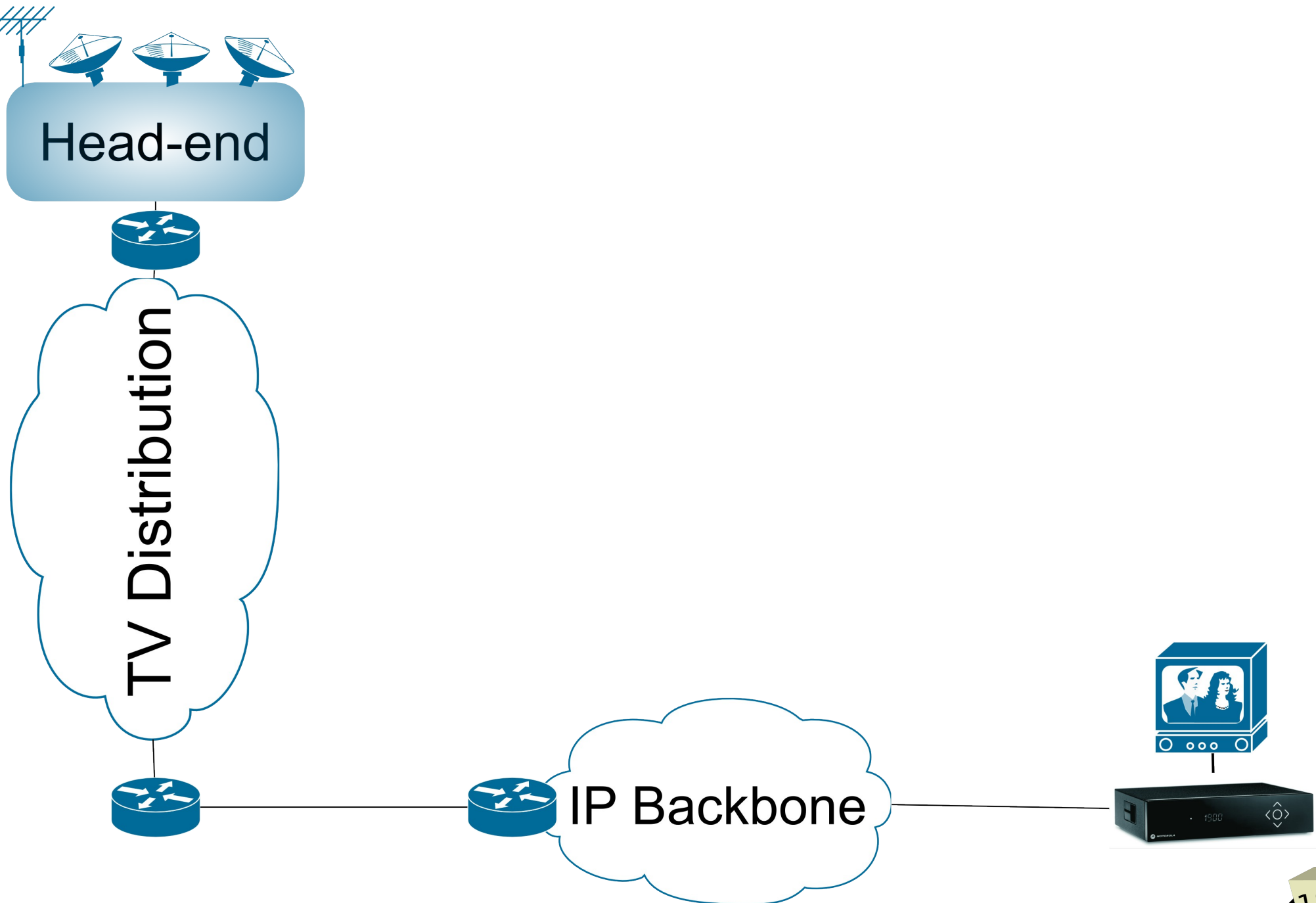
- Family + video codec
- Container – Part 1
- Video codec
 - ◆ Defined in Part 2
 - ◆ MP4
- Audio codec
 - ◆ Defined in Part 3
 - ◆ AAC
- Video Codec
 - ◆ Defined in Part 10
 - ◆ Advanced Video Coding (AVC)
 - ◆ ITU-T H.264
- File format
 - ◆ Part 14
 - ◆ MP4

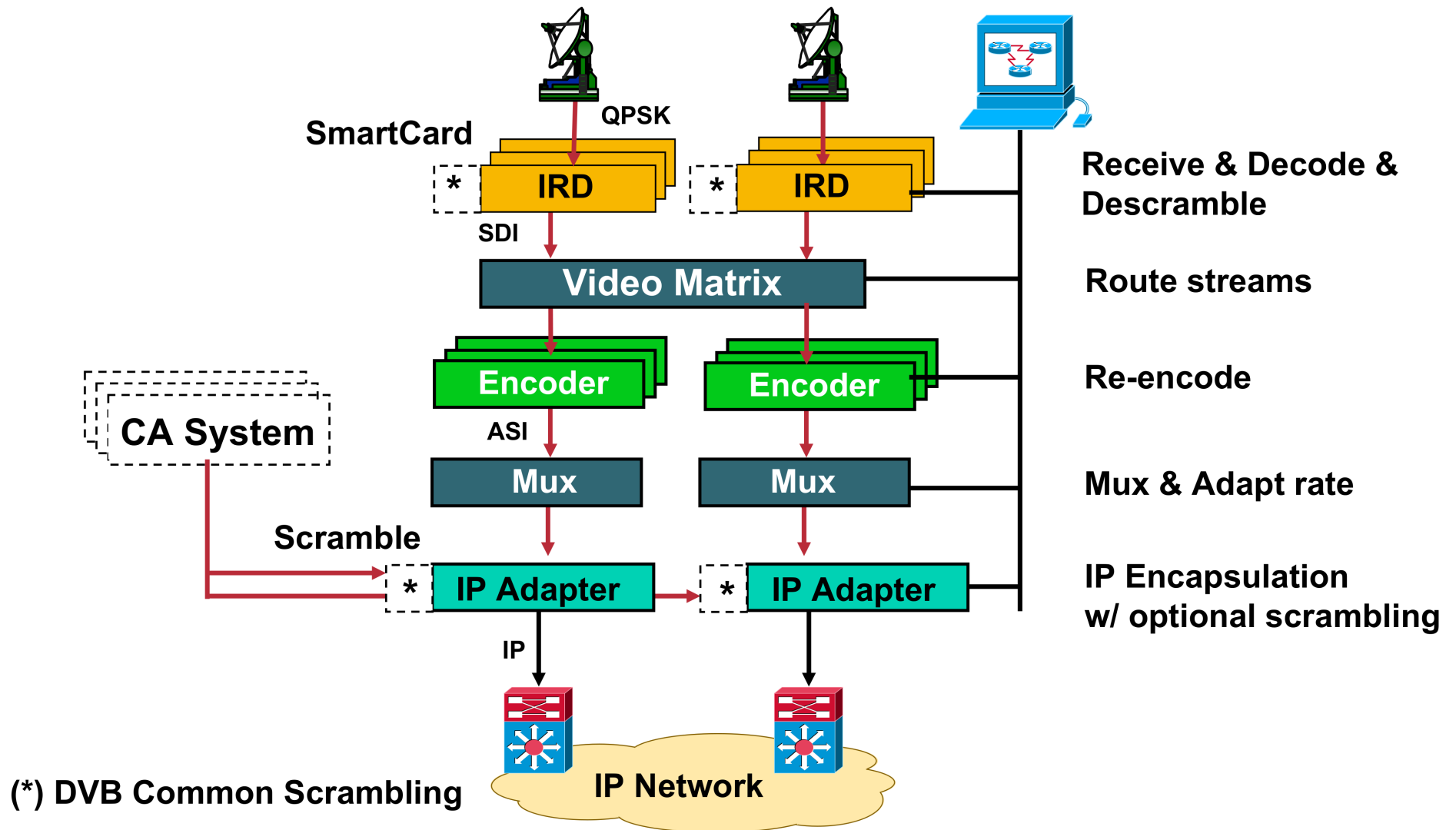
Building Blocks

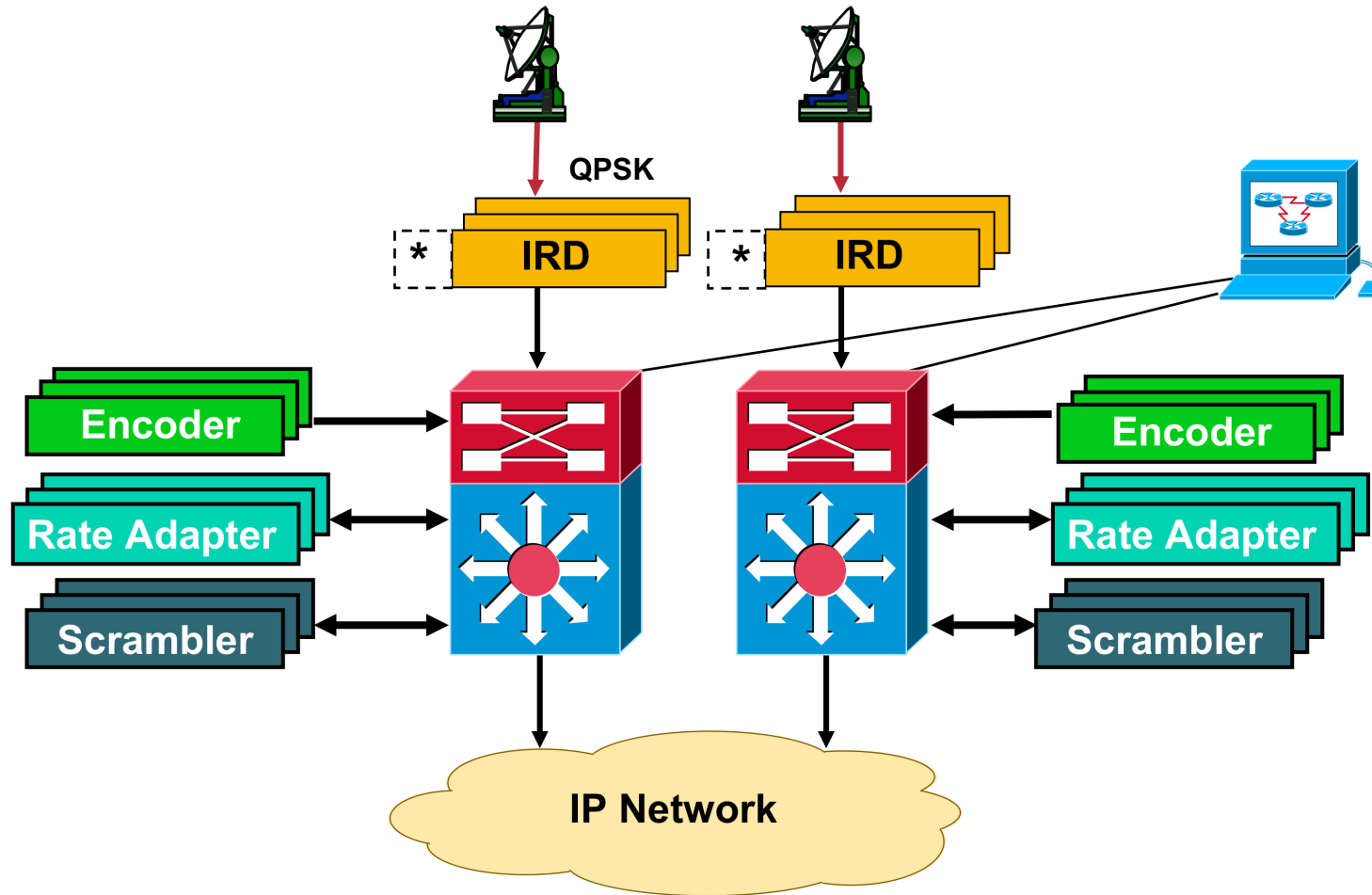




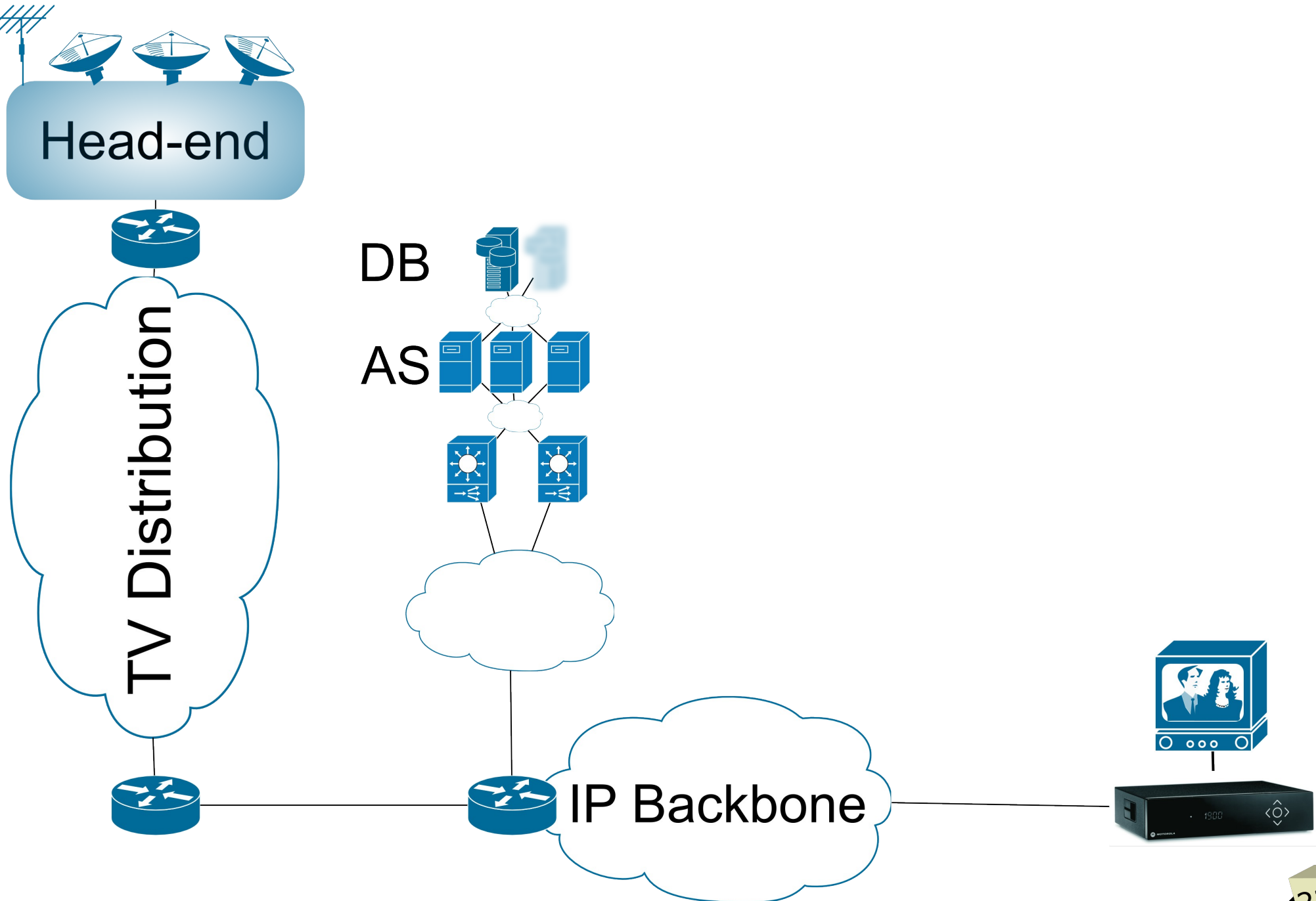
- Embedded Linux
- UI in html/JS/CSS or SVG
- Key element is API for media processing (processing pipe)
- Native applications



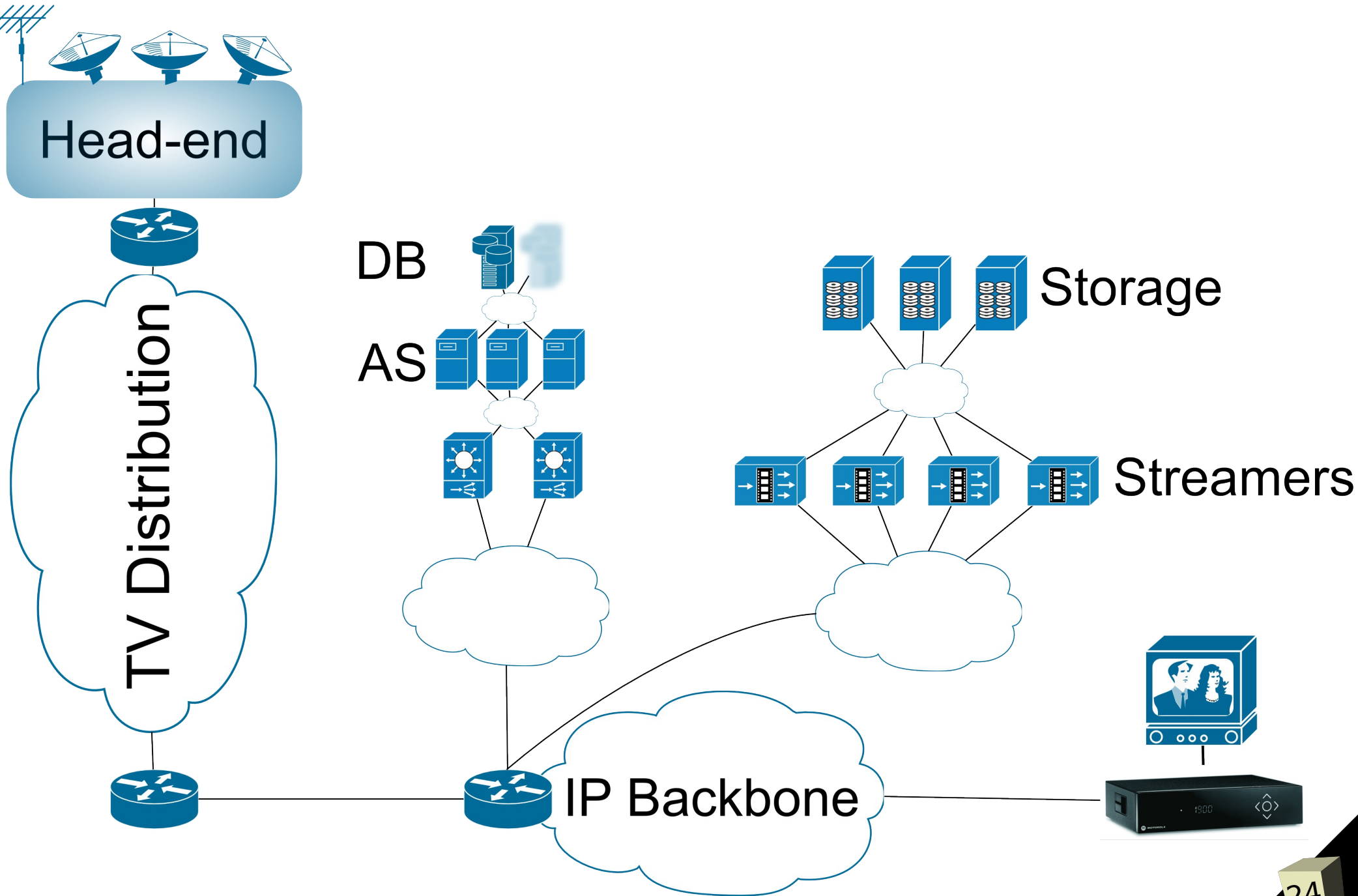




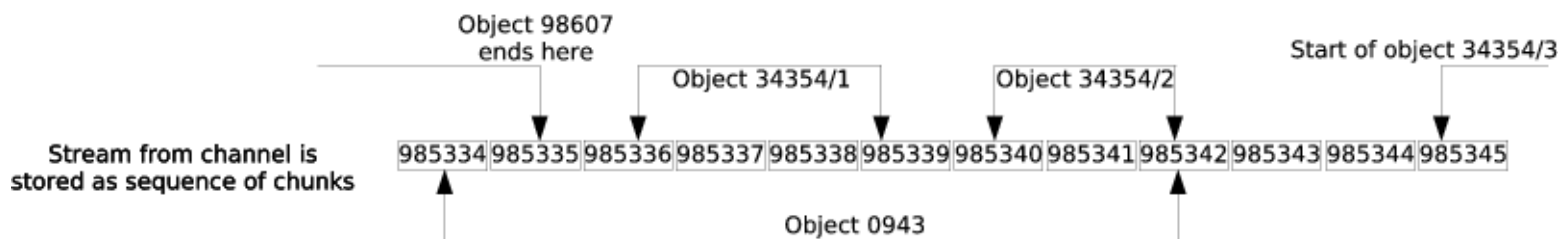
- Crippleware by definition
- Conditional Access System (CAS)
 - ◆ Comes from Broadcasting world
 - ◆ Focus on protecting the **service** against theft
 - ◆ Protects content at the **transport** level
 - ◆ Moving from hw based (SmartCard) to sw based
- Digital Rights Management (DRM)
 - ◆ Comes from IT world
 - ◆ Focus on the **contractual** right between the content owner and the consumer
 - ◆ When and how many times the content may be accessed and eventually recorded
 - ◆ Protects content at the **application** level

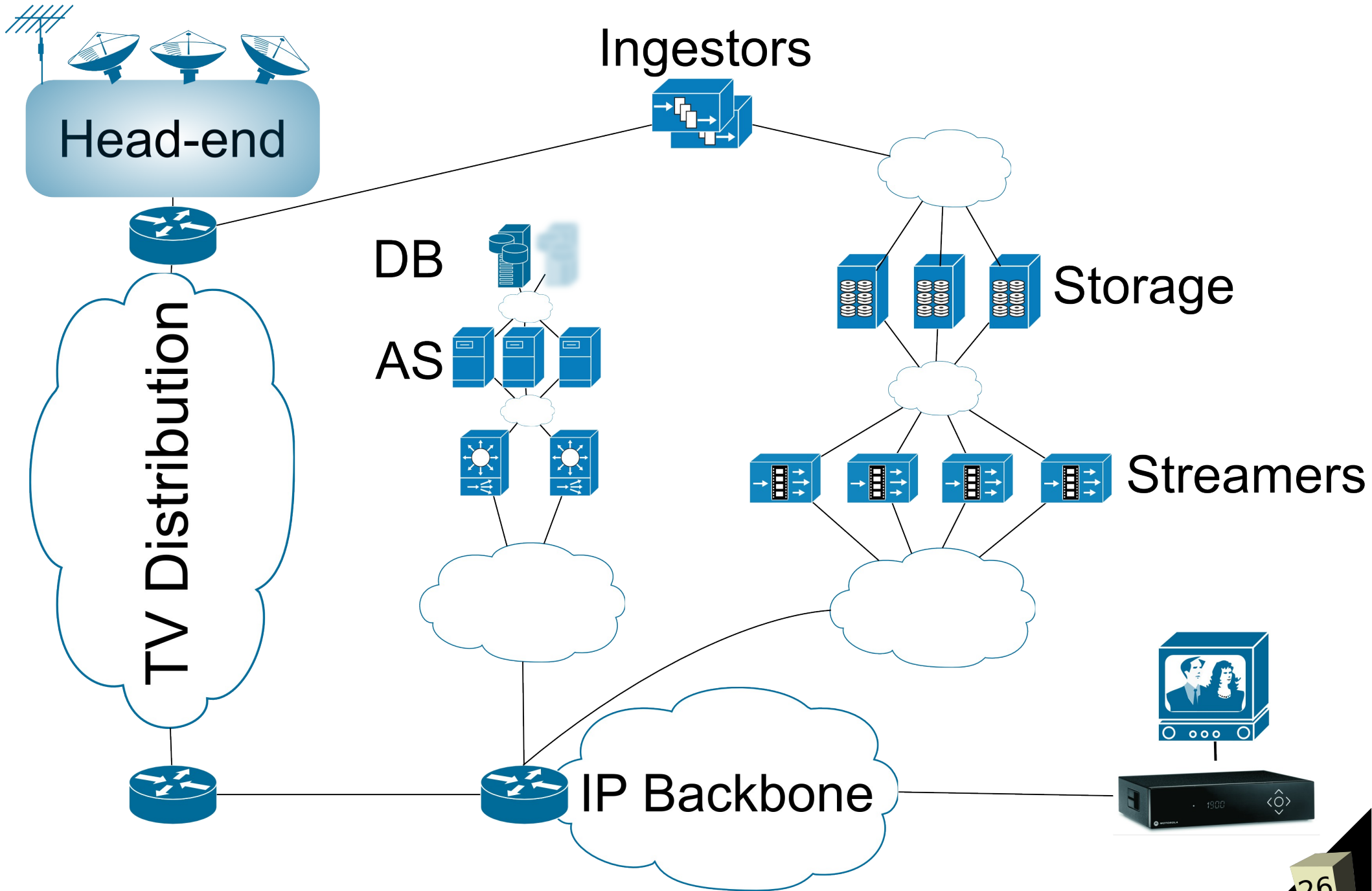


- Business logic of the service + glue
- Providing services to the consumer (EPG, portal, ...)
- Billing and provisioning
- Interfacing to the outside world – OSS/BSS systems etc.



- In-house solution based on standard servers & Linux
- Specifically implemented for IPTV deployment
- Fully redundant solution, with on-line load-balancing
- Support for time unbounded streams

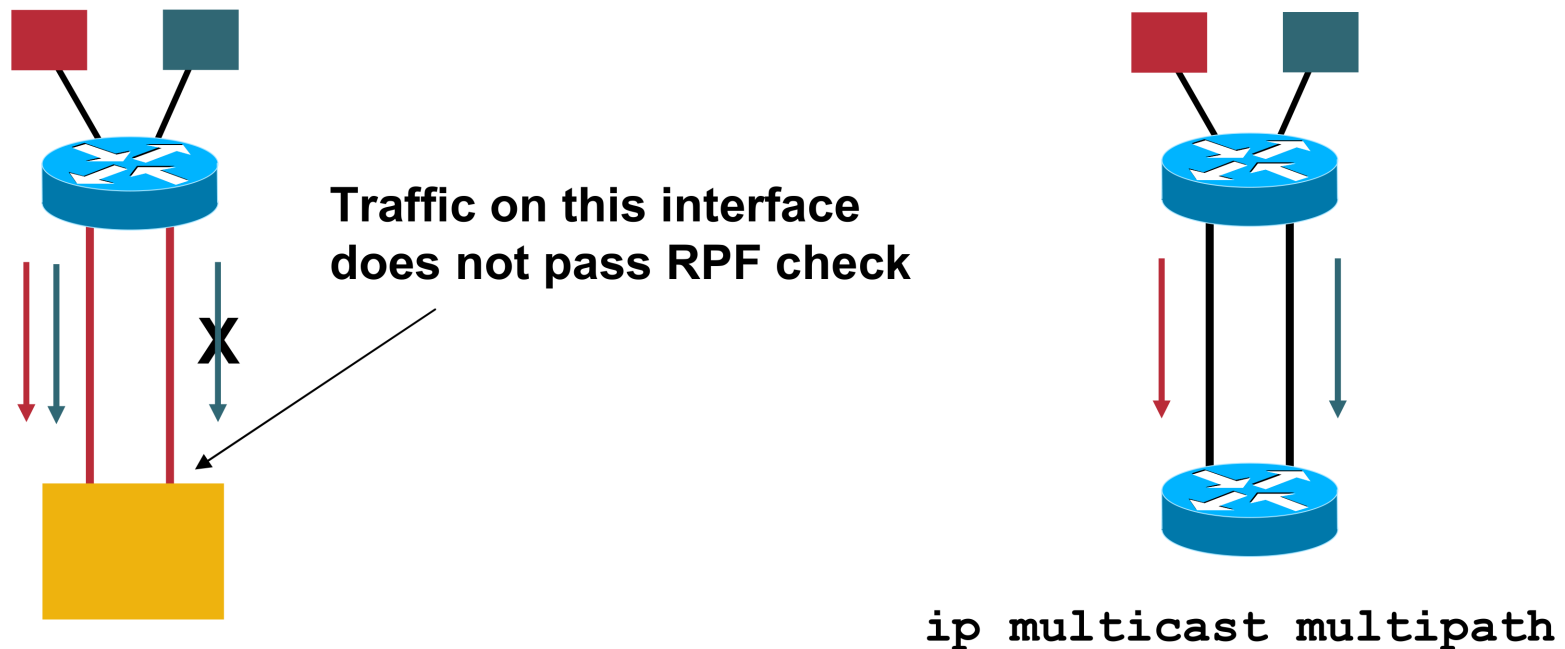




Network for IPTV

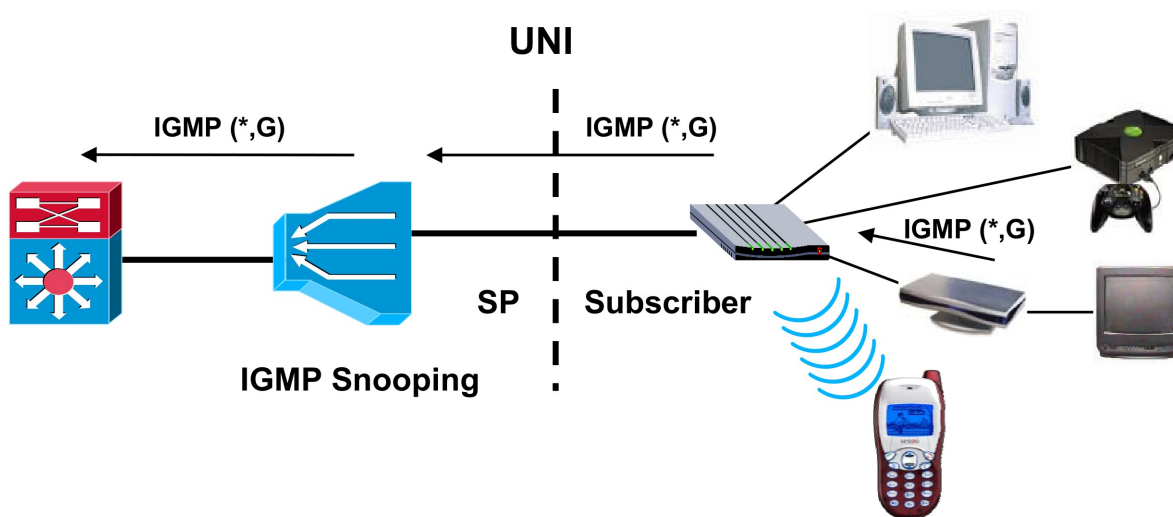
- SSM is typically used in the network
 - ◆ Sources are known in advance
 - ◆ No RP
 - ◆ Single (SPT) tree

- ◆ Only one source can send to SSM channel



- Layer 3 alternative to tunnels or link bundling (EtherChannel)
- Load balance IP multicast traffic on a per source/RP basis

- **Data plane**
 - Filter upstream multicast injection
- **Control plane**
 - PIM
 - IGMP



Prevent

- PIM Adjacencies (hellos)
- PIM Registers
- PIM Assert election
- DR election
- Unauthorized SA messages
- Unauthorized Access
- Flooding of control messages (DoS)

Using

- Administrative Boundaries
- Mroute limits
- Message Authorization
- Access Control Lists
- Filtering
- Throttling
- Rate limit

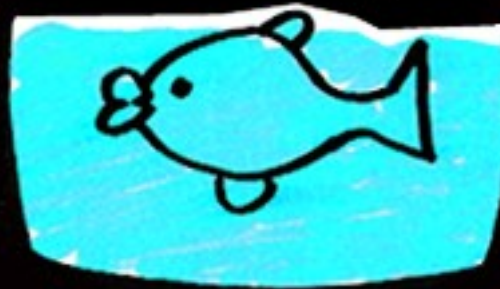
- Network SLAs
 - ◆ Delay – not critical.
 - ◆ Jitter – not so critical. STB can buffer 200ms.
 - ◆ Loss – critical. Packet loss rate $< 10E-6$

- Packet loss due to queue drops by bursts at aggregation points

- If drop needed, drop VoD packets first

	DiffServ DSCP	Prec	Behavior	Queuing	Other
Voice and voice signaling	EF	5	Low latency, High priority	Weighted queue	Police on exceeding weight
Video Broadcast	AF41	4	Assured forwarding, very low drop	Weighted queue	
Video on Demand	AF42	1	Assured forwarding, low drop		Drop on exceeding threshold
Video Signaling	CS3	3	Non oversubscribed class	Weighted queue	Police on exceeding weight
Internet Access	BE	0	Best effort	Weighted queue	WRED

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