

Do we need new contribution networks for HD?

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„A Hitchhiker's Guide to...Networks”
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Agenda

- The question
- HD network requirements
- HD in broadcaster's networks
- Network adapters
- Conclusions

The question



New
networks?

New network
technologies?

New network
adapters?

New network
structures?

Focus: Production, Contribution

Network requirements (with HDTV)



In principle nothing new: they correspond with the actual requirements for broadcast networks:

- Real-time transmission with very rigid requirements concerning signal quality for contribution
 - Extremely low jitter/wander
 - Low latency
 - No interruptions
 - Extremely low bit error and packet loss rate
- Point-to-point and point-to multipoint connections
- High-speed file transfer between video/audio servers to transport large A/V files faster than real-time
- High availability

Network requirements (with HDTV) (2)



- Flexible networks for access with different or changing bit rates
- Bi-directional connections between servers
- Ease of scalability for the adaptation to increasing traffic
- Transparent transport of different signals
- Interworking between LAN-WAN-LAN without additional coding just for network adaptation (transparent transport)
- Bandwidth requirements will rise with HDTV!

Bit rates in the production



- HD-SDI (SMPTE 292M) : 1,5 Gbit/s
- New HD-SDI Interfaces??? Up to 3 Gbit/s
(2,2 Gbit/s for 1080/P/50) ??? Or even 10 Gbit/s ??
- Compression in the production:
 - 200 - 250 Mbit/s for 1080i/720p
 - 400 – 800 Mbit/s for 1080/P/50 ??

Bit rates in storage



- HDCAM: 112-140 Mbit/s (4:2:2)
- DVCPRO HD: 100 Mbit/s (4:2:2)
- HD-D5: ~ 260 Mbit/s (4:2:2)
- HDCAM-SR: ~ 400 Mbit/s (4:2:2 and 4:4:4), Option: 800 Mbit/s
- HDV-1: 19 Mbit/s (4:2:0)
- HDV-2: 25 Mbit/s (4:2:0)

Source: EBU

A small arithmetic example



Assumption: Production of a movie in HD (uncompressed)

- HD-SDI: $1,5 \text{ Gbit/s} = 0,1875 \text{ GB/s} = 11,25 \text{ GB/Min} = 675 \text{ GB/h}$
- Or in commercially available PC units: 4,2 hard discs/h
- Duration: 90 min
- $\rightarrow 1012,5 \text{ GB} = 1 \text{ TB (Terabyte)}$

\rightarrow The server/storage could be the bottleneck, not the network (depending on the stored format)!

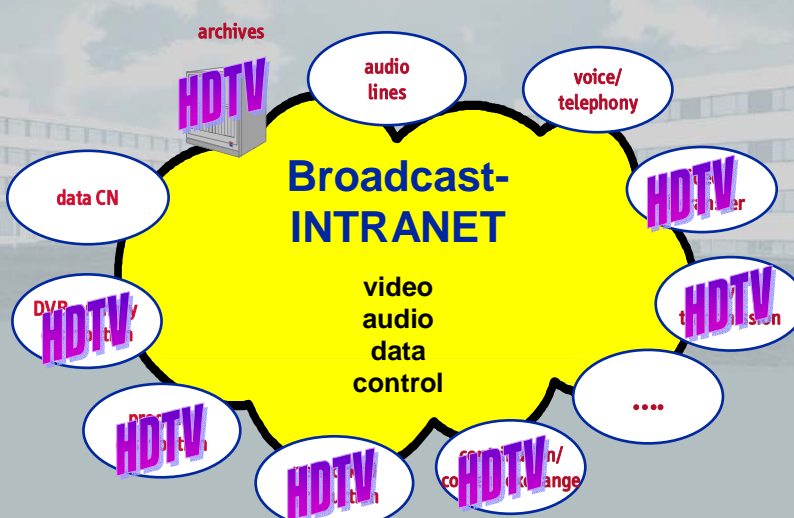
HDTV in broadcaster's networks

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HDTV in the broadcast-intranet ?



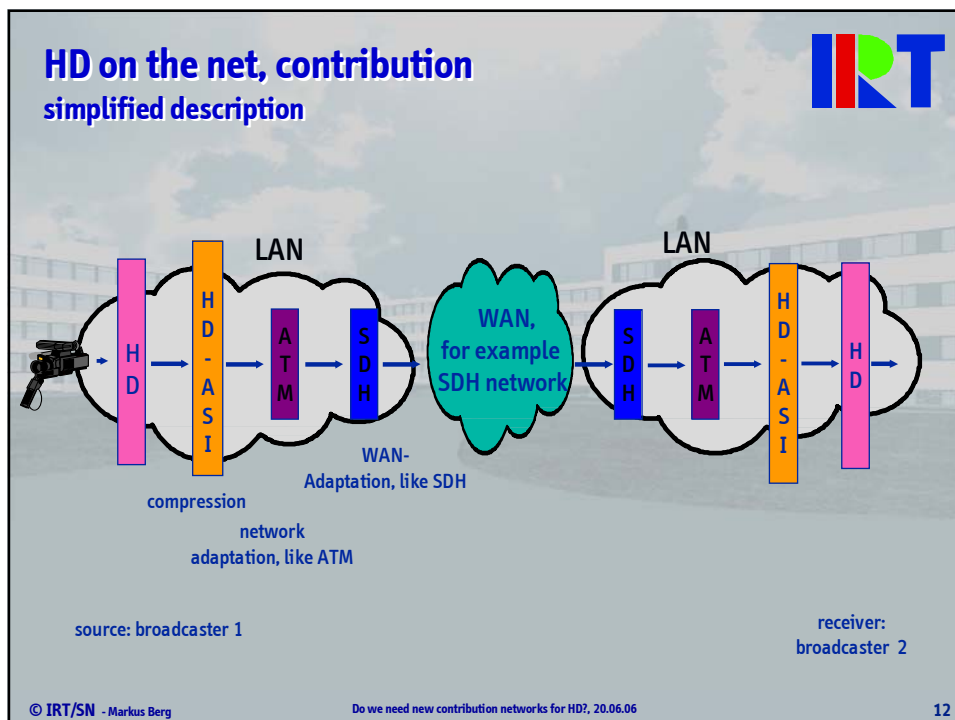
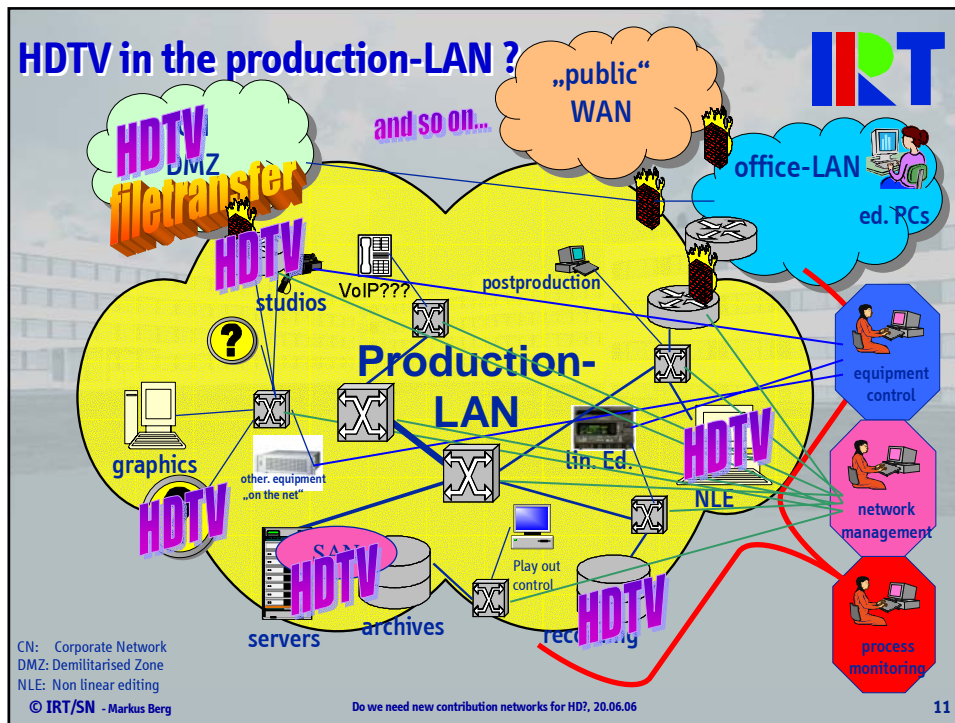
The diagram shows a central yellow cloud labeled "Broadcast-INTRANET" with the text "video audio data control" inside. Surrounding the cloud are several ovals representing different services, each with a stylized "HDTV" logo. The services include:

- archives
- audio lines
- voice/telephony
- data CN
- DVR
- production
- transmission
- control
- change
-

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HDTV in broadcaster's networks



- **Bandwidth requirements will rise massively**
 - Has to be considered when planning new networks or extending existing ones
 - Network load has to be balanced
 - High requirements to network management
 - Prioritisation of different data streams must be possible
- **New adapters “join” the network**
 - Must be included in existing management and monitoring systems

What's the right network technology?



LAN



1,5 Gbit/s



- Gigabit Ethernet widely deployed, 10 Gigabit Ethernet available (not all manufacturers), next steps: 40 and 100 Gigabit Ethernet
 - Bandwidth: yes, problems may occur with synchronisation
 - Prioritisation concepts necessary
- Fibre Channel: 2 Gbit/s actually deployed, 4-10 Gbit/s will follow
 - Bandwidth: yes
 - Prioritisation concepts may be necessary
- Fibre wiring already widespread

1,5 Gbit/s



HDTV in the LAN



- Existing networks **must be enhanced** for example to allow the transport of several uncompressed HDTV streams at the same time
- The increasing data volume must be controlled by prioritisation concepts
- Problems:
 - Real-time traffic over IP -> dedicated connections
 - Not all Gigabit Ethernet switches actually deployed can be enhanced with 10 GbEthernet
- Until the end of 2006, 10 GbEthernet should be available on twisted pair (IEEE802.3an) -> cheap alternative
- HDTV direct on fibre is also possible

Broadcast-WAN (contribution and primary distribution)



- Current ATM/SDH networks up to 2,5 Gbit/s deployed, next step: 10 Gbit/s
- DWDM systems (dense wavelength division multiplex) fulfil almost every bandwidth wish (question of price)
- IP/MPLS up to 2,5 Gbit/s, 10 Gbit/s follow
- DTM up to 2.5 Gbit/s available, 10 Gbit/s announced
- (Gigabit) Ethernet in metro networks is spreading
- RPR (Resilient Packet Ring) is also used in metro networks (based on SDH/SONET or Ethernet physical layer)
- Cost of fibre connections in Europe from 2002 until today decreased by 40-80% (last mile to the broadcasters premises reminds the problem)
- Next developments:
 - Optical Routing
 - Next Generation Optical Rings
 - Next Generation SONET/SDH (up to 40 Gbit/s)
 - OTN (Optical Transport Network)

1,5 Gbit/s



HDTV in the WAN



Bandwidth is today no big problem from **technical** point of view

But:

- The costs to connect the “last mile” at high bit rates is still high
- HD network adapters are not announced for all network technologies (following slides)
- Existing networks **must be enhanced**, in order to cope with the rising traffic through HDTV
- HDTV requirements concerning timing/synchronisation in the networks have to be evaluated
 - „mature“ technologies like ATM, SDH, DTM fulfil the requirements for real-time traffic
 - IP/MPLS based networks have to be improved
- Concerning file transfer: HDTV is „just another (bigger) file“
- New network technologies (Next Generation SDH, Optical Routing...) promise in theory good transport characteristics for HDTV, practical tests are nevertheless required

Another arithmetic example



- Request: transfer of our example movie (1 TB) as an uncompressed file:

1012,5 GB = 8.100 Gbit = 8.100.000 Mbit

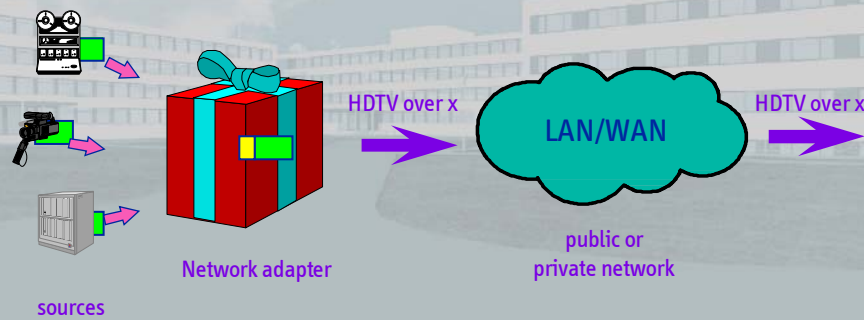
- At 4,7 Mbit/s it would take 1.723.404,25 sec
 - = 478,7 Std. = ~20 days
 - At 300 Mbit/s ~ 7,5 hours -> for uncompressed HD real-time transmission is (at the moment) faster
 - But for DVCPro (100 Mbit/s) faster than real-time is possible today!
- You certainly remember my presentation from last year concerning the TCP - round trip delay problem 😊

Problem: Carriers



- A lot of carriers even today have problems to understand the rigid requirements broadcasters have, especially those imposed by real-time transmissions
 - Especially carriers coming from the „internet world“, the ISPs (Internet Service Provider)
 - In the future the number of carriers with „broadcast departments“ will decrease
- > Broadcasters will need more and more network expertise to plan and manage their networks and negotiate with carriers
- IRT can offer assistance here!

Network adapters



Network adapters



- Tasks
 - Adaptation of the A/V signal to the network layer
 - Timing (Clock Recovery etc.)
 - Error correction (FEC, sequence numbering etc.)
 - Signalling
- For HDTV required:
 - Extension of the network interfaces
 - New interface cards for HD (compressed or uncompressed)
- HDTV network adapters already announced/deployed for (examples):
 - SDH/Next Generation SDH
 - DTM
 - IP
 - WDM
 - RPR

Current equipment situation (some examples)



- **HDTV network adapters:**
 - NetInsight: uncompressed HDTV over DTM
 - Scientific Atlanta: uncompressed HDTV over SDH/SONET and RPR
 - MediaLinks: uncompressed HDTV over WDM or SDH/SONET
 - Iptek: compressed HDTV (19,4 Mbit/s) over SDH
 - Terawave: compressed HDTV (up to 19,4 Mbit/s) over ATM, SDH, IP
 -
- **Network technology:**
 - Broadcom: Optical transceiver (single Chip) for 10 Gbit/s SDH/SONET, Ethernet and Fibre Channel, with a jitter of 200 femtoseconds
(1 femtosecond = 10^{-15} s)
 - XTERA: DWDM system with up to 240 channels at 10 Gbit/s each or up to 960 channels at 2,5 Gbit/s each at distances up to 3000 km without regenerator
 - ...

Conclusions



Do we need new networks?

- **New networks** are not implicitly necessary, but existing networks **have to be enhanced and extended**
- New network technologies may ease the transport of HD!
- Network load will increase with HDTV -> So will the demands to network managements!
- Network adapters must be enhanced or extended (or completely new adapters have to be bought for HD)



**Thank you
for your attention !**

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