# Improving the quality of video calls

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#### Who is Olivier?

- GnomeICU since 1997
- Gentoo Developer since 2003
- Farstream at Collabora since 2007



#### **Farstream**

- Formerly Farsight2 (well almost)
- VoIP Framework
- GStreamer elements
- High-level API



#### Farstream users

- Maemo / Meego
- Empathy
- Pidgin
- aMSN
- Gajim
- Minbif
- Future KDE Telepathy Call client









#### **VoIP**

- Streamed media over the IP
- Interactive
- Low latency



## Low latency

- No retransmission
- UDP



#### Voice

- Relatively low bandwidth
- Mostly constant bit rates
  - Possibly adjustable
- Gaps BAD!





#### Video

- High bandwidth
- Codecs intolerant to losses
- Tolerant to limited stuttering



#### Bit rate control

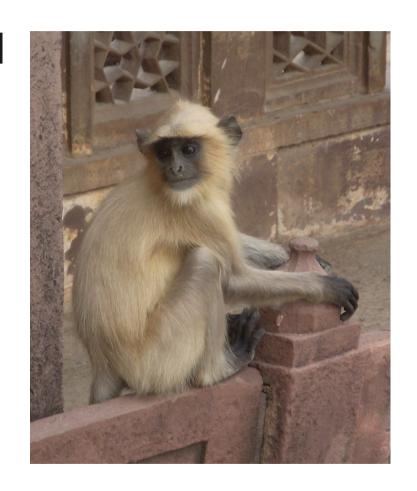
- Static (none)
- Simple RTCP
- Pre-compute
- Fully dynamic



#### **TFRC**

TCP Friendly Rate Control

- Equation-based
- RFC 3448 & 5348
- Regular
  - Video
- Small Packets
  - RFC 4828
  - Audio





## TCP Throughput Equation

$$X_{Bps} = \frac{s}{R\sqrt{2b\frac{p}{3} + (t_{RTO}(3p\sqrt{3b\frac{p}{8}}(1+32p^2)))}}$$

s = Segment Size

p = Loss Event Rate

R = Round Trip Time

 $t_{RTO} = TCP retransmission timeout = 8$ 

b = packets per TCP Ack = 1



## TCP Throughput Equation

$$X_{Bps} = \frac{1460}{R\sqrt{2\frac{p}{3} + (24p\sqrt{3\frac{p}{8}(1+32p^2)})}}$$

p = Loss Event Rate

0

R = Round Trip Time



#### Extra RTP information

- Extended RTP Profile for Real-time Transport Control Protocol (RTCP)-Based Feedback
  - AVPF
- RTP Header Extensions
- Negotiated in XMPP, SIP, etc
- Approximated ?



#### Packet losses

Retransmissions ?NO

- Loss Indications
  - Picture
  - Slice



## Video Repair

- New keyframe (IDR)
- Older reference



#### Codec tricks

- Long lived reference frames
- Slice/MTU alignment
- H.264 SI/SP frames
- Decoder magic
  - VP8 is now implementing concealment



#### Concealment for Audio

Replay

Generic

Codec specific (Speex, Opus, Silk)



#### FEC

#### Forward **Erasure** Concealment

Parity

Reed-Solomon

Opus built-in



## Video adaptation

Bit rate

- Quality
- Resolution
- Frame rate



## Audio adaption

Quality

Sample rate



### Echo

- Concealment
  - Skype, etc
- Cancellation



#### Farstream will...

- Bitrate control
  - TFRC
- Forward Erasure Correction
- Support concealment



#### **Future**

- DCCP
- Open Codecs
- VP8, etc
- Large scale testing



## Thank you

- #farsight, #telepathy, #gstreamer @ FreeNode
- #empathy @ GimpNet
- http://farsight.freedesktop.org/
- http://telepathy.freedesktop.org/
- http://gstreamer.net/

