
TOMORROW
starts here.

Emerging Video Technologies
H.265, SVC and WebRTC

BRKEVT-2666

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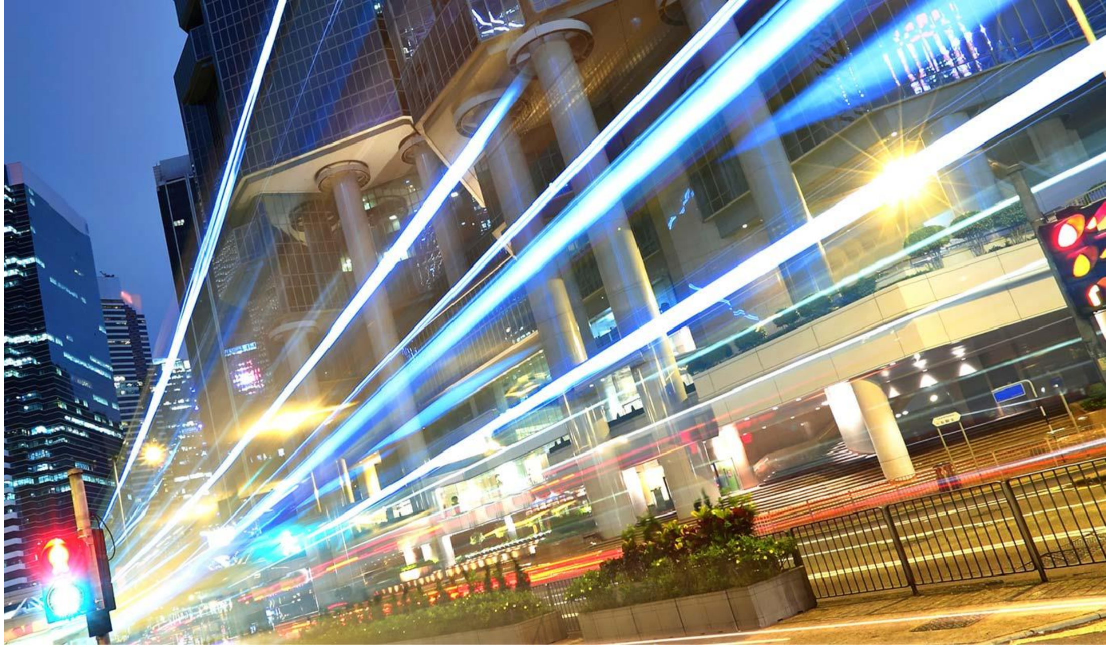
#clmel

Cisco live!

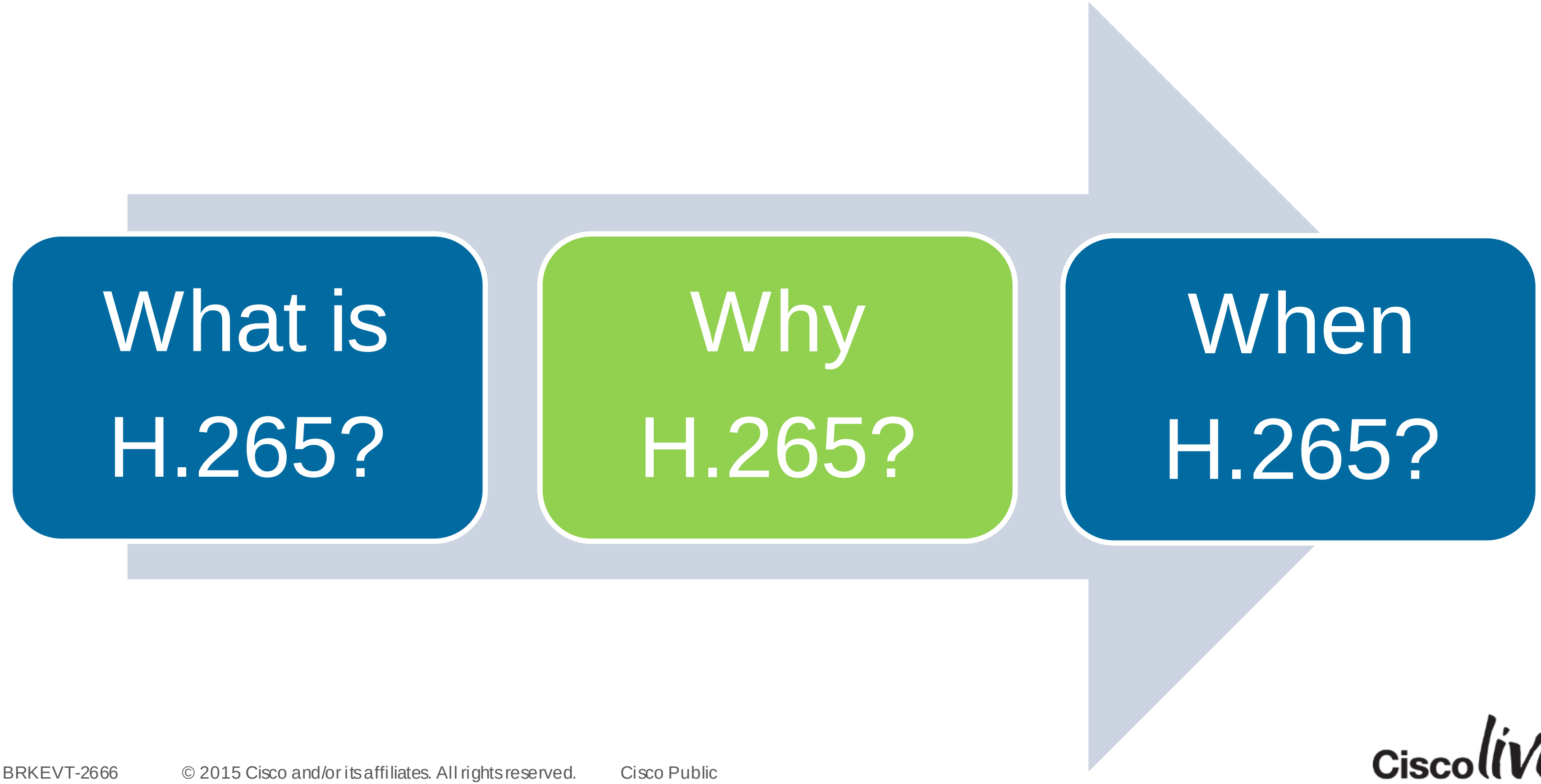
Agenda

- Introduction
- H.256
- SVC/Multi-stream
- WebRTC
- Conclusion



H.265 – The Evolution of Video

H.265/HEVC



H.265

- H.265 is a video compression standard
  - HEVC (High Efficiency Video Coding)
  - MPEG-H Part 2
- H.264’s successor
- Under joint development by Joint Collaborative Team on Video Coding (JCT-VC)
  - ISO/IEC Moving Picture Experts Group (MPEG)
  - ITU-T Video Coding Experts Group (VCEG)

Cisco's H.265 Involvement

- Call for Proposals (CfP) in 2010
  - (response from 27 companies)
- Cisco and partners submitted a proposal, TENTM
  - 1 of 5 proposals included in first draft of H.265 standard
  - Multiple Cisco patents adopted
- Four meetings every year up to 2013 to define the final H.265 standard

Timeline For Ratification of H.265

Year-Month	Milestone
2010-01	Call for Proposals (CfP), issued jointly by ITU-T & ISO
2010-02	CfP Submission deadline
2010-04	Evaluation of proposals (27)
2010-07	Test Model Under Consideration (TMuC)
2010-10	HEVC Test Model (HM) v1.0
2012-02	Committee Draft (CD)
2012-07	Draft International Standard (DIS)
2013-01	Final Draft International Standard (FDIS)
2013-04	Approved as ITU-T Standard (v1)
2013-06	Published on ITU-T Website
2013-11	Formal publication by ISO/IEC
2014-10	Approved as ITU-T Standard (v2)

History of ITU-T Standardisation

Year	ITU-T	Neutral name	ISO/IEC
1988	H.261		MPEG-1
1996	H.262, H.263		MPEG-2
1998	H.263+		MPEG-4 Part 2
2000	H.263++		
2003	H.264	AVC	MPEG-4 Part 10
2007	H.264 SVC	AVC SVC	MPEG-4 Part 10 SVC
2009	H.264 MVC	AVC MVC	MPEG-4 Part 10 MVC
2013	H.265	HEVC	MPEG-H
2014	H.265 SVC/MVC	HEVC SVC/MVC	MPEG-H MVC/SVC

H.264 and H.265

- H.264 – AVC – MPEG-4
  - “Family of standards”
  - Profiles are “family members”
  - Profiles define coding tools and algorithms
- H.264 Profiles
  - 2003: 3 profiles included same year as ratification (i.e. Baseline Profile)
  - 2004: High Profile (HP)
  - 2007: Scalable Video Coding (SVC)
  - 2009: 16 profiles
  - 2012: 21 profiles

- H.265 – HEVC – MPEG-H
- 2013: Main profile, Main 10 profile, Main still profile
- 2014: 24 additional profiles including 2 scalable profiles and one multi-view profile

Why H.265?

- Improved performance over H.264
  - Higher compression
  - Less bandwidth required
  - Large picture resolutions supported (scale from 320x240 to 8192x4320 ("8K”))
- Higher complexity than H.264
  - Video encoder requires significantly more computing power
  - Decoder requires ”marginally” more resources vs. H.264

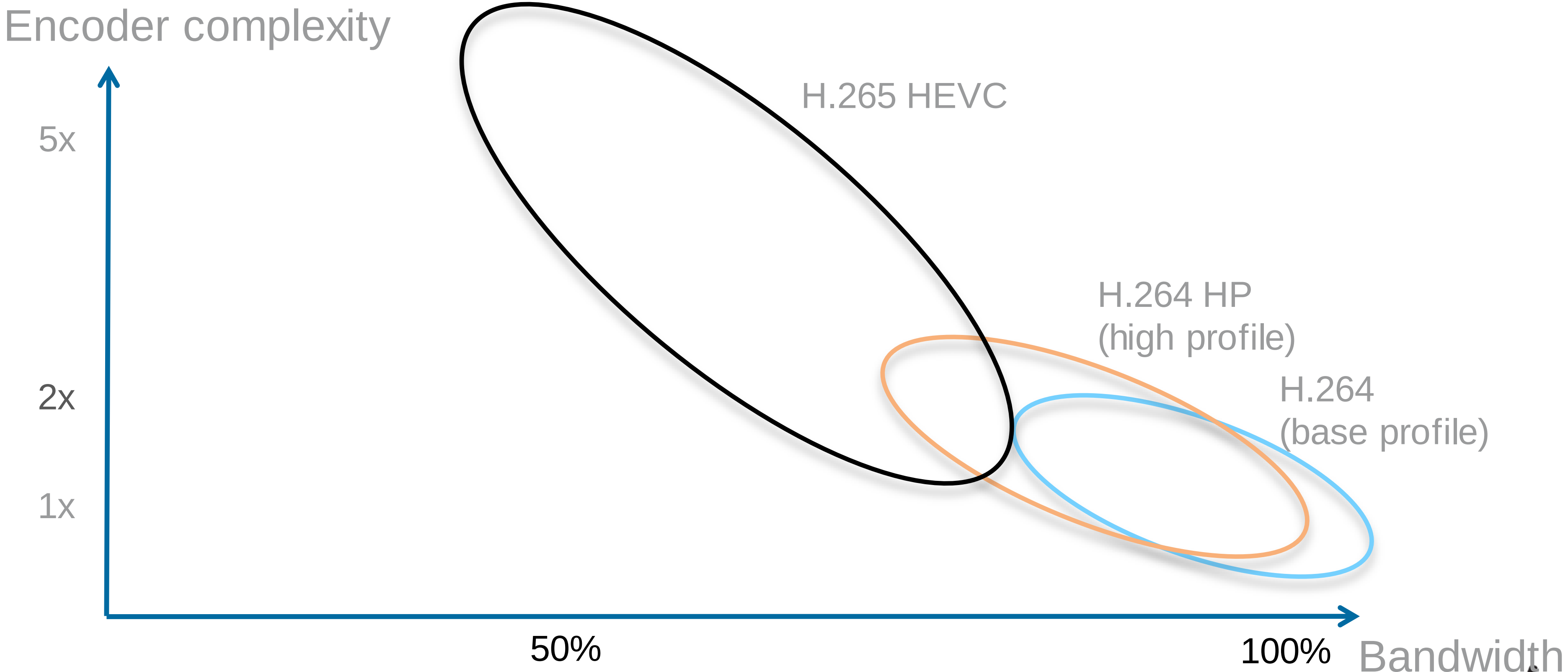
H.265 Compression Performance

- Performance goal for H.265 Main Profile
  Same quality as H.264 High Profile with 50% bandwidth reduction
- Depends on:
  - Content
  - Encoder implementation
- Subjective tests using reference software: >50% BW reduction
- Estimates from chip manufacturers: 30%-40% BW reduction

H.265 Complexity

- Complexity estimates (H.265 vs. H.264):
  - Video encoder: 1x – 5x
  - Video decoder: 1x – 2x
- Depends on:
  - Implementation of encoder
  - Compression-complexity trade-offs in encoder

H.265 Encoder Complexity



H.265/HEVC: The State of Play

Windows 10

Why Will Transition to H.265 Take Time?

- New endpoint HW required, no easy SW upgrade for efficient H.265 deployment
  - Due to complexity in processing and trade-offs of encoding tools for H.265 it will require higher performing processors than exists in install base endpoints.
- A total solution required for efficient utilisation of H.265
  - H.265 needs to be supported for SW clients, conferencing (transcoding and switching), 3rd party interop
- Implementation of H.265 encoding tools take time to develop
  - Standard defines the decoder and bit stream format
  - Encoder not specified
  - Encoder optimisation takes time, HW evolves
  - Many additional Profiles will be added (e.g. SVC, MVC)

Summary

- H.265 claims to cut BW requirements by 50%
  - Improved quality by doubled resolution at the same bandwidth as of today
  - Same quality experience at half the network cost
- Things take time
  - Will not see this effect immediately – available in 2014, improving in 2015, common by late 2016
  - Need new HW platforms – and we are seeing these emerging now
  - Encoder optimisation is time consuming
- “Do it right the first time!”

Scalable Video Coding (SVC) and Simulcast for H.265 & H.264

Scalable Coding

- Encode a high fidelity source using multiple layers of increasing fidelity

Base Layer with lowest fidelity	360p 30Hz 0.3Mb/s
Spatial Enhancement Layer to increase resolution	**720p** 30Hz 1.0Mb/s
Temporal Enhancement Layer to increase frame rate	720p **60Hz** 1.5Mb/s
Quality Enhancement Layer to increase bit rate	720p 60Hz **2.0Mb/s**

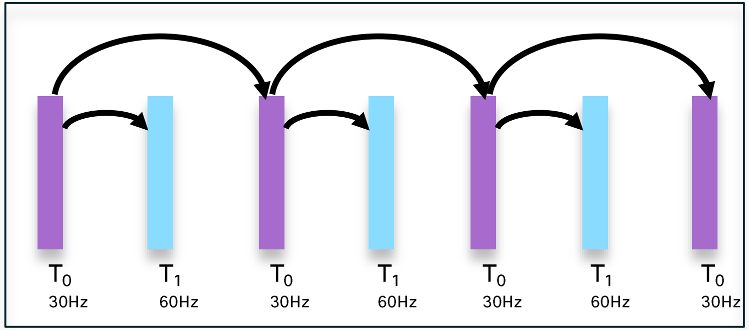
- Main motivation is scalable conference servers
  - Switching vs. transcoding, trading flexibility for scale and speed

- Other benefits include rate adaptation and error resilience
- Drawbacks include interoperability and lower coding efficiency

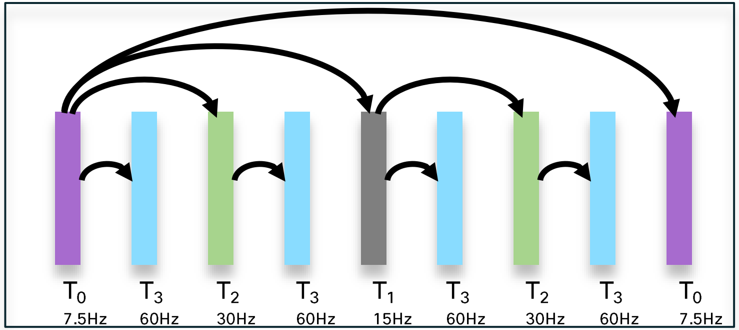
Temporal Scalability

- Supported in H.265 HEVC and H.264 AVC without SVC/SHVC extensions
  - H.264 SVC merely adds temporal layer identification headers for easier parsing
  - H.265 HEVC has temporal layer info in standard headers even without SHVC

Simplest example with 2 layers: $T_{0/1}$=30/60Hz

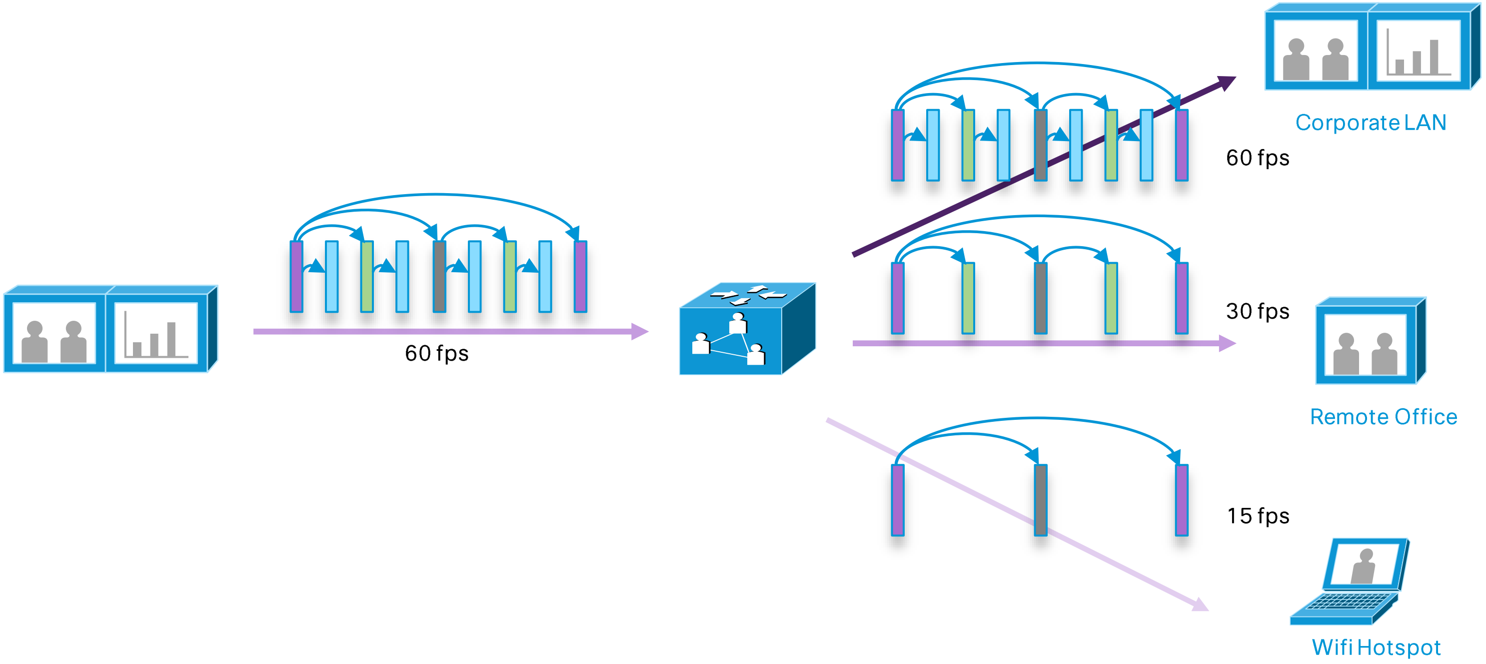


Example with 4 layers: $T_{0/1/2/3}$=7.5/15/30/60Hz



Mult iple Fra me Rat

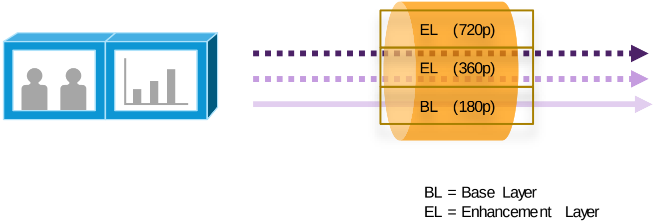
Conference with Multiple Frame Rates

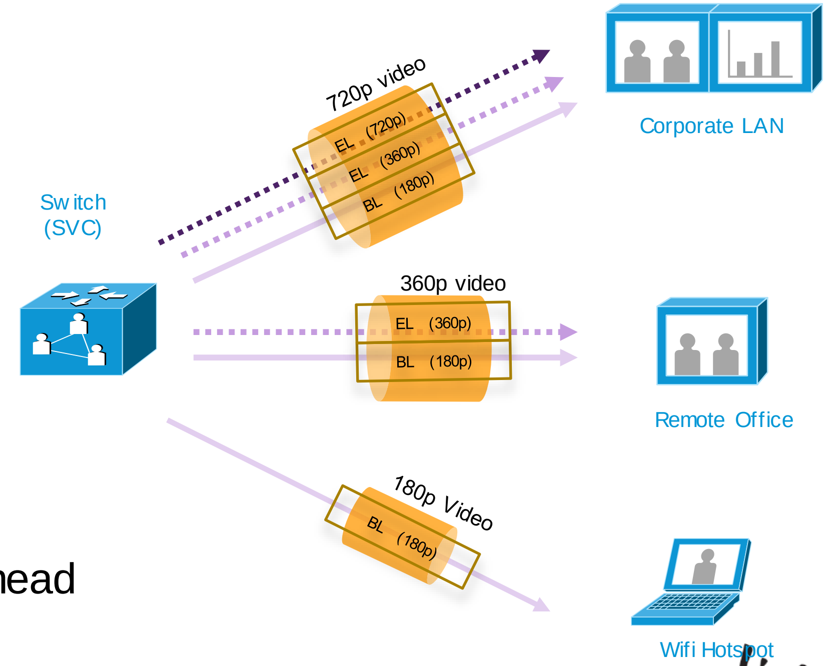


4 Temporal Layers: 7.5/

Spatial Scalability

- Supported in H.264 SVC (Annex G)
- Planned in H.265 SHVC (in progress)
- H.265 SHVC will support a base layer of H.265 HEVC or H.264 AVC

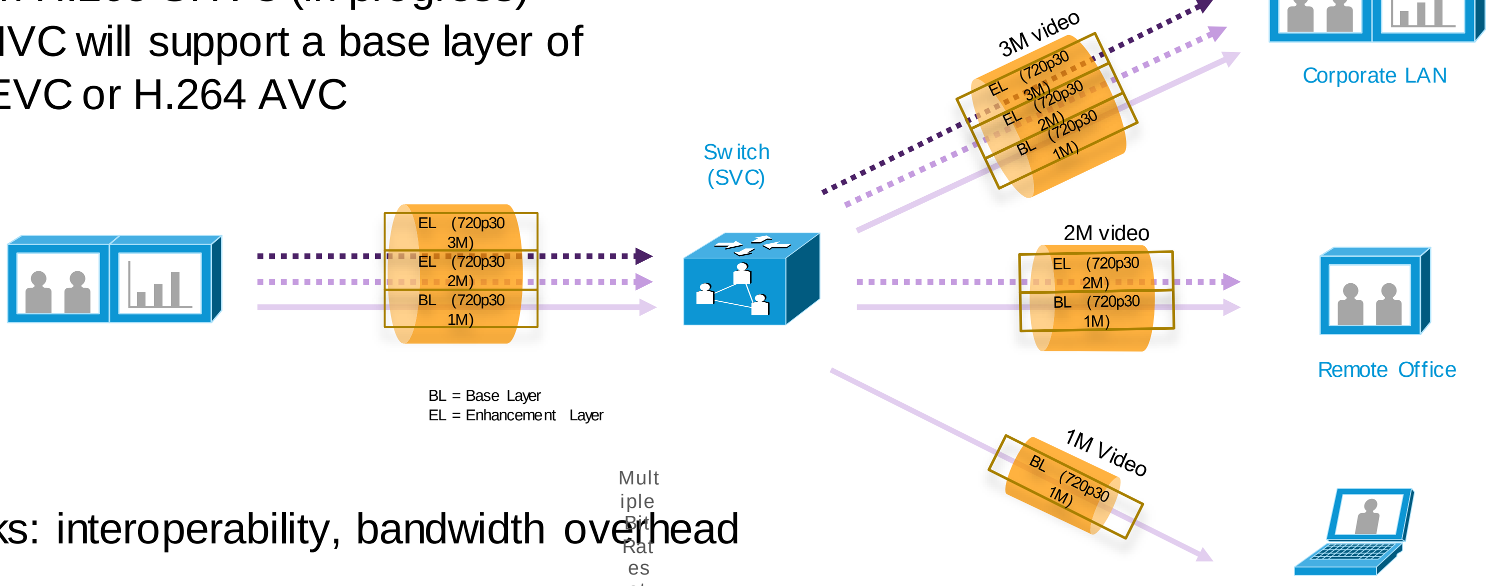




- Drawbacks: interoperability, bandwidth overhead

Quality Scalability

- Supported in H.264 SVC (Annex G)
- Planned in H.265 SHVC (in progress)
- H.265 SHVC will support a base layer of H.265 HEVC or H.264 AVC

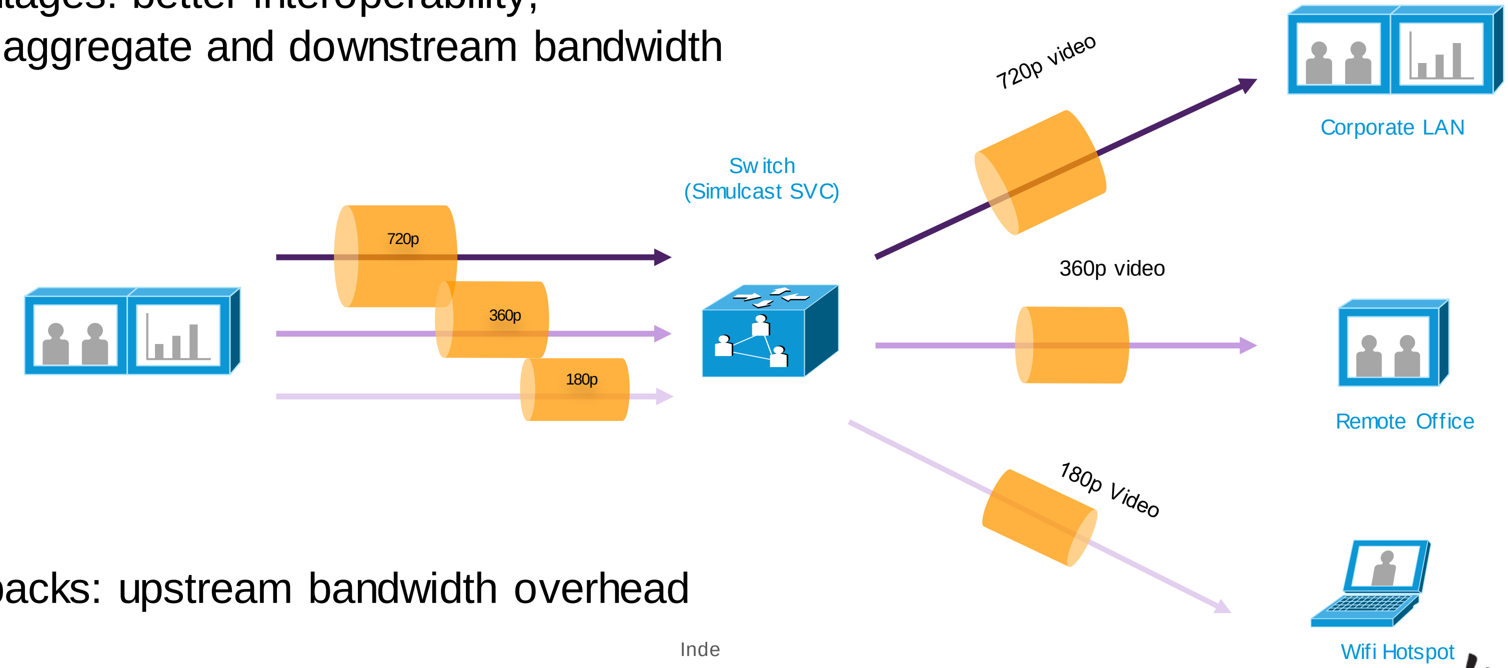


- Drawbacks: interoperability, bandwidth overhead

Multiple Bit Rates at the same Resoluti

Simulcast SVC (SSVC)

- Advantages: better interoperability, lower aggregate and downstream bandwidth



- Drawbacks: upstream bandwidth overhead

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Spat
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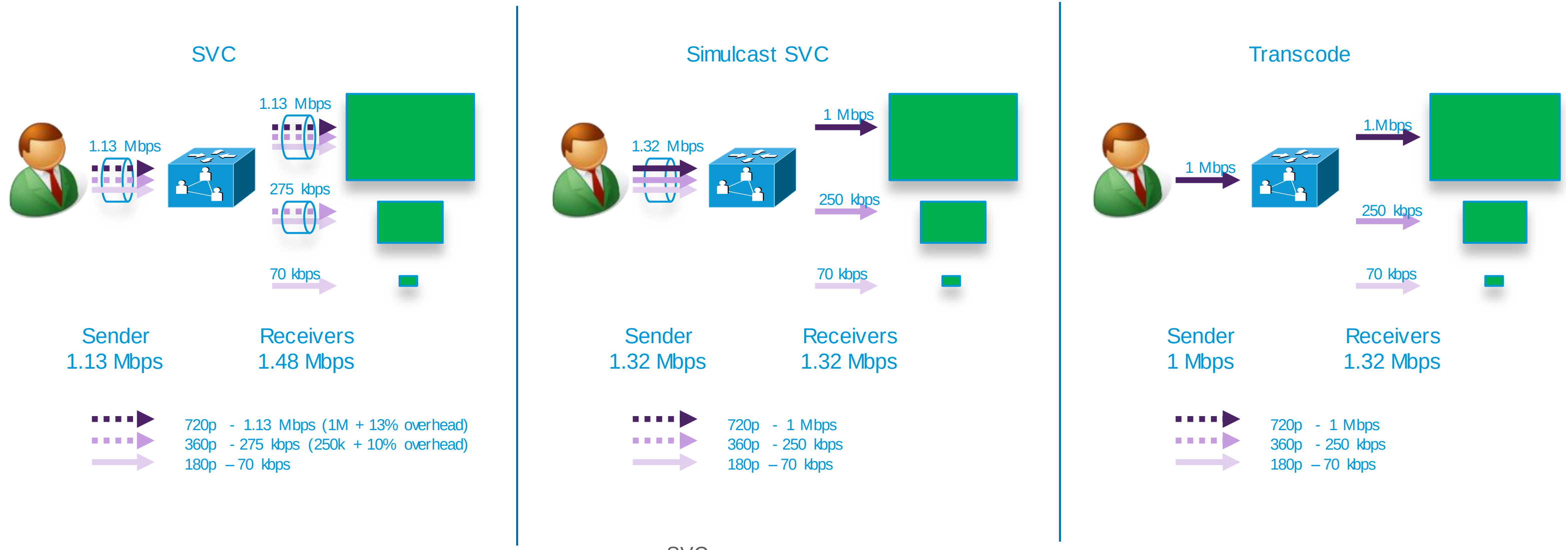
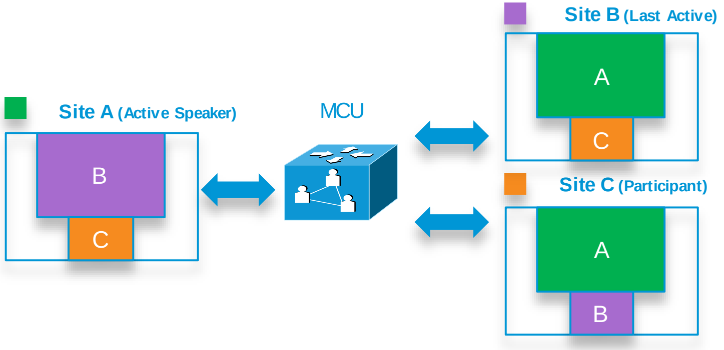
Bandwidth Comparison



SVC, Simulcast SVC, and Tran

Conference Bandwidth Comparison

- Only 2 resolutions, 720p and 360p,
  so only 10% SVC overhead



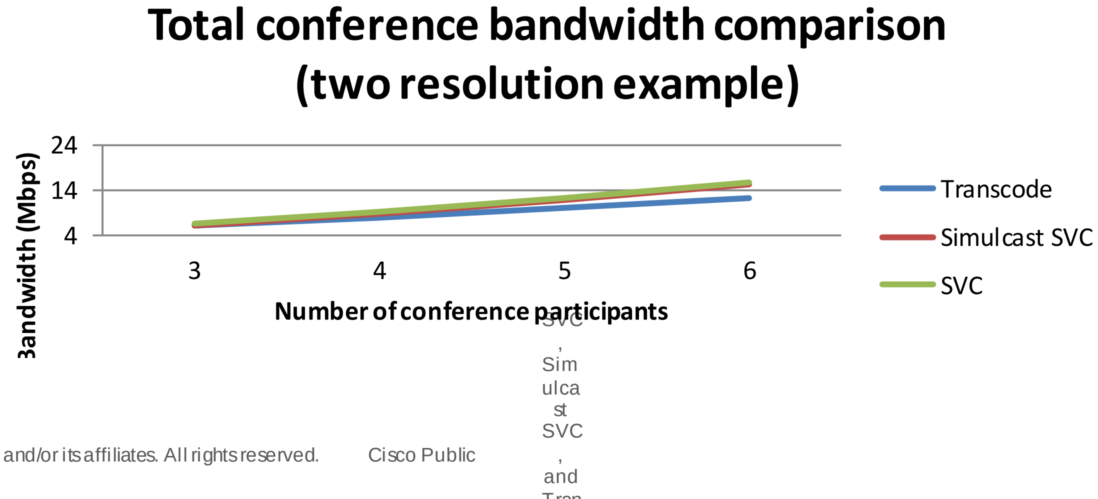
# of site (n)	SVC (Mbps)	SSVC (Mbps)	Transcode (Mbps)
3	6.50	6.25	6.00
4	9.10	8.75	8.00
5	12.20	11.75	10.00
6	15.80	15.25	12.00

SVC BW Values
BL+EL (720p) stream 1.1 Mbps
BL (360p) stream 250 kbps
HD (720p) 1 Mbps
SD (360p) 250 kbps

SVC, Simulcast SVC, and Tran

Conference Bandwidth Comparison

- Conclusions
  - Simulcast SVC can save bandwidth over SVC, while Transcode always uses the least bandwidth.
  - Bandwidth savings grow with conference size. Larger conferences (10-30+) would save significantly more.
  - A hybrid SSVC+Transcode solution can deliver the best of both worlds, giving the scale and speed of switching when possible, as well as the flexibility and bandwidth efficiency of transcoding when needed.



H.264 SVC in the Video Conferencing Industry

B2B & Intra-Enterprise Interoperability?

Cisco webex

Microsoft Lync 2013

Polycom

H.264 SVC Status and Challenges

- An emerging standard with benefits for balancing quality and bandwidth
- Loosely defined – each vendor has a different SVC implementation
- No backward compatibility - H.264 AVC is the industry norm
- Cisco H.264 SVC interoperability tested with Microsoft Lync 2013

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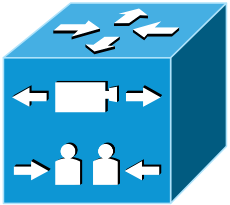
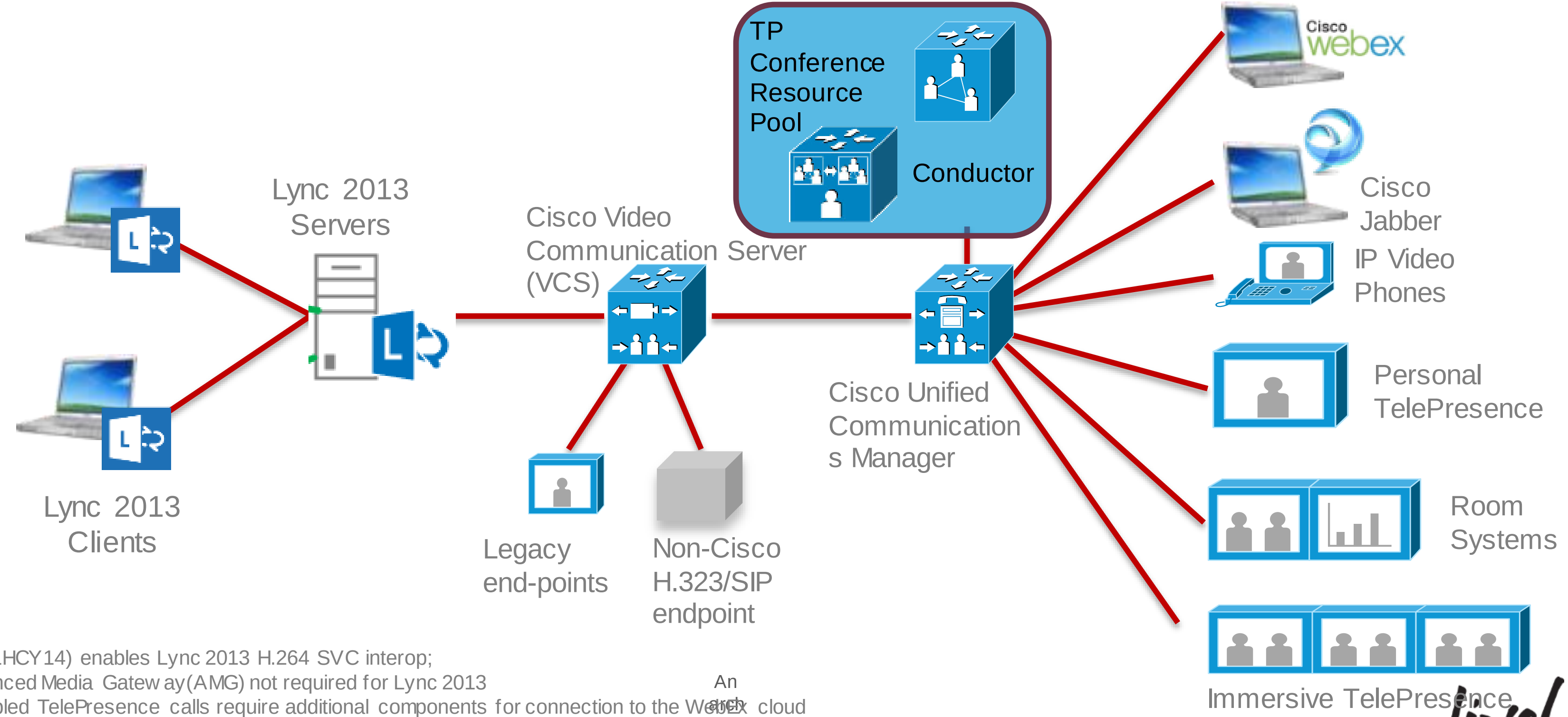
H.264 SVC In the Industry

- Cisco WebEx has used H.264 SVC video for five years
- Cisco Video Conferencing Codecs (TC Software) all support native H.264 SVC as well as H.264 AVC
- Cisco VCS Control and VCS Expressway Plus the Cisco Expressway series all support H.264 SVC to AVC gateway functionality

Cisco webex



Example: Microsoft Lync 2013 Interoperability



VCS X8.1 (1HCY14) enables Lync 2013 H.264 SVC interop;
Cisco Advanced Media Gateway (AMG) not required for Lync 2013
WebEx enabled TelePresence calls require additional components for connection to the WebEx cloud

An architectural approac

Summary

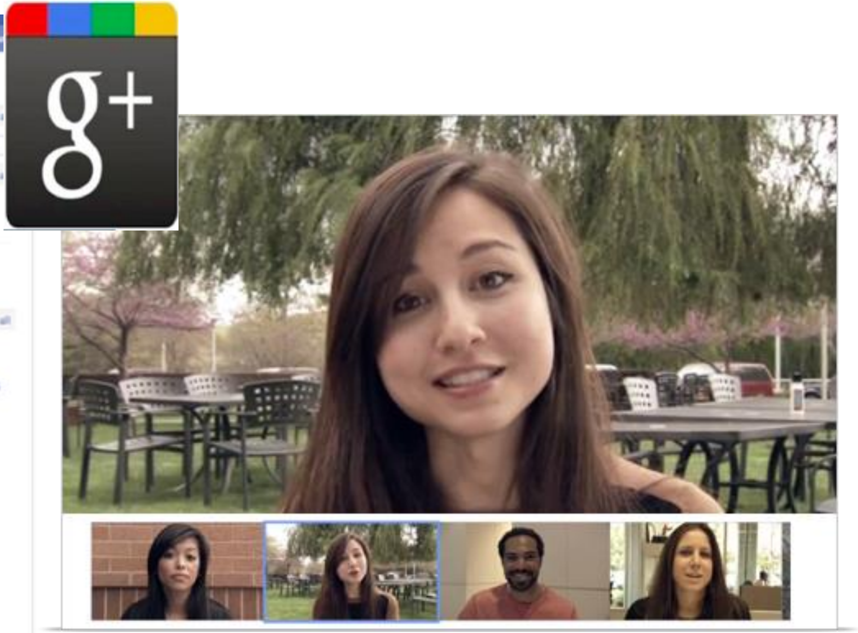
- H.264 SVC has been plagued by loose interpretations of the standard leading to interoperability issues
- H.264 SVC alone does not lead to bandwidth savings in most video calls
- H.264 Simulcast SVC can lead to aggregate bandwidth savings and larger scale in larger and more complex call scenarios
- SVC will continue to be an important component going forward and will soon be seen in H.265 implementations.

WebRTC – The Emerging Endpoint

About WebRTC

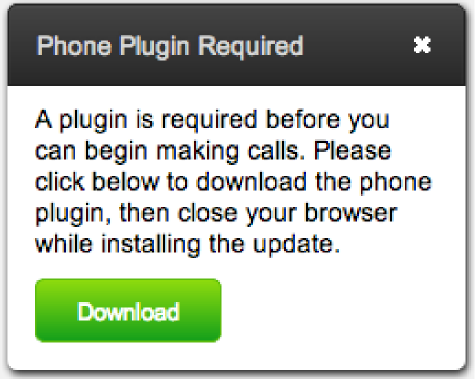
- What is WebRTC:
  - WebRTC is an API definition being drafted by the World Wide Web Consortium (W3C)
  - It is a free, open project that enables web browsers with Real-Time Communications (RTC) capabilities via simple JavaScript APIs
- What is the merit of WebRTC:
  - WebRTC enables applications such as voice calling, video chat and P2P file sharing inside the browsers without plugins (or separate clients)

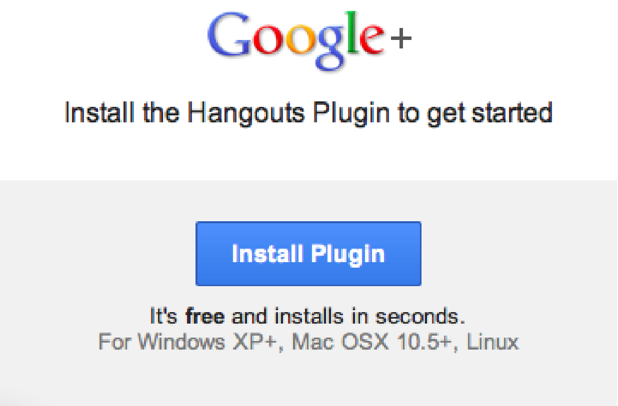
Interactive Voice and Video in your Browser Today…

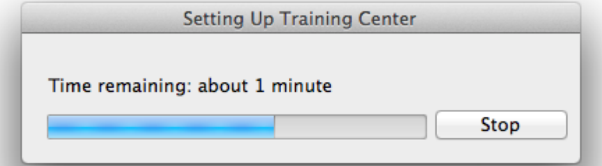


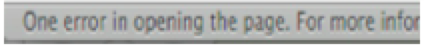
But…

- Proprietary – no interoperability
- Requires 3rd party plugins
- Difficult to deploy (permissions, etc…)
- Not available on all platforms



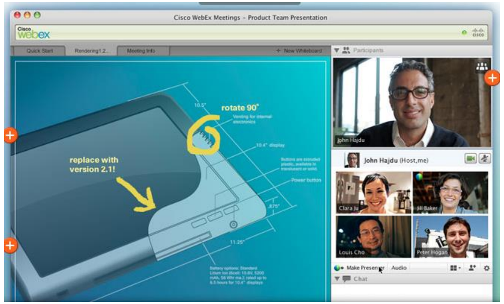


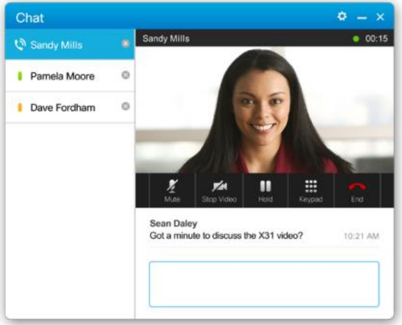




UC/Video Is Not Broadly Deployable Today in Browsers Alone

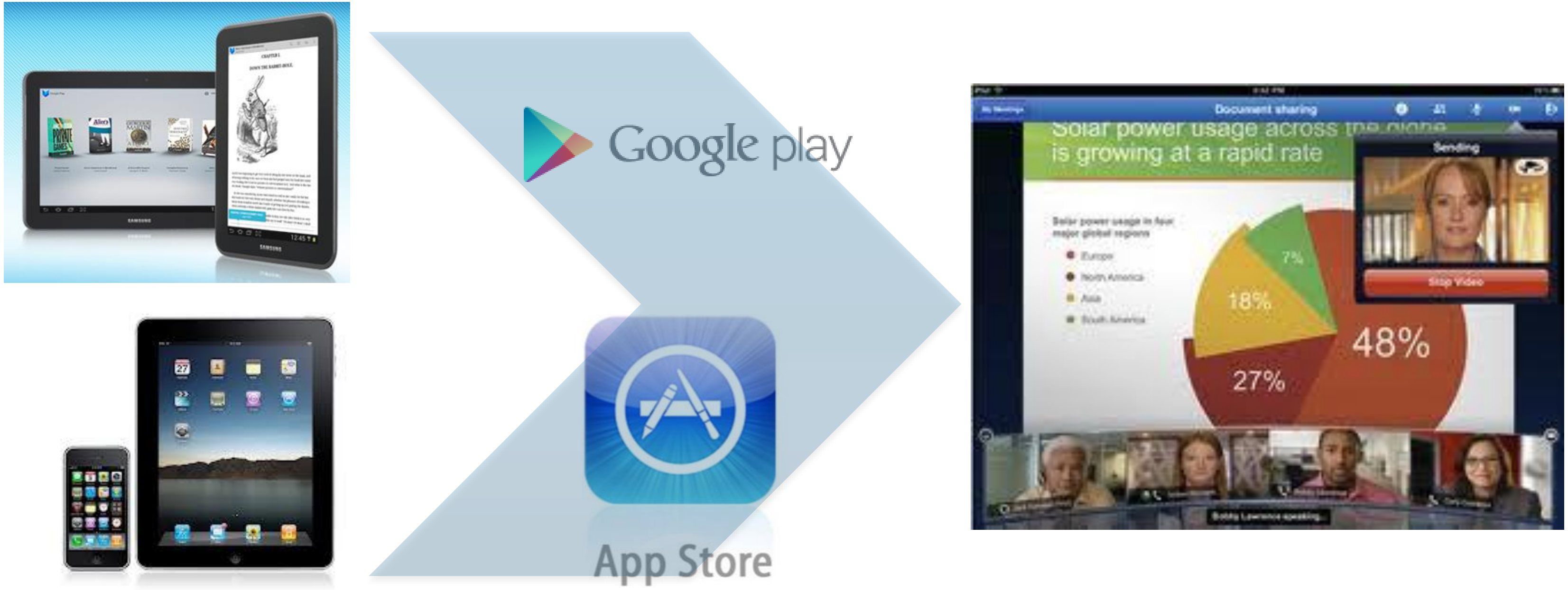
- Plugins or native apps that browsers can launch are required





And Mobile Browsers Are Not Extensible

- Native mobile apps are required



… But Notable UC/Video Capabilities Missing from Browsers

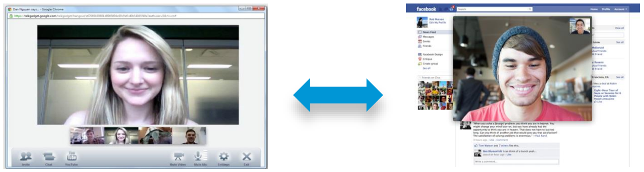
Plugins and native apps fill these gaps

- Softphone engine
- Real-time voice codecs
- Real-time video codecs
- Real-time data/content sharing
- Call signalling
- Media encryption
- Ability to send media to other endpoints
- Notifications
- Firewall traversal negotiation
- Peripheral controls
- System activity detection

Key Features

- Media Stream:
  - WebRTC can carry a media source containing one or more synchronised Media Stream Tracks
  - Media should be converted to URL to be played by HTML5
  - Get User Media: for capturing video and audio from webcam and microphone

- Peer Connection: high quality peer to peer easy audio/video calls
  - Peer-to-peer
  - Codec Control
  - Encryption
  - Bandwidth Management



- Data Channels:
  - p2p application data transfer (not supported by any browser yet)

What Does This Mean?

- It means standalone audio-video chat clients (e.g., Skype) can be replaced with browser based clients
  - No need to install any more applications. Browsers will do the job
- Once Data Channel feature is also implemented by browsers remote desktop, file transfer, gaming, real time text chat, and many other apps would become possible just from within the browser

What is the Gap?

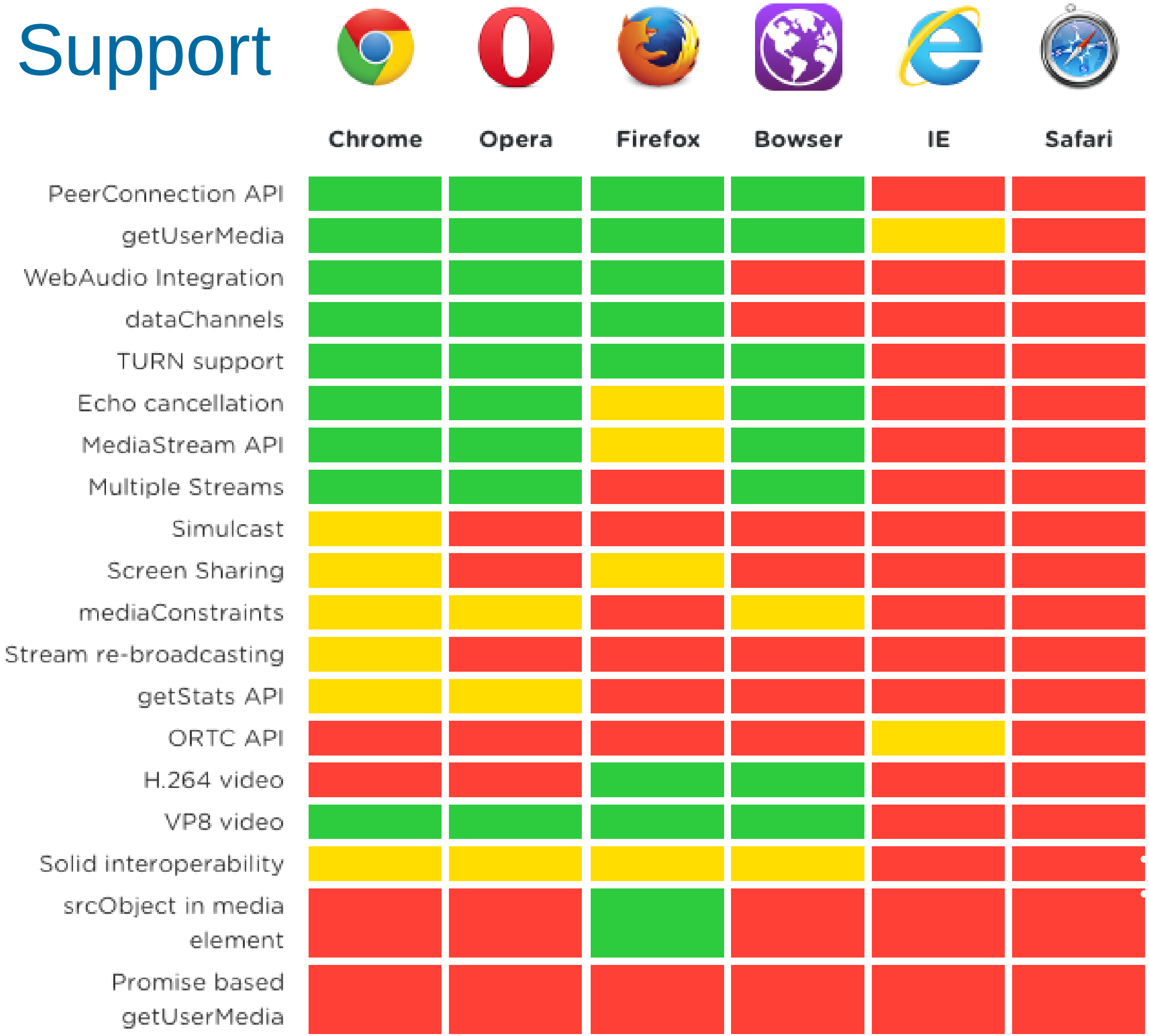
- Initiating the session is not a part of WebRTC.
- Checking for presence is not part of WebRTC
  – Session initiation and Presence should be taken care by the application that embeds WebRTC
- WebRTC is peer-to-peer architecture not One/Many-to-many (multicast, broadcast)
- Third party libraries provide signalling capabilities
  – CaféX (Fusion Client SDK) provides a rich SDK that includes libraries for SIP so applications can easily conduct the session initiations.

What Else Becomes Possible?

- Combining with other web technologies will open new doors
- WebGL and HTML5 combined with WebRTC can make an entirely new web experience
  - Example: Applying video effects on live streaming video

<u>All of these will be possible at really low cost</u>

Browser Support



Source: iswebrtcreadyyet.com

WebRTC Standards

Good Progress on Technology Agreement

CONVERGING

- Audio Codecs … G.711, Opus
- Video Codec(s) … VP8 + H.264
- Signalling … SDP-based offer/answer using JavaScript
- Firewall/NAT Traversal … ICE, STUN, TURN
- Media Encryption … DTLS-keyed SRTP
- Media Consent … ICE/STUN
- Identity … identity provider model
- QoS … DiffServ Code Point markings to enhance WiFi, residential GWs, LTE links

Though Some Significant TBDs

In Works

- Congestion Control … goals = minimise latency, quick reaction, consistent data flow
- Screen/Application Sharing
- Multiple end points
- Webcasting
- Etc …

WebRTC / RTCWeb - Standards Efforts

- RTCWeb Working Group
  - Primary effort in IETF
  - Cullen Jennings of Cisco is co-chair
- Defining how browsers communicate with others … largely re-using existing protocols
- Notable documents …

draft-ietf-rtcweb-audio
draft-ietf-rtcweb-data-channel
draft-ietf-rtcweb-jsep
draft-ietf-rtcweb-overview
draft-ietf-rtcweb-qos
draft-ietf-rtcweb-rtp-usage
draft-ietf-rtcweb-security-arch
draft-ietf-rtcweb-use-cases-and-requirements

Cisco Playing Key Role

- WebRTC Working Group
  - Primary effort in W3C
  - Cullen Jennings of Cisco co-authors draft
- Defining how Web applications access browser real-time communications, i.e. API's
- Notable documents …
  - WebRTC 1.0: Real-time Communication Between Browsers
  - Media Capture and Streams
  - Media Capture Scenarios

WebRTC Video Codec MTI Debate

- MTI = Mandatory to Implement
- Google proposed VP8 codec
- Other industry players proposed H.264
- 2 year standoff
- November 2014 decision – BOTH codecs are MTI

WebRTC is Real

appear.in

talky

Project Squared

Next Steps for WebRTC

- Standard needs to continue to develop
  - Screen sharing
  - Multi-participant sharing
- Gateways to SIP and H.323 environments
- IE and Safari adoption!

Q & A

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