

画像情報特論 (2)

Advanced Image Information (2)

Streaming Background

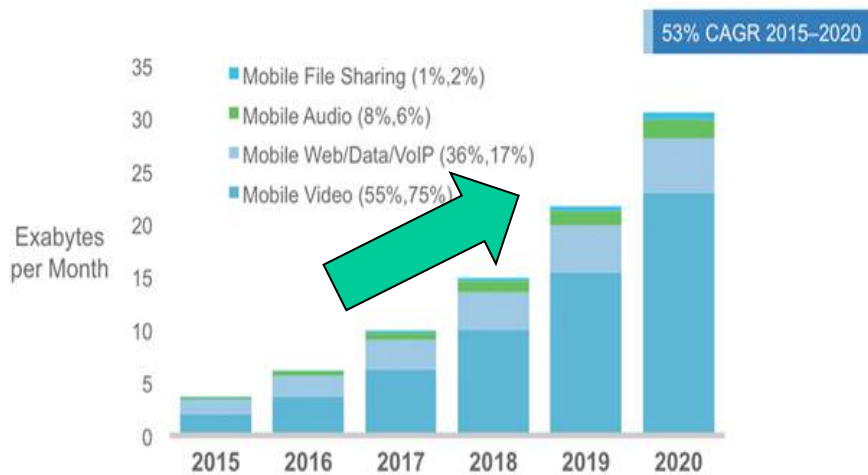
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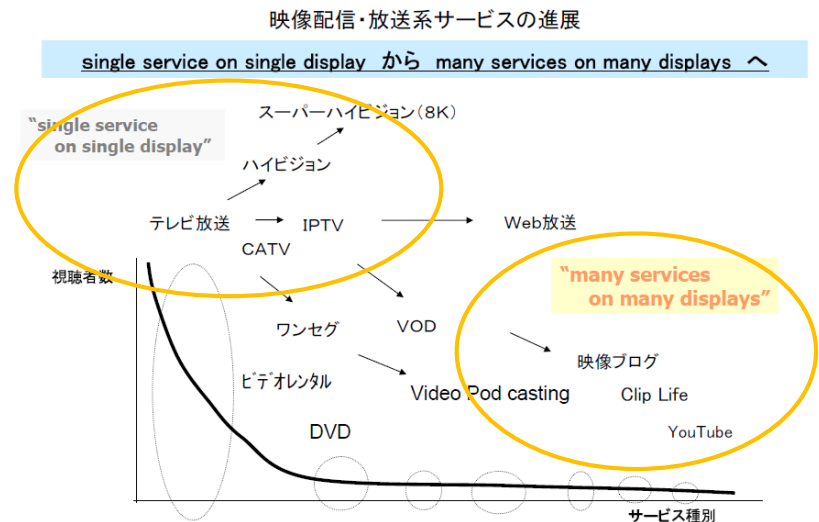
Recent Trends

- Drastic Increase of Video Traffic on Internet
 - more than 70%

- Evolution of Various Video Services
 - higher resolution and personalization

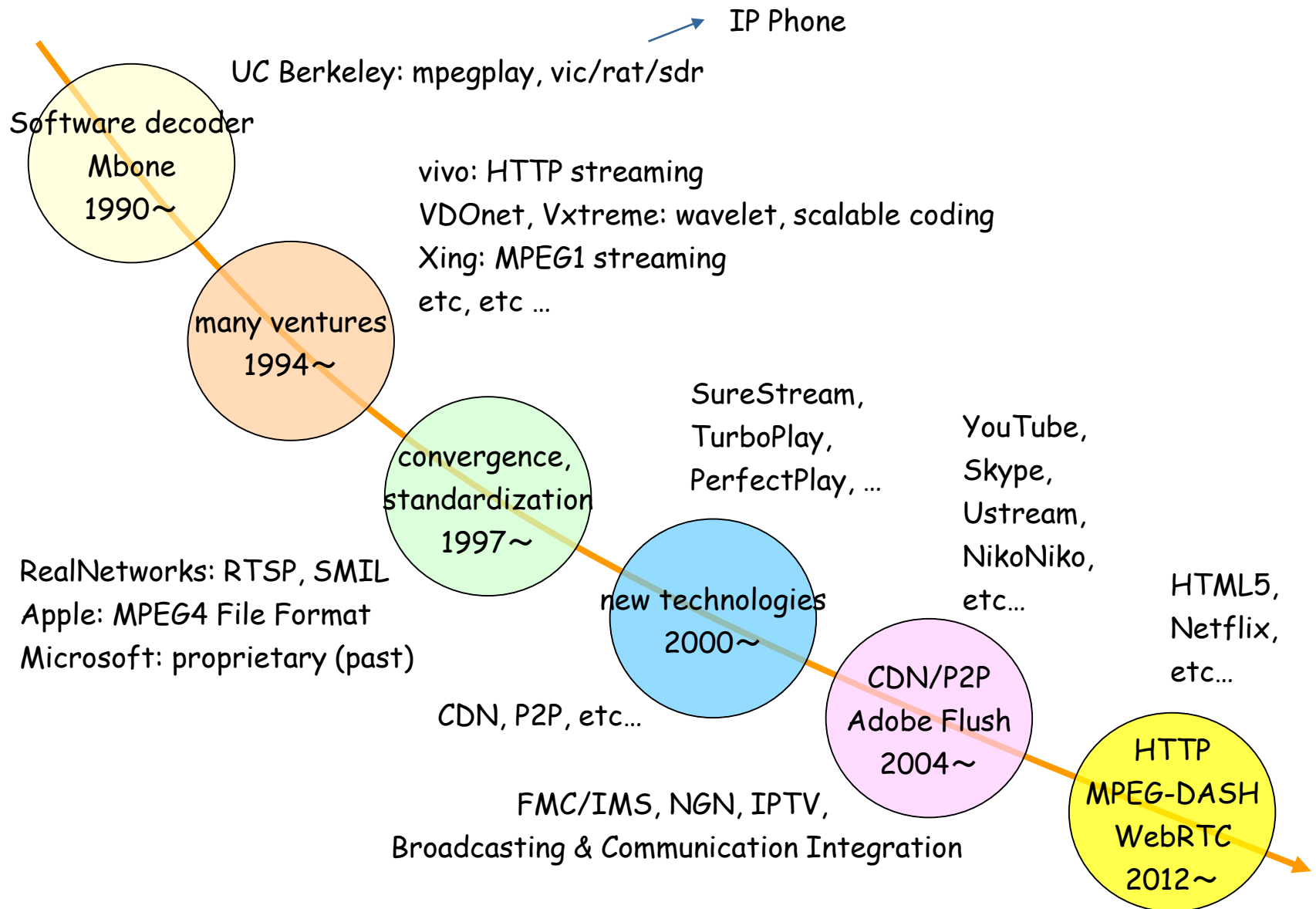


(Cisco VNI, 2016)



(MIC Report, 2008)

History of Video Streaming



Protocol Stack for RTP/UDP Video Streaming (and IP phone)

protocol stack for low-delay video streaming (e.g. conference)

application (L7)	video (H.264 etc...)	audio	SDP	layout (HTML, SMIL)
adaptation	RTP / RTCP		RTSP, SIP, SAP*	HTTP
transport (L4)	UDP / TCP / DCCP		TCP / UDP / SCTP	
network (L3)	IP (IPv4, IPv6, IP-multicast)			
datalink & physical (L2 & L1)	actual networks (802.3 (ethernet), 802.11 (WiFi), etc)			

* SAP: delivered by IP-multicast for program advertisement

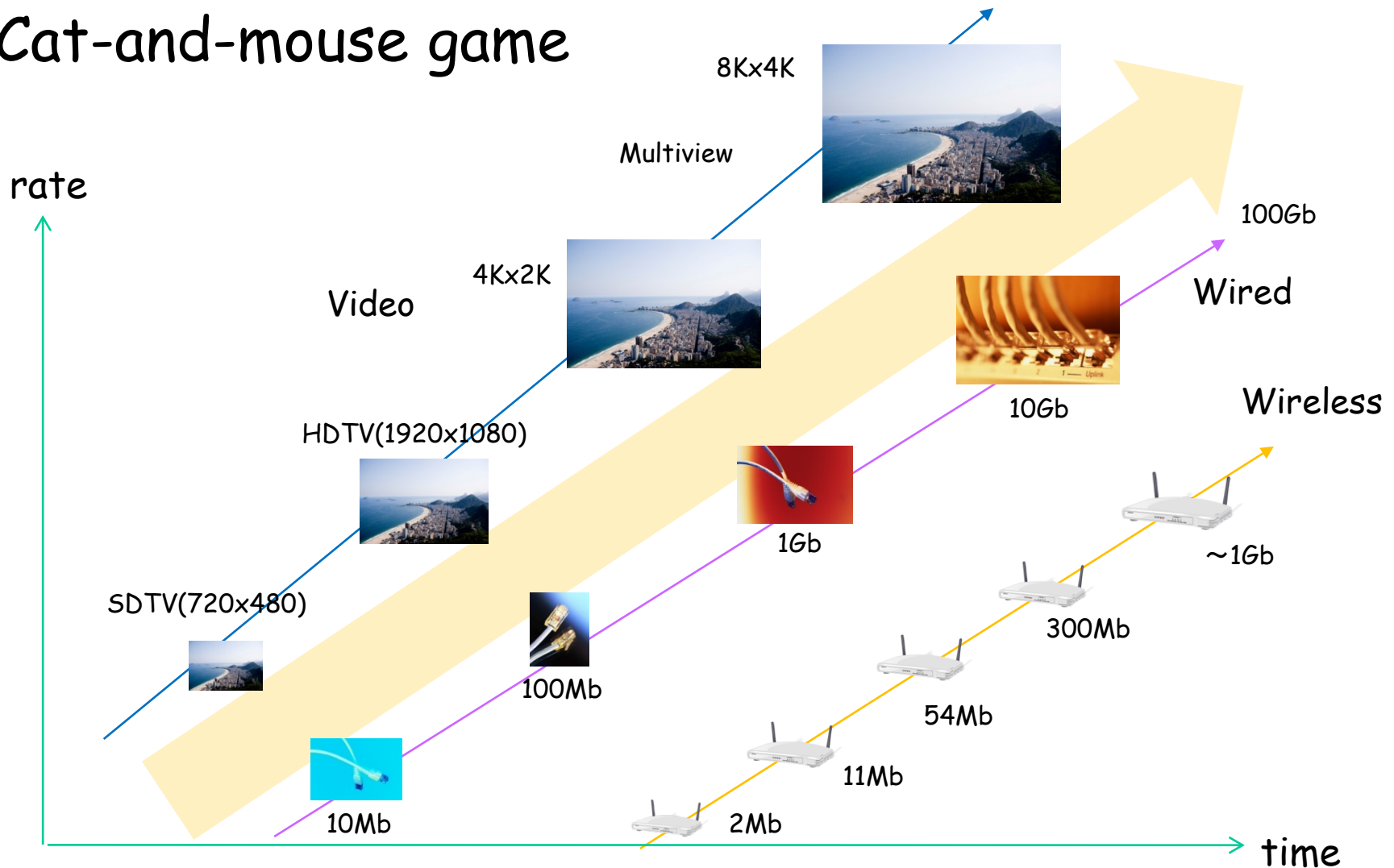
Protocol Stack for HTTP Video Streaming

protocol stack for one-way video streaming

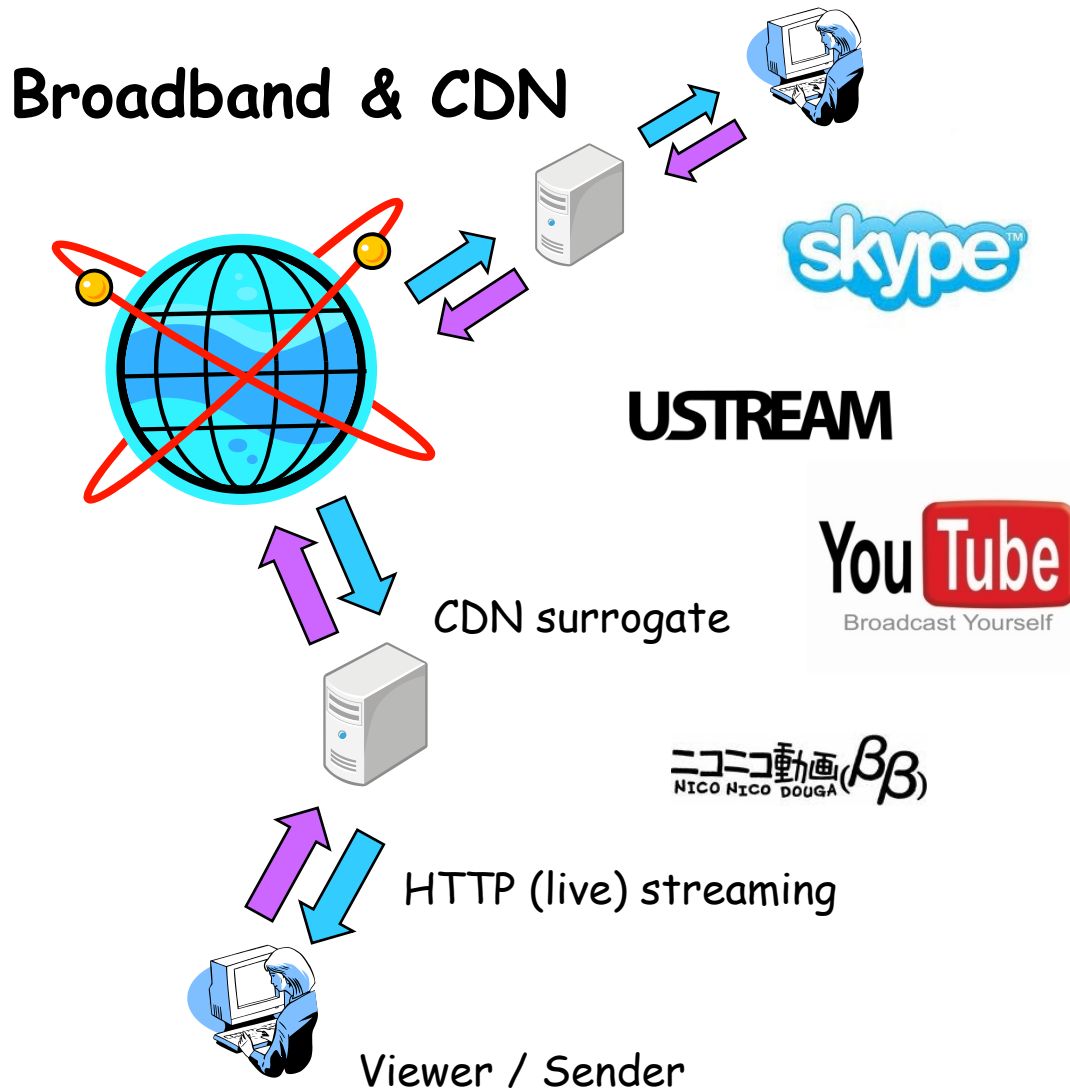
application (L7)	video (H.264 etc...)	audio	MPD (MPEG-DASH)	layout (HTML)
adaptation	HTTP			
transport (L4)	TCP			
network (L3)	IP (IPv4, IPv6)			
datalink & physical (L2 & L1)	actual networks (802.3 (ethernet), 802.11 (WiFi), etc)			

Networks and Multimedia

- Cat-and-mouse game



Wired Networks



RTP/UDP & RTSP & TFRC

→ HTTP/TCP streaming

- Broadband
- CDN (Akamai, Lime Networks)
- Firewall (port 80)
- ...

One-way (on-demand / live)

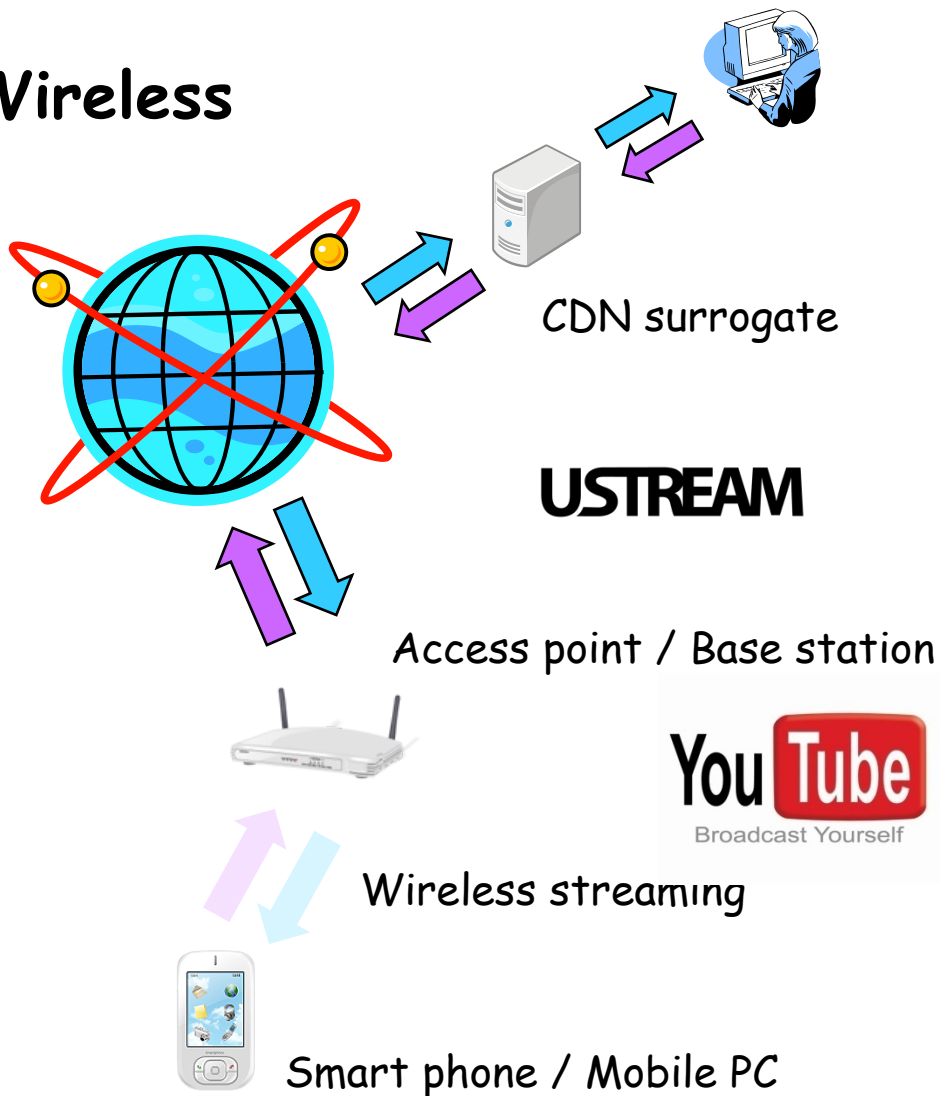
- large buffer

Bi-directional (interactive)

- small buffer

Wireless Networks

Wireless



Wireless specific problems

- WiFi: IEEE 802.11 n/ac/ax
- Cellular: 3G, 4G(LTE), 5G
- WiMAX: IEEE 802.16
- Home Networks: DLNA
- (Satellite)
- ...

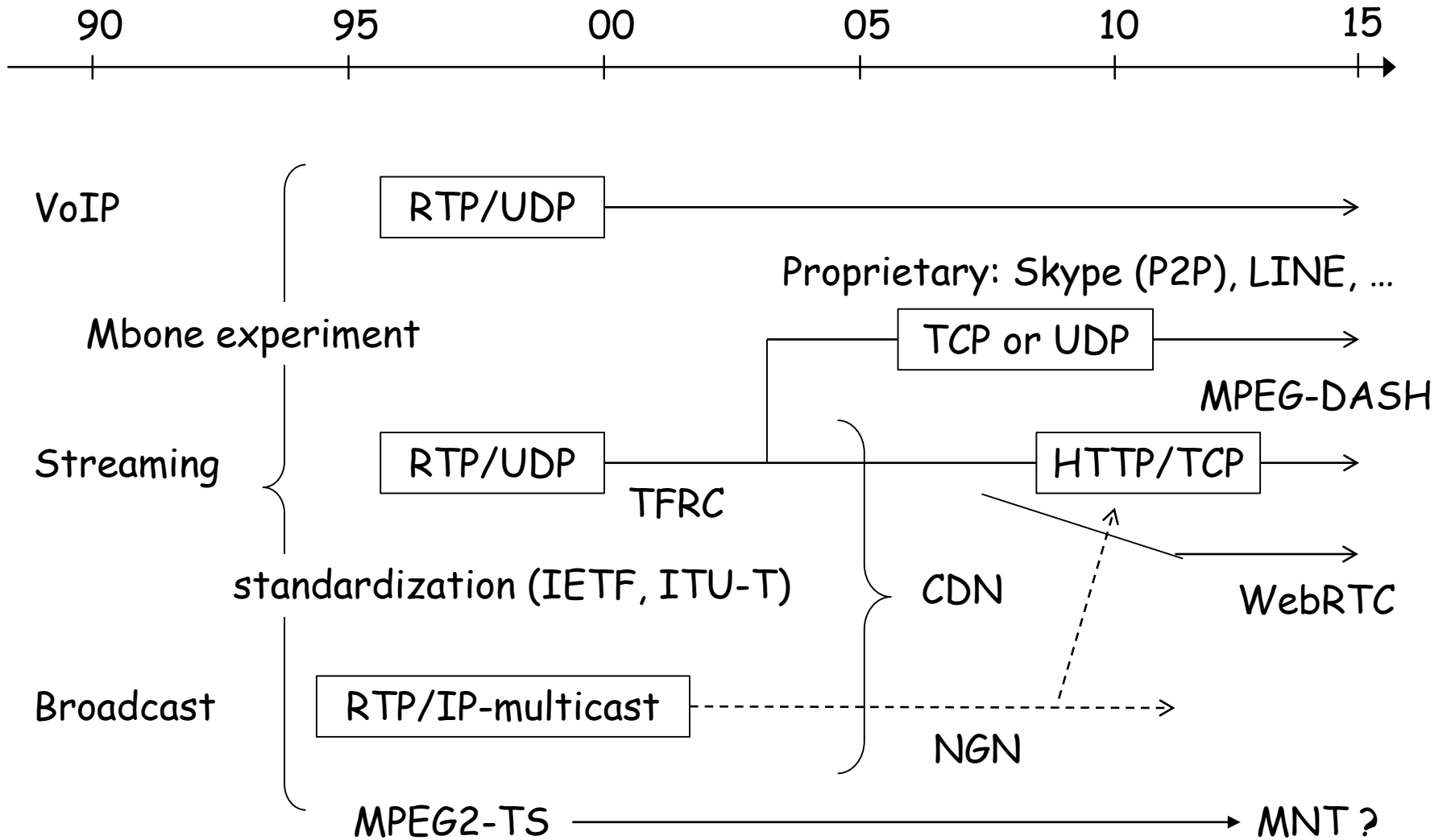
- **Wireless issues**

random errors, collisions,
interference, delay increase

- **Multi-hop issues**

severe interference, lower
throughput and higher delay

Protocol Transition



Overview

- TCP versions
- TCP over wireless
- TFRC (TCP friendly rate control)
- (simulators)
- CDN & P2P
- Upper layer protocols
- MPEG-DASH, WebRTC

Supplement

- Keynotes and tutorials on video streaming
 - "Internet Video: The 2011 Perspective," IWQoS 2011.
<http://www.ieee-iwqos.org/2011/keynote.html>
 - "Internet Video: Past, Present, and Future," SIGCOMM 2013 Tutorial.
<http://conferences.sigcomm.org/sigcomm/2013/ttliv.php>
 - "Optimizing QoE in Large-Scale Video Networks," Packet Video 2013 (YouTube).
 - "Double, Double, Toil and Trouble, Bandwidth Grows and Congestion Bubbles," Packet Video 2013 (Akamai).
<http://pv2013.itec.aau.at/workshop-program/>