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TNO report

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Inter-Destination Media Synchronization, now standardized by ETSI TISPAN

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Project number 035.32574 (Celtic Rubens)
Key words Synchronization, Social TV, ConnecTV, ETSI TISPAN, IPTV, IMS-based IPTV, Integrated IPTV, Standards

Summary These are the slides presented at a colloquium at the Dutch Centrum Wiskunde & Informatica on 18 May 2010, 11:00-12:00.

Inter-Destination Media Synchronization (IDMS) is a set of technologies to synchronize media content at multiple TVs. Social TV is an important application of IDMS. Social TV enables friends to watch a TV program together from different places, while communicating with each other using text, voice and/or video. However, the "watching-apart-together" experience is severely disturbed if you hear your friends cheer for a scored goal in a life TV football match, and only some moments later you see it on your own TV. Unfortunately, such delay differences are quite common in digital TV networks, hence IDMS.

Technologies for IDMS have been standardized by the international standardization body ETSI TISPAN. Dr. van Deventer has been one of the main contributors to this standard. In his presentation, Dr. van Deventer will provide some background on the ETSI IPTV standards and explain the architecture and protocols for standardized IDMS. The key network elements for IDMS are the Synchronization Client (SC) and the Media Synchronization Application Server (MSAS). Protocols like SIP, RTSP and HTTP are used to initiate IDMS sessions. An extension of the RTCP protocol is used to exchange synchronization information between SC and MSAS.

The presentation concludes with some application examples for IDMS, like IDMS directly between TVs, large-scale IDMS with SCs in the network and the impact of transcoders between different types of TV distribution networks, e.g. fixed and mobile TV's.

M. Oskar van Deventer, TNO, Netherlands
Dr. M. Oskar van Deventer is senior scientist on network and service control. His focus is on the realization of national and international standards. He has been active contributor and editor of several ITU-T and ETSI standards, most

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recently the ETSI TISPAN standards on IMS-based IPTV. He was also chairman of Dutch taskforces on VoIP and ENUM. He has won several international awards in the area of Mobile Gaming. His current focus is f IPTV systems and Content Delivery Networks. He is (co)author of one book, more than 90 publications, over 40 patents applications and over 300 standardization contributions.

Inter-Destination Media Synchronization

Now standardized by ETSI TISPAN

Dr. M. Oskar van Deventer
Ir. Hans Stokking
Dr. Omar Niamut
Fabian Walraven, MSc

ETSI tispan

TNO

About

TNO: Innovation with ICT

- TNO Information and Communication Technology (ICT) is a 350-employee not-for-profit Dutch research institute. Its mission is to bring innovation to small and large businesses. Expertise includes telecommunication and content delivery networks, network planning and performance analysis, application development, security, but also business modeling, usability and predicting the success of innovations.
- One of TNO's focus points is innovation in television and interactivity. TNO contributes actively to OMA BCAST and ETSI TISPAN standardization of interactive mobile TV and IMS-based IPTV.

www.tno.nl/telecom

Oskar van Deventer

Dr. M. Oskar van Deventer is responsible for the IMS&IPTV project, in which new services are created that combine content with communication. In order to see vision turned into reality, he is actively contributing to ETSI TISPAN standardization of IMS-based IPTV. He has been (co-)author of over 100 international publications, over 350 standardization contributions and several Dutch and international standards in the areas of voice-over-IP and IPTV. His creativity has led to over 40 patent applications and to the award-winning location-based mobile game "Triangler".

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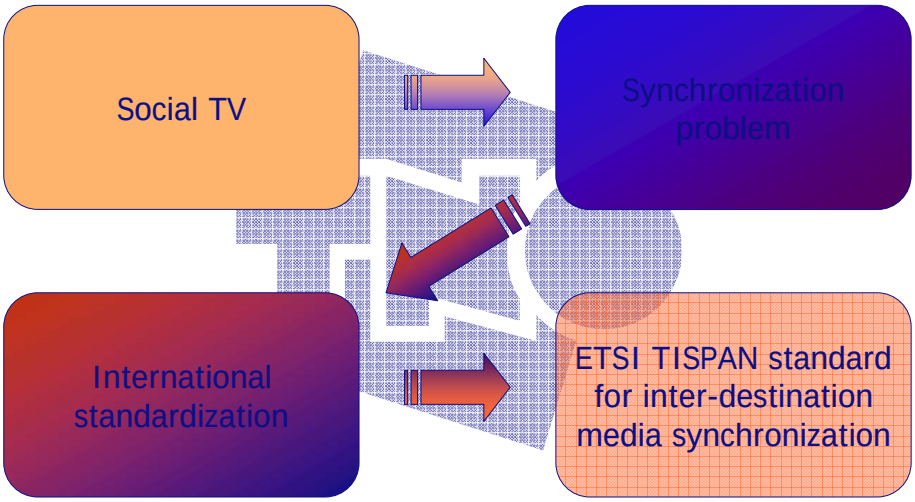
Social TV requires synchronization standard



Social TV ...

- Humans are social beings. We want to interact and communicate with others, so we can share our experiences.

- Nowadays, watching television has become an individual experience.

- Imagine that you can share your TV experience with others, even if they are separated in location and time...!

... with the push of a button

- This is **not** Joe Average in front of his TV...

This is!

- Social TV starts by using only the remote control

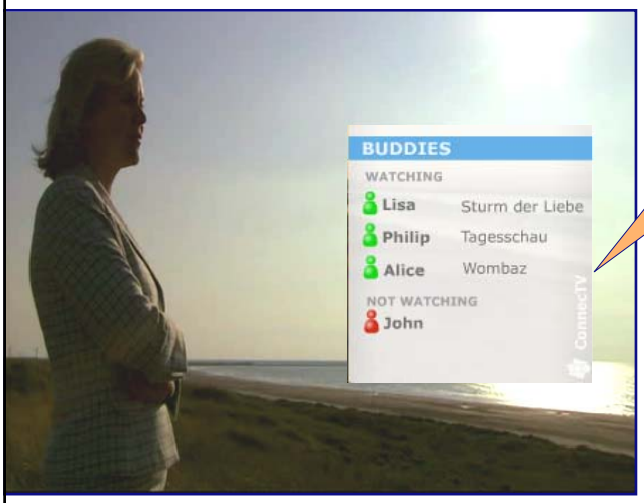
ConnecTV offers social TV using just the remote

So you can ...

- Feel connected by seeing what programs your buddies are watching
- Share your TV experience by sending and receiving program recommendations
- Show that you care by recording and playing content for and from others
- Enjoy many more services that are easily added ...

All with a simple user interface, using just the remote

ConnecTV: See what buddies are watching



My buddy list shows who is watching TV...

Social TV

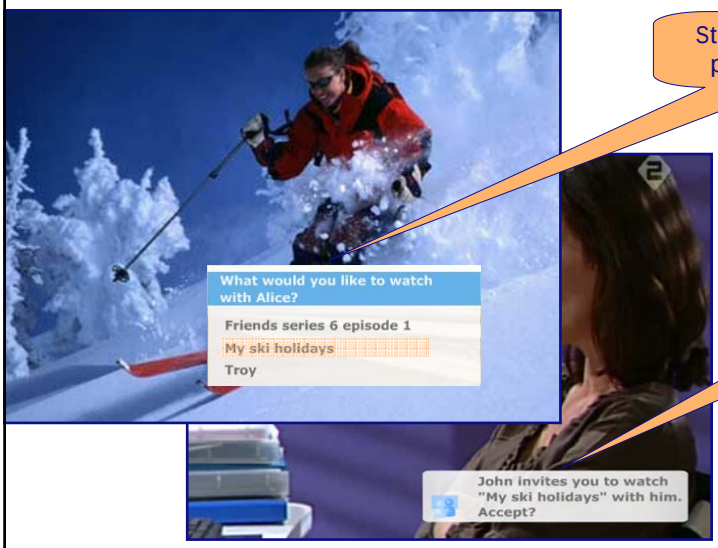
ConnecTV: Send and receive program recommendations

... so I can send a recommendation if I'm watching an interesting program...

... and see when my buddy accepts the recommendation!

Social TV

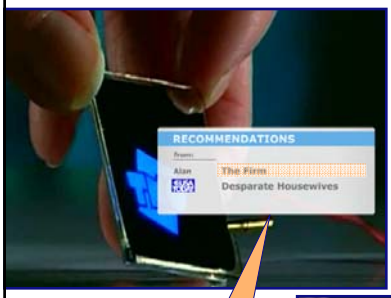
ConnecTV: Record and play content for and from buddies



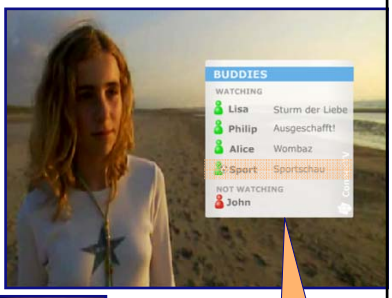
Store my recorded or personal content...

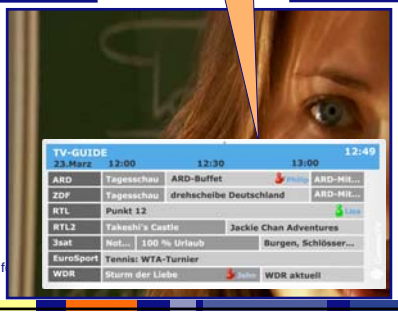
... and share it with my budddies!

ConnecTV: … and many more services!



…schedule a movie with my buddies using the Program Guide…





Receive recommendations even if I am offline…

…get recommendations from my Sport Buddy.

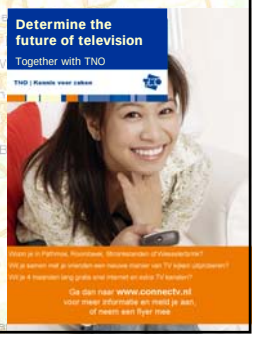
ConnecTV is a proven concept

- One of the most extensive field trials of its kind
  - tested in 52 households
  - 9 groups with 4-10 interrelated friends
  - from September till November 2007

Enschede

TNO has shown that:

- **ConnecTV** increases social interaction
  - Buddy list (2.3x per TV session)
  - Recommendations (47% accepted)
  - Watching together (90% accepted)
- **ConnecTV** stimulates communication via other channels (sms, calling, etc.) and increases the sense of connection between buddies



Participants value **ConnecTV**

Results and quotes from survey:

- 50% of users want to use improved version of ConnecTV
- 50% of users do not mind advertisements

"It is not an intrusion of my privacy. I actually learn to know my friends better."

"Although a few bugs, it is a nice service."

"Knowing what my friends are watching is fun."

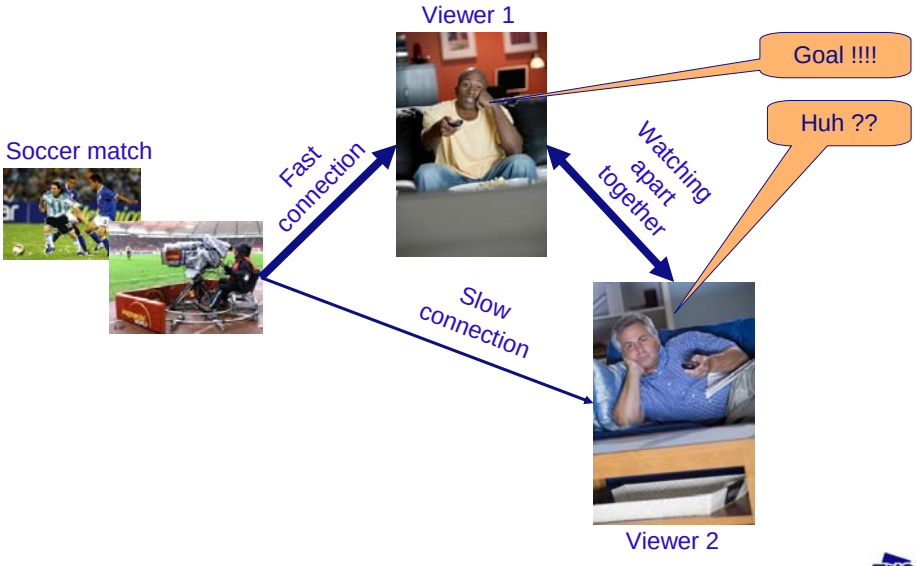
"Nice add-on to television."

"Set-up of the service is good but still very limited."

"No added value for what I'm willing to pay money."

"Where is the chat-functionality? If a buddy is online I want to chat with him."

Social TV requires synchronization



Analysis suggests significant delays

Delays		Typical delay range (ms)
Source	Video capture	17 - 40
	Video encoder	50 - 2000
	Encryption	0 – 50
	Error protection	0 – 100
	Output stream buffer	50 - 500
Uplink	Transmission	10 - 300
Processing	Transcoder	0 - 2000
Downlink	Transmission	10 - 300
Home	Input jitter buffer	50 - 500
	Error correction	0 - 100
	Decryption	0 - 50
	Decoder	50 - 500
	Display buffer	0 - 50
Total		**250-6500**

Source:
M. Oskar van Deventer, Hans M. Stokking, Omar A. Niamut, Fabian A. Walraven, Victor B. Klos, "Advanced interactive television services require content synchronization", 15th International Conference on Systems, Signals and Image Processing, IWSSIP, Bratislava, Slovak Republic, June 25-28, 2008.

Measuring delay differences

Signal-under-test no.1

Signal-under-test no.2

- Fixed set-up in TNO lab
- Mobile set-up with smart-phone TV for measuring in people's homes

HD progressive camcorder

Measuring delay differences

1. Note camcorder frame number of a specific scene change on each TV using VirtualDub
2. Calculate time difference using camcorder's 25 frames/second

Analogue signal

DVB-T signal

T_0=0.0 sec T_1=1.1 sec T_2=3.3 sec

Significant differences per technology and channel

Channel	Analogue	DVB-T no.1	Diff (sec)
NL1	17.92	16.16	1.76
RTL4	18.16	21.8	-3.64
SBS6	11.72	12.84	-1.12

Channel	Analogue	DVB-T no.1	Diff (sec)
NL1	10.68	7.28	3.4

Channel	DVB-H	DVB-T no.1	Diff (sec)
NL1	17.6	11.92	5.68
RTL4	27.56	21.44	6.12
SBS6	7.08	2.92	4.16

Channel	Analogue	DVB-T no.2	Diff (sec)
NL1	5.64	7.4	-1.76
TV-West	9.4	14.44	-5.04
NL2	0.76	1	-0.24
NL3	5.92	6.08	-0.16

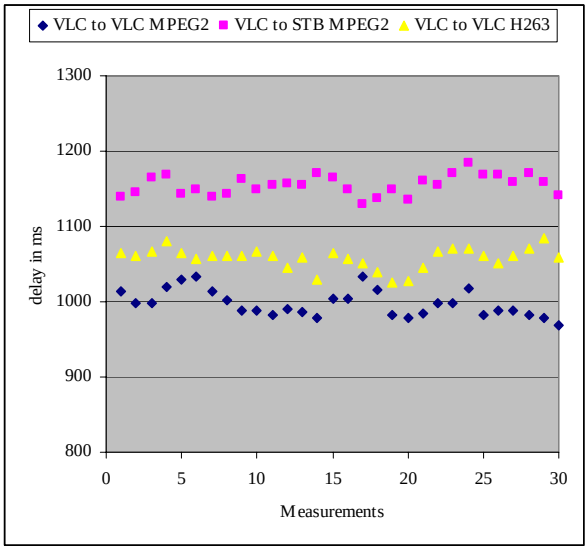
Analogue: Ziggo

DVB-H: KPN via smartphone

DVB-T no.1: KPN Digitenne, tuner

DVB-T no.2: KPN Digitenne, media center PC)

Delay differences seem to vary over time



Source:

M. Oskar van Deventer, Hans M. Stokking, Omar A. Niamut, Fabian A. Walraven, Victor B. Klos, "Advanced interactive television services require content synchronization", 15th International Conference on Systems, Signals and Image Processing, IWSSIP, Bratislava, Slovak Republic, June 25-28, 2008.

ITU standard says: such delay is too much

- ITU-T G.114 standard recommends maximum one-way transmission time for an international telephone connection to achieve transparent interactivity.
  - "if delays can be kept below [150 ms], most applications, both speech and non-speech, will experience essentially transparent interactivity"
  - "delays above 400 ms are unacceptable for general network planning purposes".
- **➔ So several seconds of delay differences will definitely spoil social TV interaction**

Reference:
ITU-T G.114: "General Recommendations on the transmission quality for an entire international telephone connection, One-way transmission time", May 2003.

Some literature on inter-destination media synchronization

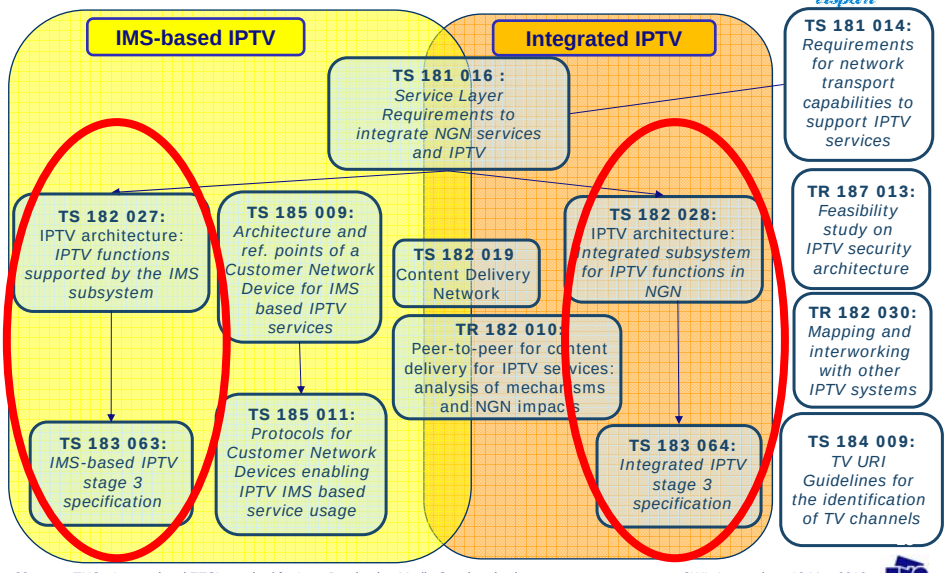
- M. Oskar van Deventer, Hans M. Stokking, Omar A. Niamut, Fabian A. Walraven, Victor B. Klos, Advanced interactive television services require content synchronization, IWSSIP 2008, June 2008.
- O.A. Niamut, J.J.M. Staal, H.M. Stokking, E.M. Boertjes, J. Klok, S. Schultz, Large-scale user trial shows viability of social experience-sharing TV services, IBC 2008, sep 2008.
- Fernando Boronat Seguí, Juan Carlos Guerri Cebollada, Jaime Lloret Mauri, An RTP/RTCP based approach for multimedia group and inter-stream synchronization, Multimedia Tools Appl. 40(2): 285-319 (2008).
- Fernando Boronat, Jaime Lloret, Miguel García, Multimedia group and inter-stream synchronization techniques: A comparative study, Information Systems, Vol 34, Issue 1 (March 2009).
- R. Kernchen, P. Cesar, S. Meissner, M. Boussard, K. Moessner, C. Hesselman, and I. Vaishnavi, Intelligent Multimedia Presentation Delivery in Ubiquitous Multi-Device Scenarios, special issue of IEEE MultiMedia on Mobile and Ubiquitous Multimedia, To be published in April-June 2010.

Many standardization activities on (IP)TV

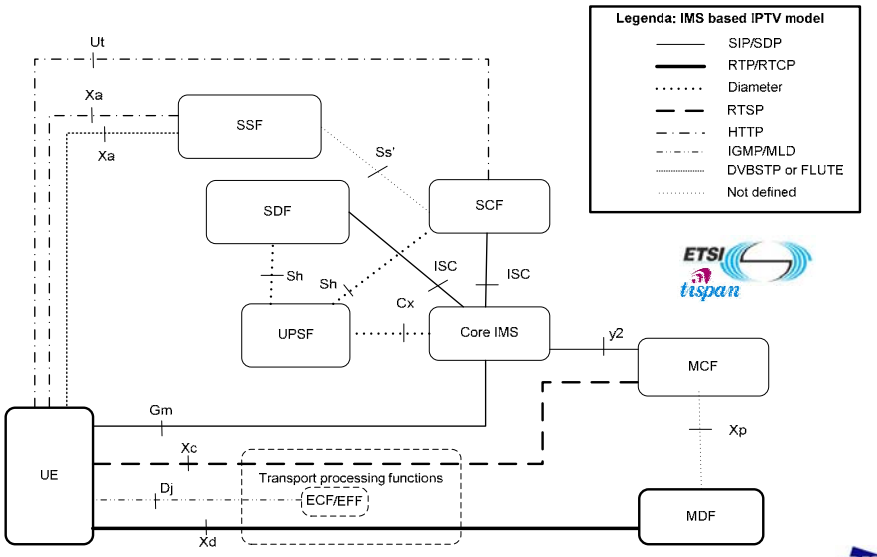
- IETF: Base protocols, like SIP, RTSP, UDP, TCP, RTP, RTCP, HTTP, FLUTE, IGMP, MLD, …
- DVB: Digital TV over fixed lines, mobile and satellite
- 3GPP: Core IMS architecture, MBMS
- ITU-T: IPTV Focus Group
- ETSI MCD: Media Content Delivery
- ETSI TISPAN: IPTV architectures and protocols
  - **Including inter-destionation media synchronization**

ETSI TISPAN IPTV Specifications

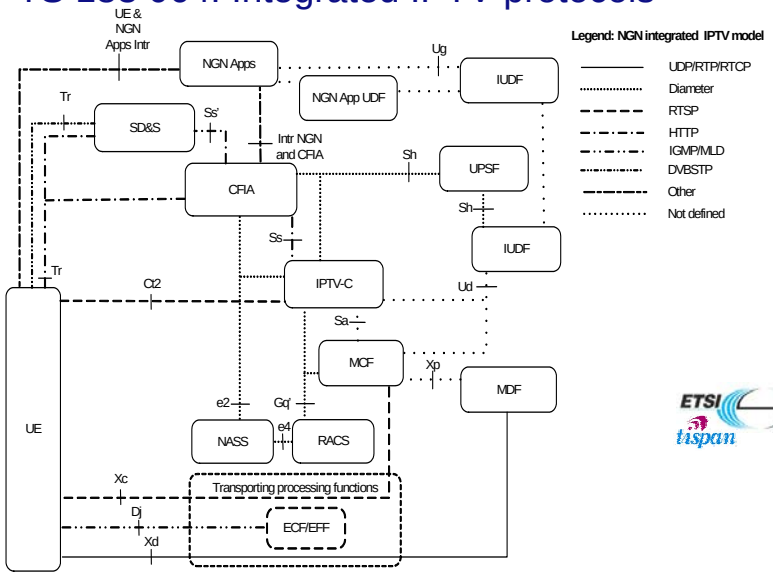
- **Download ETSI specifications for free from http://pda.etsi.org/pda/queryform.asp**



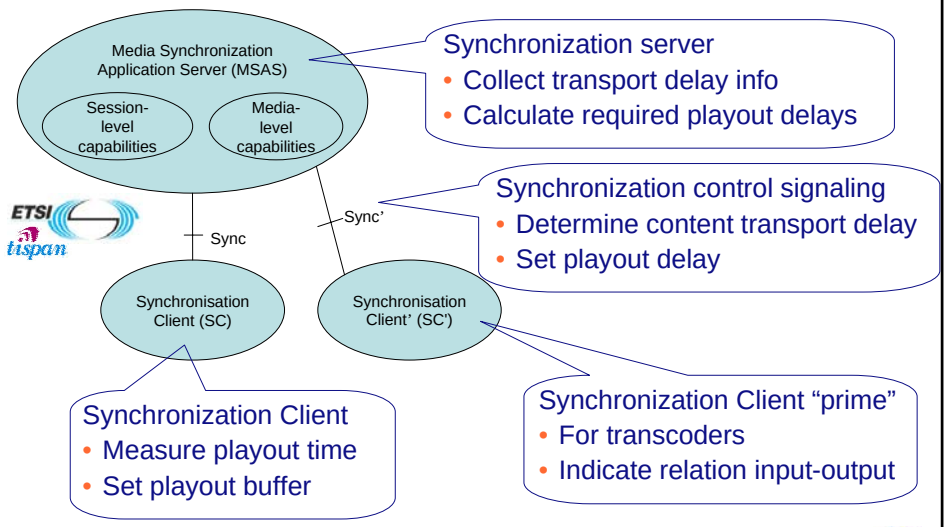
TS 183 063: IMS-based IPTV protocols



TS 183 064: Integrated IPTV protocols



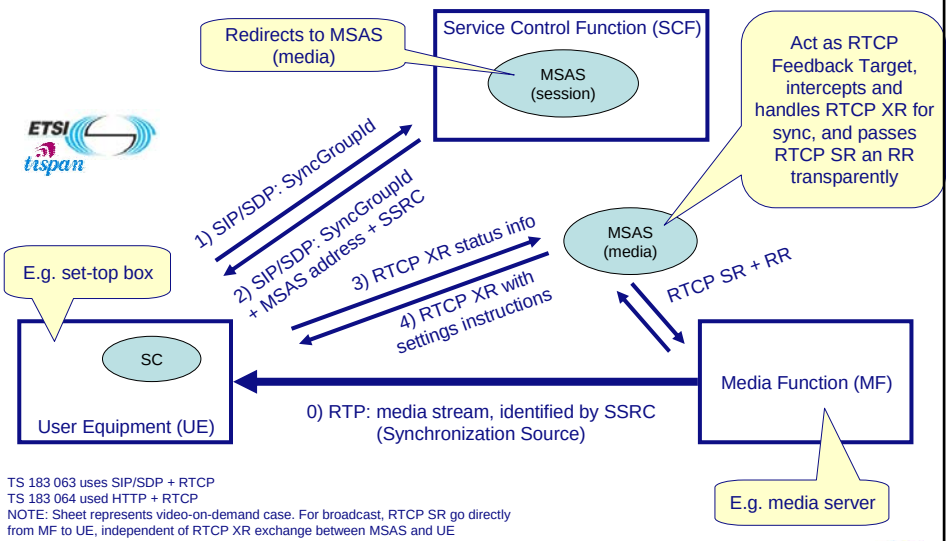
Inter-destination media synchronization (IDMS)



Inter-destination synchronization ingredients

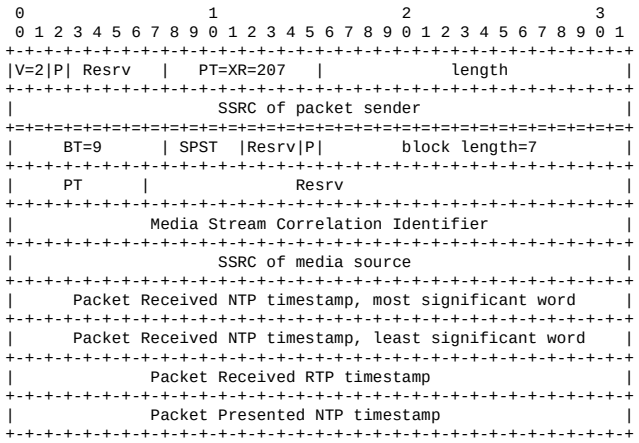
- Determine delays
  - Content time reference in/with broadcast signal
    - Frame number in MPEG transport stream
    - Time stamp or frame number in RTP stream
    - Use of RTCP (c.f. video conferencing)
  - “Absolute” time reference
    - GPS or other radio-based external clock
    - Via Network Time Protocol (NTP)
- Calculate required synchronization correction
  - Slowest link determines playout time
- Communicate delays and corrections
  - Stand-alone synchronization protocol
  - Piggybacking on existing protocols
    - SIP, RTSP, RTP, RTCP, …

SIP/SDP plus RTCP

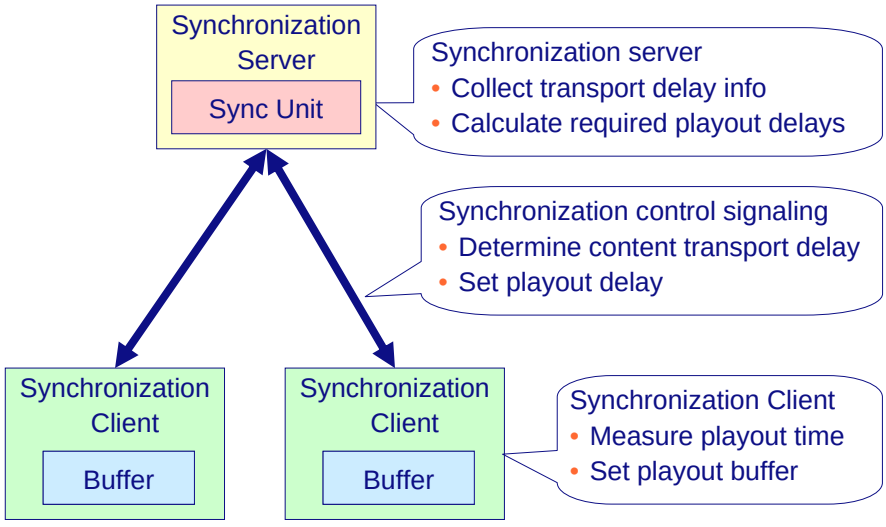


TS 183 063 uses SIP/SDP + RTCP
TS 183 064 used HTTP + RTCP
NOTE: Sheet represents video-on-demand case. For broadcast, RTCP SR go directly from MF to UE, independent of RTCP XR exchange between MSAS and UE

RTCP Extended Report for IDMS

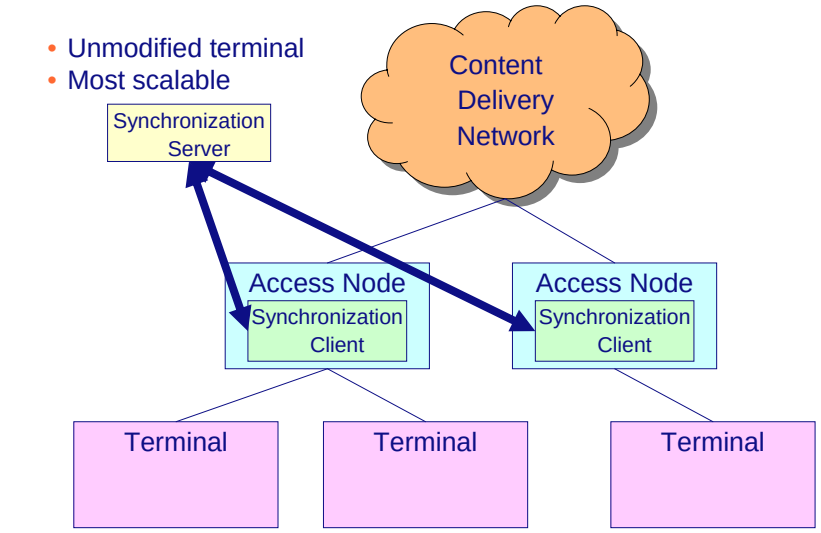


Inter-destination content synchronization



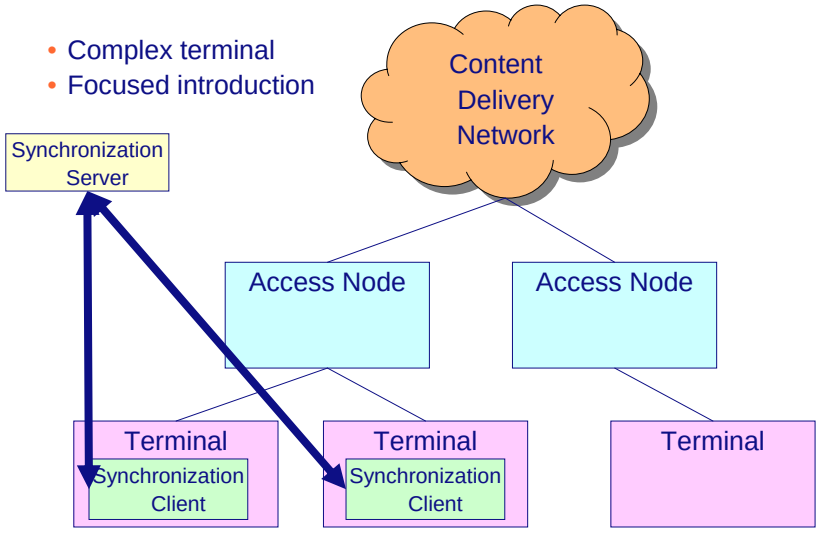
Option 1: Synchronization in the network

- Unmodified terminal
- Most scalable



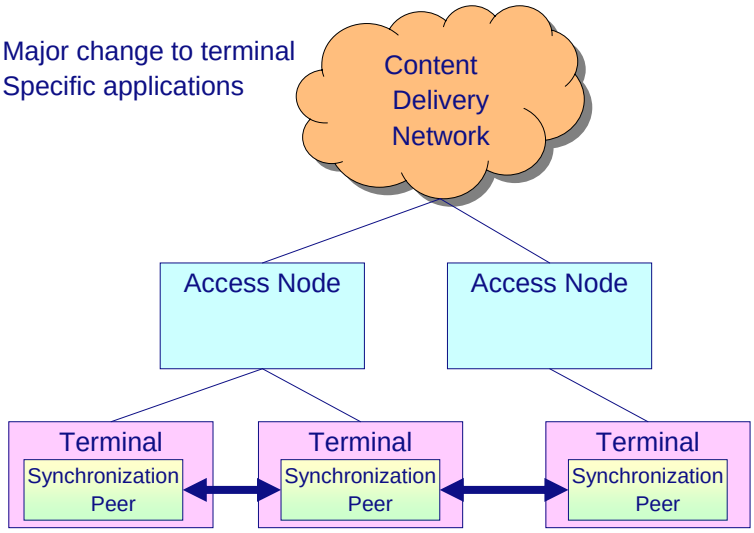
Option 2: Synchronization in (some) terminals

- Complex terminal
- Focused introduction



Option 3: Synchronization on peer-to-peer basis

- Major change to terminal
- Specific applications



Conclusion: IDMS standardized, more needed

- Social TV needs inter-destination media synchronization (IDMS)
  - "Watching apart together", implemented in TNO ConnecTV
  - Delay differences of several seconds in practice
  - Delay differences below 150 ms needed
- Standardized solutions by ETSI TISPAN
  - TS 183 063: SIP/SDP+RTCP for IMS-based IPTV
  - TS 183 064: HTTP+RTCP for integrated IPTV
- Next step: perception tests and implementation of standard
  - Graduate project by Rufeal Mekuria (TU Delft): "Synchronization-reference protocol implementation and prototype"
  - Graduate project (vacancy, see http://www.tno.nl/werkenbij): "Synchronisation reference protocol implementation"
  - Upgrade iNEM4U implementation?