Institut für Rundfunktechnik

Video transport over IP – Can we still avoid the errors?

EBU Seminar:

Networks 2007

To IP and Beyond

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Overview

Video transport over IP

- Introduction
- MPEG-TS Encapsulation
- Protocol Overhead
- UDP
- RTP

Features of von IP- Networks

- IP-Network/Internet
- Overload
- Consequence for Real-time applications
- CoP #3
- Quality of Service
- Feature of CoS
- Experience: Managed Networks
- First Measurements

Conclusion

Video transport over IP

On this subject:

- contribution purpose
- high data rates
- Production quality
- post processing

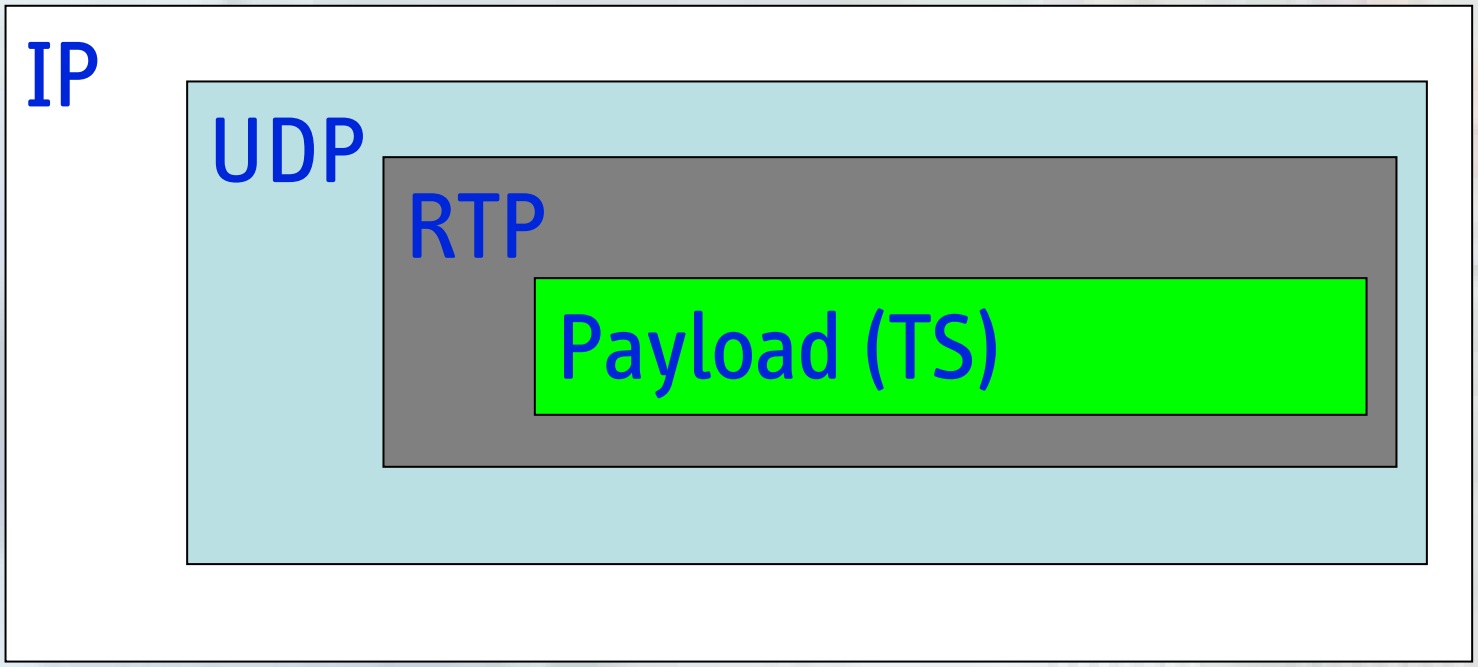
Not:

distribution propose

IPTV

MPEG-TS Encapsulation

Structure of an IP-Packet:



IP: Internet Protocol

UDP: User Datagram Protocol

RTP: Real-Time Transport Protocol

Protocol Overhead

	Header	Payload
Ethernet	18 Byte (22 VLAN)	46 – 1500 Byte
IP	20 Byte	26 -1480/(65.515) Byte
UDP	8 Byte	18 – 1472 Byte
RTP	12 Byte	6 – 1460 Byte
Overhead:	**40 Byte per IP-Packet**	Up to 7 MPEG-TS Packets (188 Byte, Ethernet)

Bit error and UDP

UDP-Header:

Source Port
Destination Port
Length
Checksum

Checksum: Verification: if bit errors happen

error detection – no error correction possible!

in case → reject IP-Packet!!!

A single bit error always causes the loss of the complete IP-Packet!

RTP

Main features of RTP:

Sequence numbering:

- Detect packet loss
- Detect out of order packets

Timestamp

- Synchronisation purpose
- Calculate network jitter
- regardless PCR

PCR: Primary Clock Reference

Characteristics of IP-Networks

IP-Network/Internet

Overload

Consequence for Real-time applications

CoP #3

Quality of Service

Feature of CoS

Experience: Managed Networks

Internet - IP Networks

IP-Networks ≠ Internet

Internet: based on Internet Protocol

- No QoS
- Everything can happens at every time

IP-Network:

- Managed network
- Defined QoS
- Deterministic behaviour (hopefully)

Overload

every single IP-Packet competes with each other

→ intermediate storage within routers (individual delay, Jitter)

→ buffer over flow

→ rejected packets

→ every connections and data streams equally concerned!

→ no difference witch contents is carried!

Consequence for Real-time applications

bit error (UDP) → packet loss

overload → packet loss

delay (Jitter) → packet loss

→ Consequence: forward error correction?

Pro MPEG Forum: CoP #3

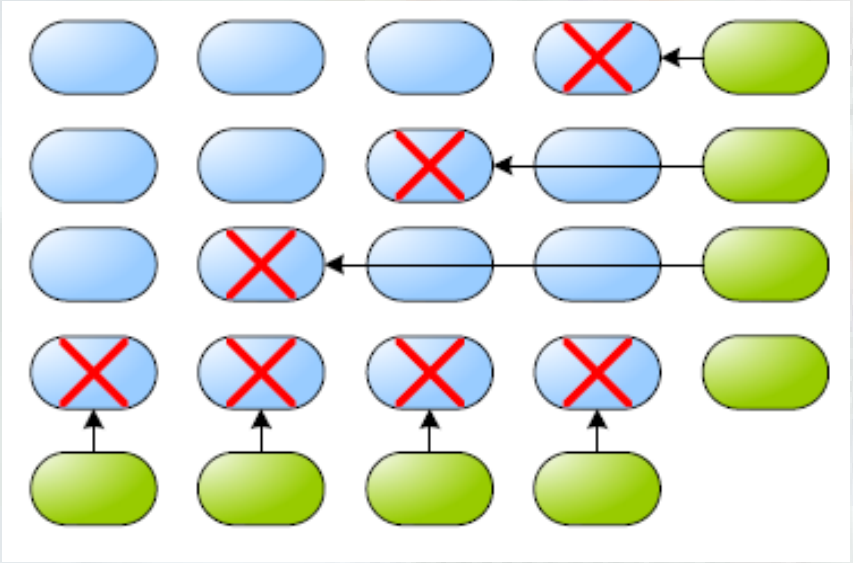
Codes of Practice #3 :

Forward Error Correction (FEC)
for MPEG-TS

Matrix: L columns, D rows

Correction of burst errors
possible!

Long delay
(particularly at low data rates)



MPEG: Moving Picture Experts Group

Feature: CoP #3

Data stream, Column FEC and row FEC are separate streams

FEC Overhead: 5 – 30 % redundant data necessary!

FEC-Packets are interleaved with data packets

→ to avoid large traffic rate changes (traffic shaping)

→additional delay: depend on the arrangement of packets (up to L x D packet time)

Quality of Service (QoS)

Priority of Packets (DiffServ)

3 Bit for classification → 7 Class of service (CoS)

→ Typical 4 for users

→ 2 classes for OAM

5 VoIP	Voice over IP, Audio
4 Multimedia	e.g. Videoconferences, Video over IP
3 Privilege	Preferred data applications
1 Best Effort	all others (Email, www, ...)

QoS: Quality of Service
VoIP: Voice over Internet Protocol
CoS: Class of Service
DiffServ: Differentiated Services
OAM: Operation, Administration and Maintenance

QoS Parameter

QoS Class	Packet loss	Round Trip Delay Backbone (domestic)
VoIP	0,10%	30 ms
Multimedia	0,20%	35 ms
Privilege	0,30%	40 ms
Best Effort	1 %	60 ms

Feature of service class

→ every connection and data within a service class (CoS) have equal rights!

Overload within a service class:

→ Reject of packets

→ every connection is concerned!!!

Example (multimedia class has a capacity of 10 video streams):

A additional video (11th) connection release overload

→ Rejection of packets

→ every present video connection is concerned!!!

→ additional mechanism necessary!

CoS: Class of Service

Experience: Managed Networks

Bit error: → single packet loss

Correctable by FEC

Overload: → periodic packet loss

easy to correct by FEC (within limits, low loss rate)

Re-order: → atypical for managed networks

Except auto configuration is used

Switch over (equivalent network, cut-off, auto configuration):

→ burst errors

burst rate depend on data rate

common not compensation able

Interrupt!

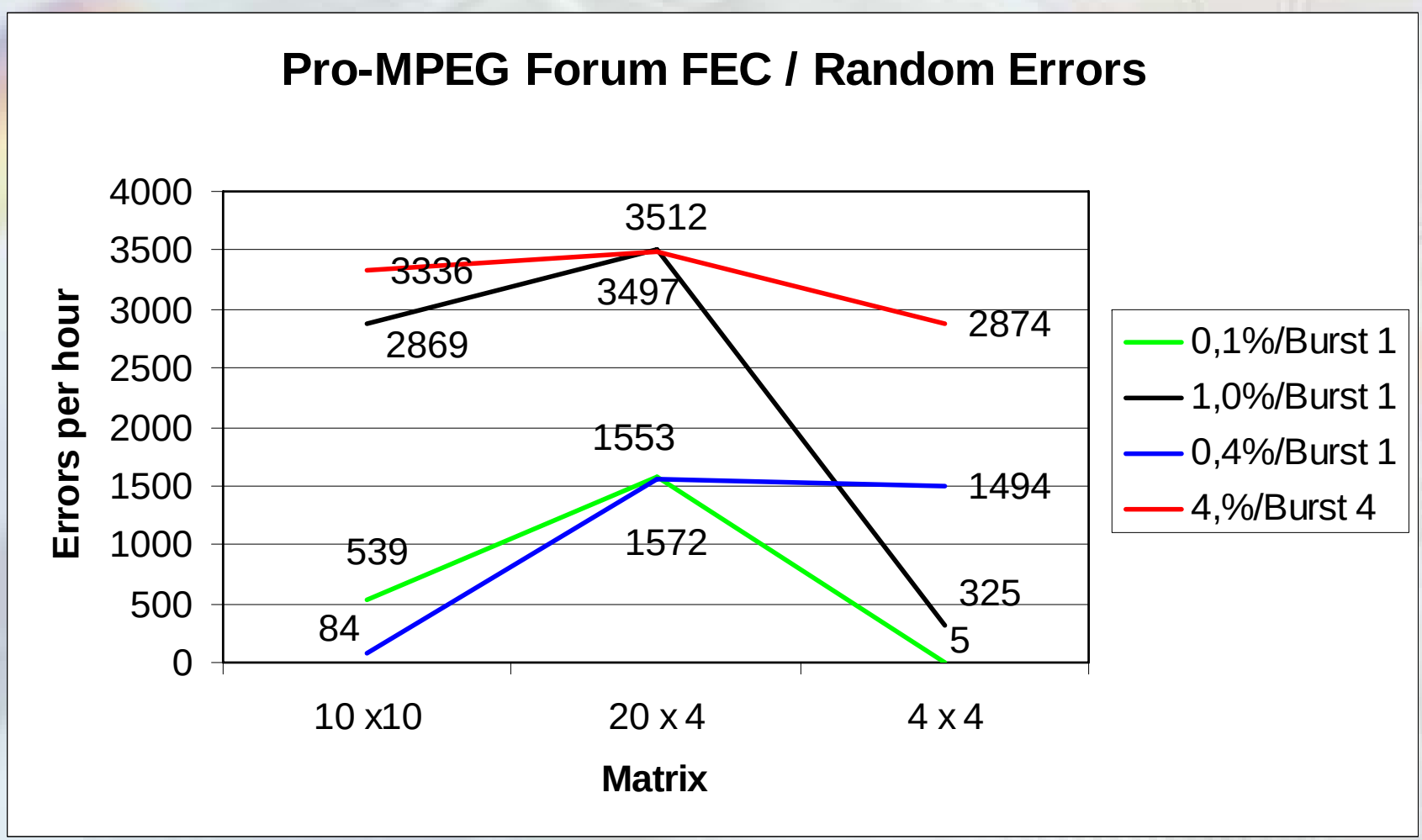
First Measurements

Configurations:

video rate: 10 Mbit/s

Matrix (CoP 3)	Max. corrigible errors	Delay
4x4	4	25 ms
10 x 10	10	180 ms
20 x 4	4	142 ms

First Measurement Results (1)



First Measurement Results (2)

Random Errors:

Data and corresponding FEC packets are lost

Constellations with the FEC cannot correct always exist

Periodic Errors:

Every lost packet is corrected

Behaviour of low error rates

Conclusion

Managed networks increase deterministic behaviours

But IP-Networks are not ready for real-time broadcast quality!!!

Nevertheless additional mechanism is necessary to prevent packet loss (e.g. FEC)

IP tax: FEC increase bandwidth and delay

Further improvement necessary

→ no guarantee for real-time video and audio!

Thank you for your attention !

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