

3GPP Packet Switch Streaming Quality of Experience

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Content

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 - Architecture, Protocols, Codecs
 - Services and User Expectations wrt QoE
- o 3GPP PSS QoE
 - QoE Metrics
 - QoE Protocol
- o Conclusion



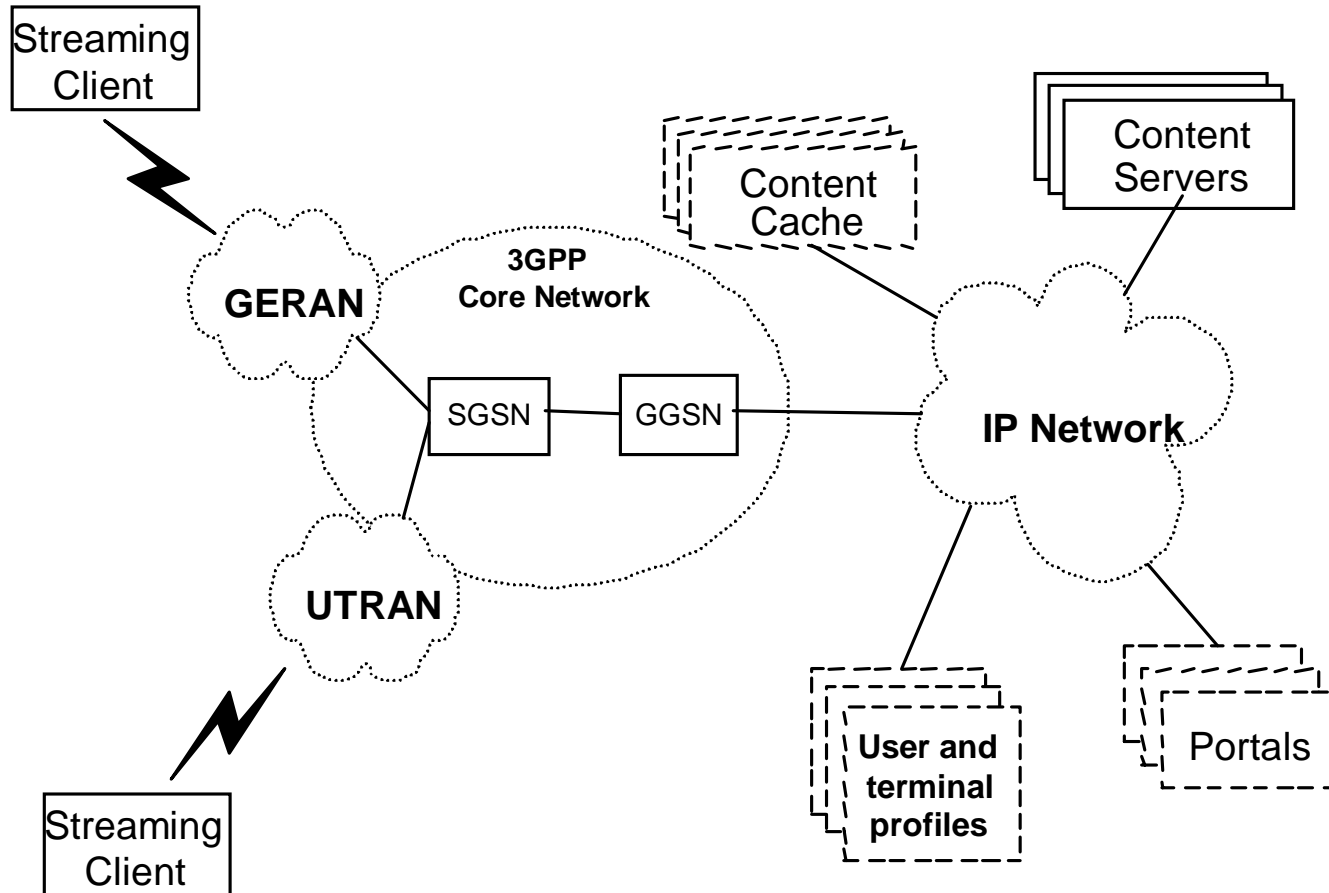
3GPP Packet switch Streaming

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- o What is streaming ?
 - “Streaming refers to the ability of an application to play synchronized media streams like audio and video streams in a continuous way while those streams are being transmitted to the client over a data network”
- o History of PSS in 3GPP
 - Rel-4: default codecs and protocols
 - Rel-5: Device capabilities, new formats/codecs e.g. SP-MIDI and timed Text.
 - Rel-6: QoE metrics, Bitrate adaptation, eacPlus, AMR-WB+ and H.264.
- o References
 - TS 22.233 PSS stage 1
 - TS 23.233 PSS General Description
 - TS 26.234 PSS Protocols and codecs
 - TS 26.346 MBMS Protocols and codecs
 - www.3gpp.org

PSS Architecture

The PSS follows a client-server model sitting on a 3G Radio Access and Core Network





PSS Protocols

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- o 3GPP PSS uses IETF defined protocols
 - RT media Transport: RTP/UDP
 - NRT media transport: HTTP/TCP/IP
 - Control/Signalling: RTSP

Video Audio Speech Timed Text	Capability exchange Scene description Presentation description Still images Bitmap graphics Vector graphics Text Timed text Synthetic audio	Capability exchange Presentation description
Payload formats	HTTP	RTSP
RTP		
UDP	TCP	UDP
IP		



PSS Codecs

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- o Main codecs, based on Rel-6 specifications
 - Speech/Audio
 - AMR, AMR-WB, AMR-WB+, eaacPlus
 - Video
 - H.263, MPEG4, H.264
 - Others
 - SP-MIDI, JPEG, GIF, PNG, SVG Tiny, Text and Timed Text
- o Formats
 - Scene description: SMIL 2.0
 - Audio: narrow band/wideband/audio
 - Video: QVGA, 15 fps
- o Neither acoustic nor display requirements defined
- o .3gp file format based on ISO (common with MMS)



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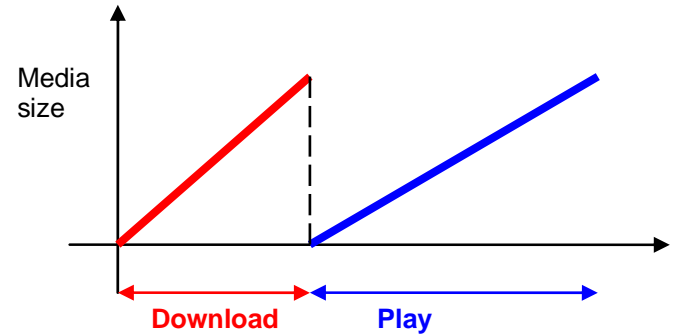
Services

- What are Streaming Services today ?
 - Mostly driven by the web
 - Video/Audio on demand
 - Realized as
 - Download and play
 - Progressive Download
 - Unicast A/V streaming with offline encoding
 - Web TV
 - Realized as
 - Multicast A/V streaming with real time encoding
- -> 3G Mobile streaming services compete with the web.



Download and Play

- User experience
 - After request for the clip, the user awaits for the file to be fully downloaded before it plays



- Pros
 - No playout errors/pauses
 - Allows potential replay without re-download
 - Download can be as fast as possible

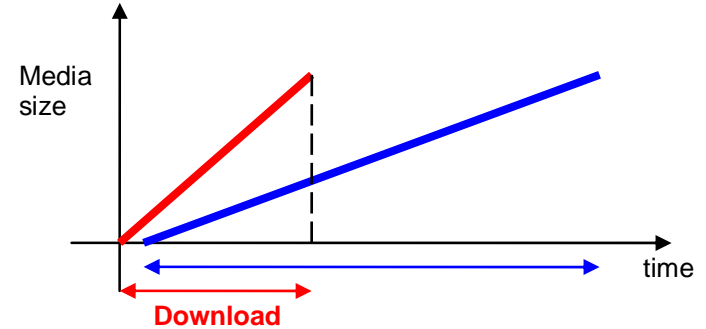
- Cons
 - File size limited
 - User has to wait for download

- .3gp files and 3gpp codecs/formats are used for such services currently.



Progressive Download

- User experience
 - After request for the clip, the user awaits until enough of the file is buffered before it plays



- Pros
 - No playout errors
 - Allows potential replay without re-download
 - Shorter waiting time

- Cons
 - File size limited
 - Potential playout pauses

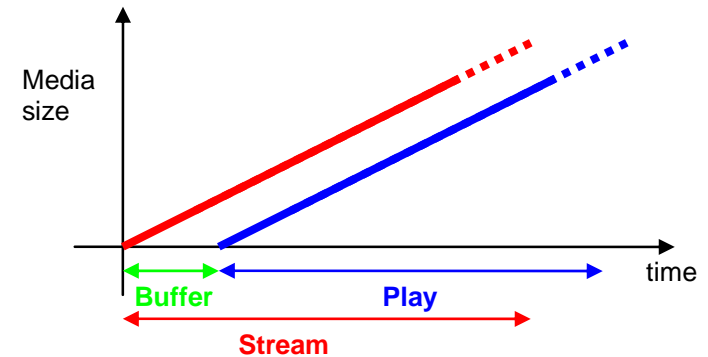
○ .3gp files offer a progressive download profile.



Streaming (3GPP PSS)

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- User experience
 - After request for the clip, the user awaits for the buffer to be filled before playout.
- Pros
 - Shorter delays before playout
 - No file size limitation
 - Limits peak rate requirements compared to download.
 - Allows Play/Pause/Seek commands



- Cons
 - Potential Pauses during playout due to rebuffering
 - Potential Artefacts due to packet errors/losses
 - Media rate < bearer rate

- This is "full" PSS. The remaining of the presentation focuses on this scenario.



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User Expectations

- o What drives a good streaming QoE then?
 - Low establishment delay/tune in
 - Fast 3G Bearer Establishment
 - Short initial buffering delay
 - Fast Stop/Play/Pause and Tune-In times
 - High Audio/Video Quality
 - Quality Encoding
 - Low packet loss rates
 - Low delay/jitter
 - Quality Decoding/Playout/Lip sync
 - Seldom Rebuffering
 - Seamless adaptation to bearer and client
 - Application design & MMI
 - Integration of media components and available commands
 - User notification of initial buffering, rebuffering, playout seems to be critical.



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User Expectations (cont.)

- Streaming QoE, a standards issue ?
 - No dedicated PSS subjective testing were done by 3GPP
 - IMTC focuses on interop: top priority is that the service works between compliant clients and servers
 - 3GPP provides hints on how to optimize QoE
 - E.g. buffering model and informative figures for bearer design:
 - Streaming traffic class
 - Residual BER $1 \cdot 10^{-5}$
 - SDU error ratio $1 \cdot 10^{-4}$ or better
 - Transfer delay 2 sec.
 - In the field PSS is currently realized over background / interactive bearers with RLC AM



3GPP PSS QoE

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- o History
 - Requirements expressed in 3GPP by '3' with support from several operators and manufacturers
 - Requirements approved by 3GPP in Dec. 2002.
 - QoE Specification finalized in June 2004
 - Rel-6 frozen December 2005
- o Goals
 - Determine the actual customer experience
 - Monitoring and improvement
 - Charging flexibility/customer care
- o Design constraints
 - Reliable
 - Extensible/Flexible
 - Efficient/Minimal complexity



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PSS QoE Metrics

- Applicable to audio, video, speech and timed text media types only.
 - Media level
 - Corruption duration
 - Successive loss of RTP packets
 - Frame rate deviation
 - Jitter duration
 - Session level
 - Initial buffering duration
 - Rebuffering duration

PSS QoE Metrics

- o Where to measure at receiver ?
 - Up to implementers

RTP Packets /
Media Frames

A/V Samples

Session

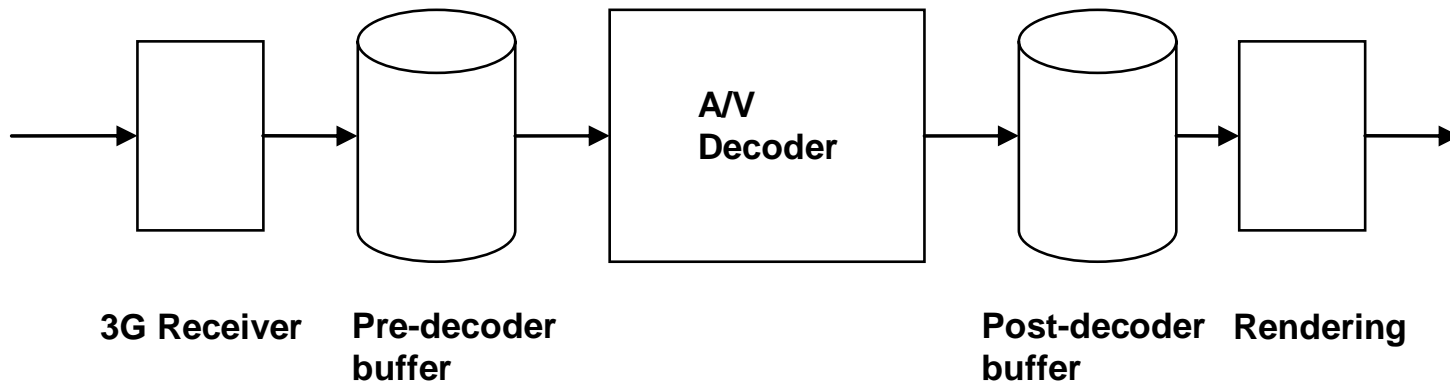
- Initial buffering duration
- Rebuffering duration

Media

- Corruption duration
- Frame rate deviation
- Jitter duration

Media

- Corruption duration
- Successive loss of RTP packets





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PSS QoE Protocol

- o Reuses the PSS architecture
 - Server controls the QoE metrics
 - Client gathers metrics and feedback to server
 - Analysis/Usage is out of the scope of 3GPP PSS
- o Protocol
 - QoE negotiation with SDP and RTSP
 - Uses RTSP for reliable transport of reports
 - RTCP receiver reports can also be used by servers



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Conclusion

- PSS is deployed currently onto 3G and 2.5G networks. There is high demand for mobile TV services. And key user expectations are known.
- 3GPP PSS QoE provides means for operators to receive feedback on user QoE. PSS QoE server solutions are available on the market but no publicly available data.
- PSS QoE were recently introduced to 3GPP MBMS service.
- Early users have low expectations but as streaming becomes common on the web, paying users will require better QoE over mobile.
- Questions ?



Definitions & Acronyms

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- 3GPP: Third Generation Partnership Project
- AM: Acknowledged Mode
- AMR: Adaptive Multirate codec
- AMR-WB: AMR Wideband codec
- AMR-WB+: Extended AMR-WB codec
- eaacPlus: Enhanced aacPlus audio codec
- GERAN: GSM EDGE RAN
- IMTC: International Multimedia Teleconferencing Consortium
- MBMS: Multimedia Broadcast and Multicast system
- PSS: Packet Switch Streaming
- QoS: Quality of Service
- QoE: Quality of Experience
- RAN: Radio Access Network
- RTCP: Real Time Control Protocol
- RTP: Real Time Transport Protocol
- RTSP: Real Time streaming Protocol
- SP-MIDI: Scalable Polyphony MIDI
- UTRAN: UMTS Terrestrial RAN