Network Architecture Res. Group

Multimedia Information System Lab.

MPEG-4 Video Transfer with TCP-Friendly Rate Control

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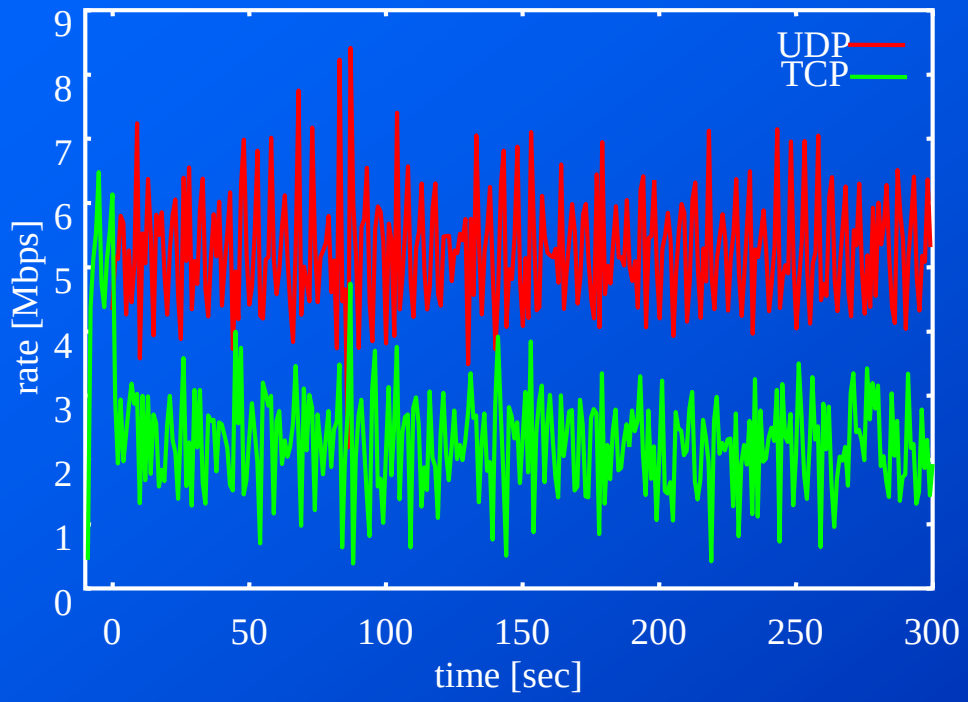
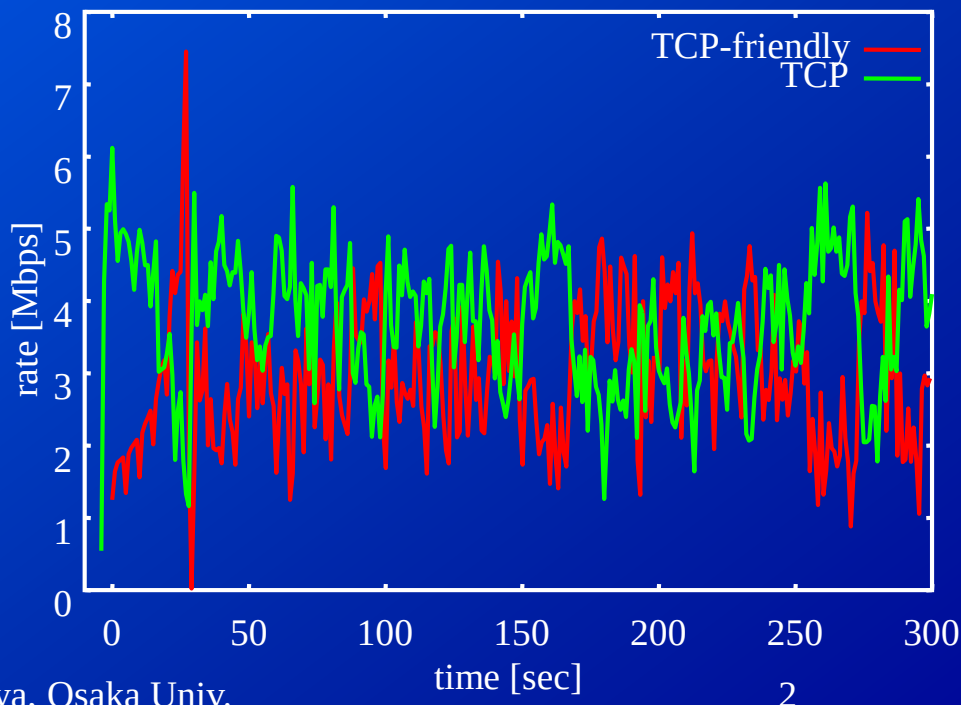
Why TCP-friendly rate control is required?

- When TCP and UDP co-exist in best-effort Internet, performance of TCP sessions deteriorates.





TCP-friendly rate control

- To have the same throughput on UDP session as TCP session traversing the same path.
- TCP throughput is estimated from observed RTT and packet loss.

$$r_{TCP} \approx \frac{MTU}{RTT\sqrt{2p/3} + T_o\left(3\sqrt{3p/8}\right)p\left(1+32p^2\right)}$$

Application-level QoS guarantee

- To accomplish TCP-friendly video transfer, we have to regulate video traffic taking into account
  - characteristics of video coding algorithm
  - mechanism of video quality adjustment
  - influence on application-level QoS
    = perceived video quality

MPEG-4 video transfer with TCP-friendly rate control

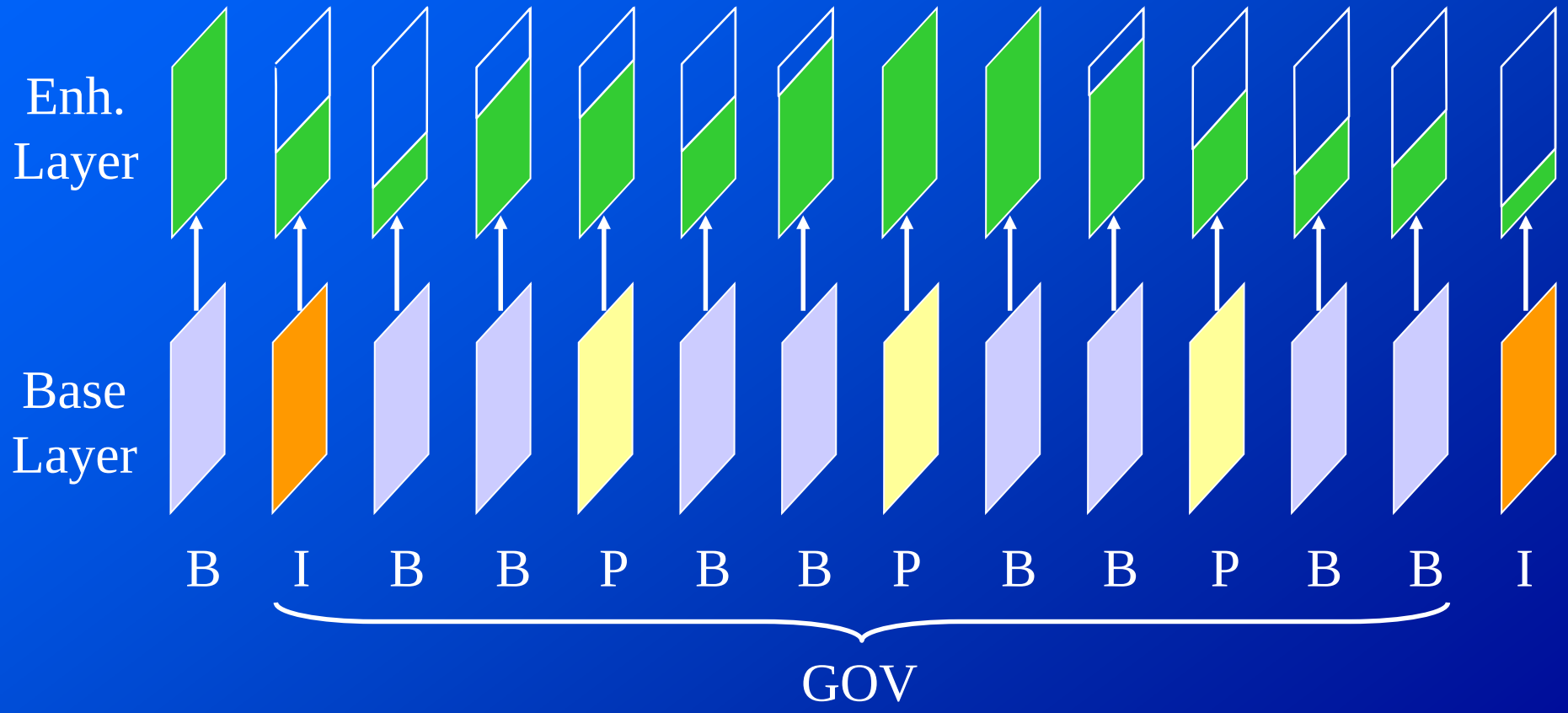
- MPEG-4 FGS video coding algorithm
- Narrow bandwidth from 40Kbps to 2.2Mbps
- TFRC by Sally Floyd [10]

- **How should FGS adjust video traffic to TFRC rate without introducing unacceptable video quality degradation?**

FGS video coding algorithm

- Fine-Granular-Scalability

Thanks to M. van der Schaar, Phillips Research Laboratories

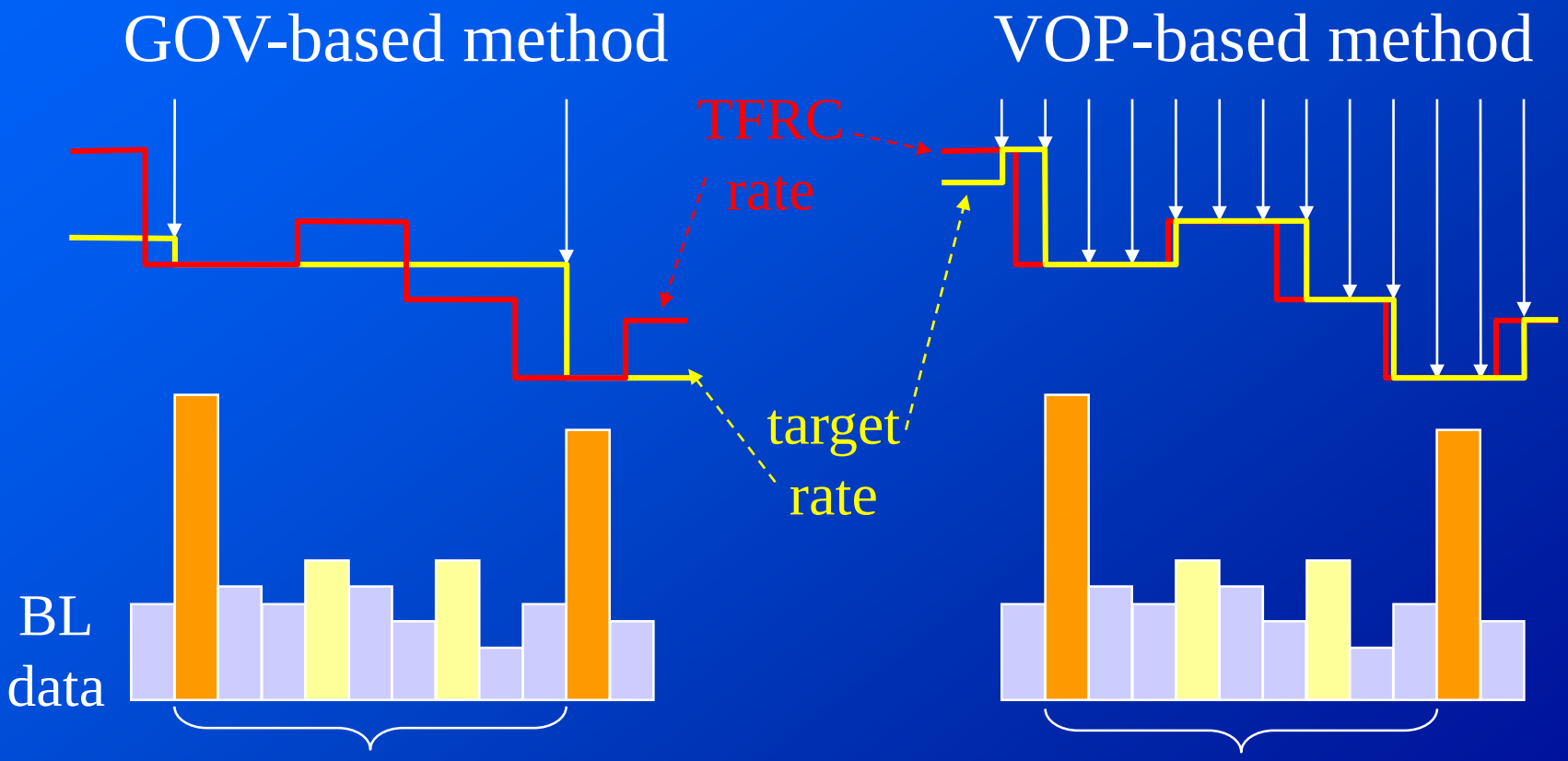


Issues

- **How should FGS adjust video traffic to TFRC rate without introducing unacceptable video quality degradation?**
  - **Target rate determination**
  - **Video rate adjustment**
  - **BL rate violation**

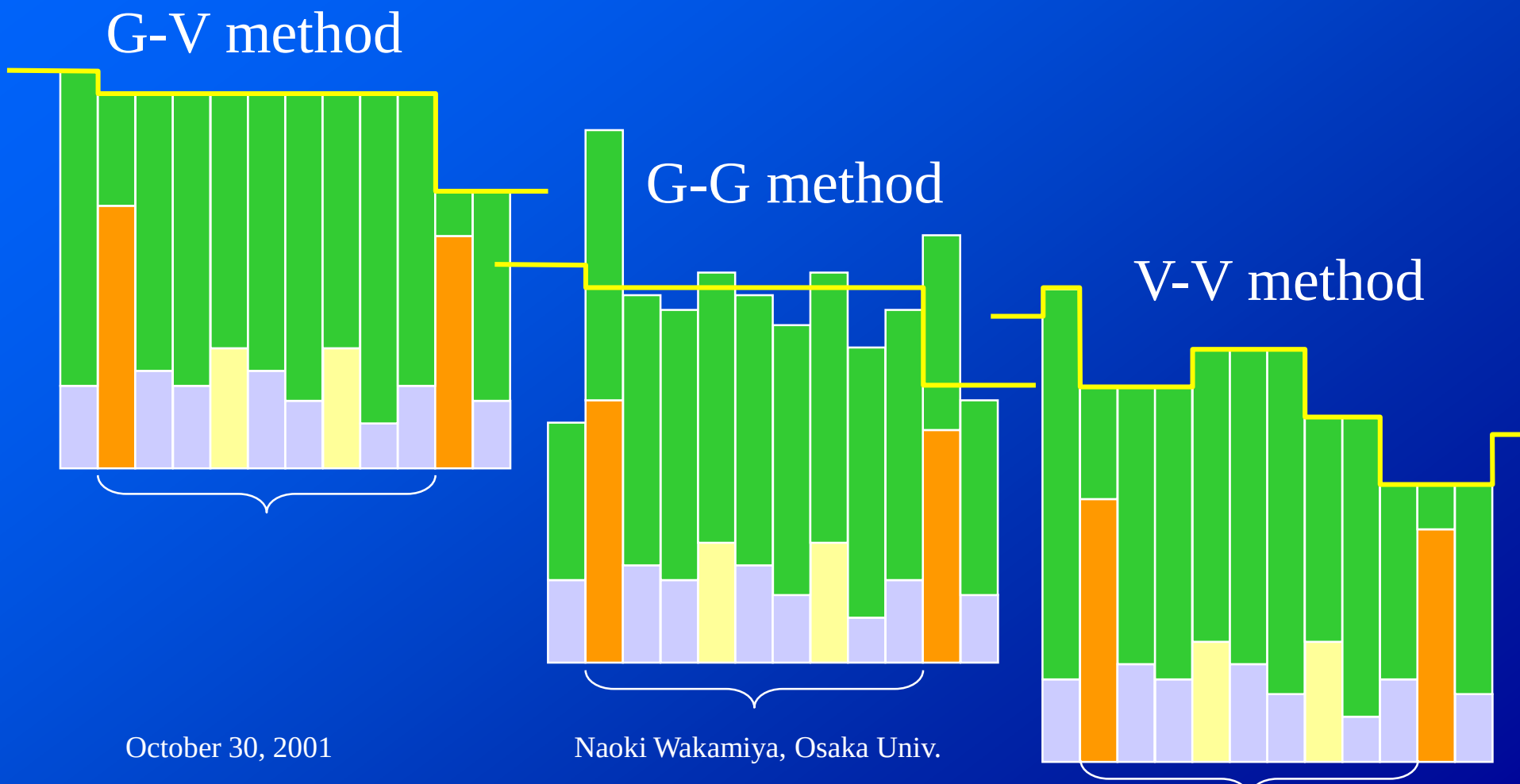
Target rate determination

- G and V methods for target rate determination



Video quality adjustment

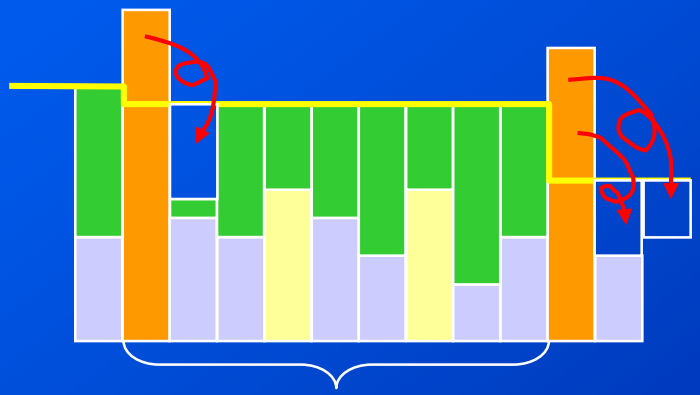
- G and V methods for determination of amount of enhancement layer data



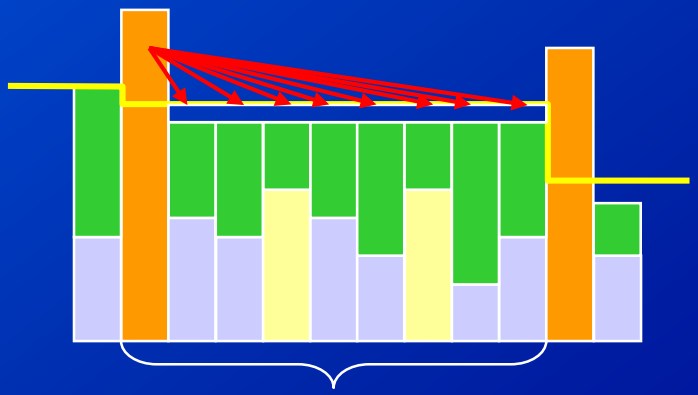
BL rate violation

- When network is congested,
  BL rate may exceed target rate.

early method



smooth method



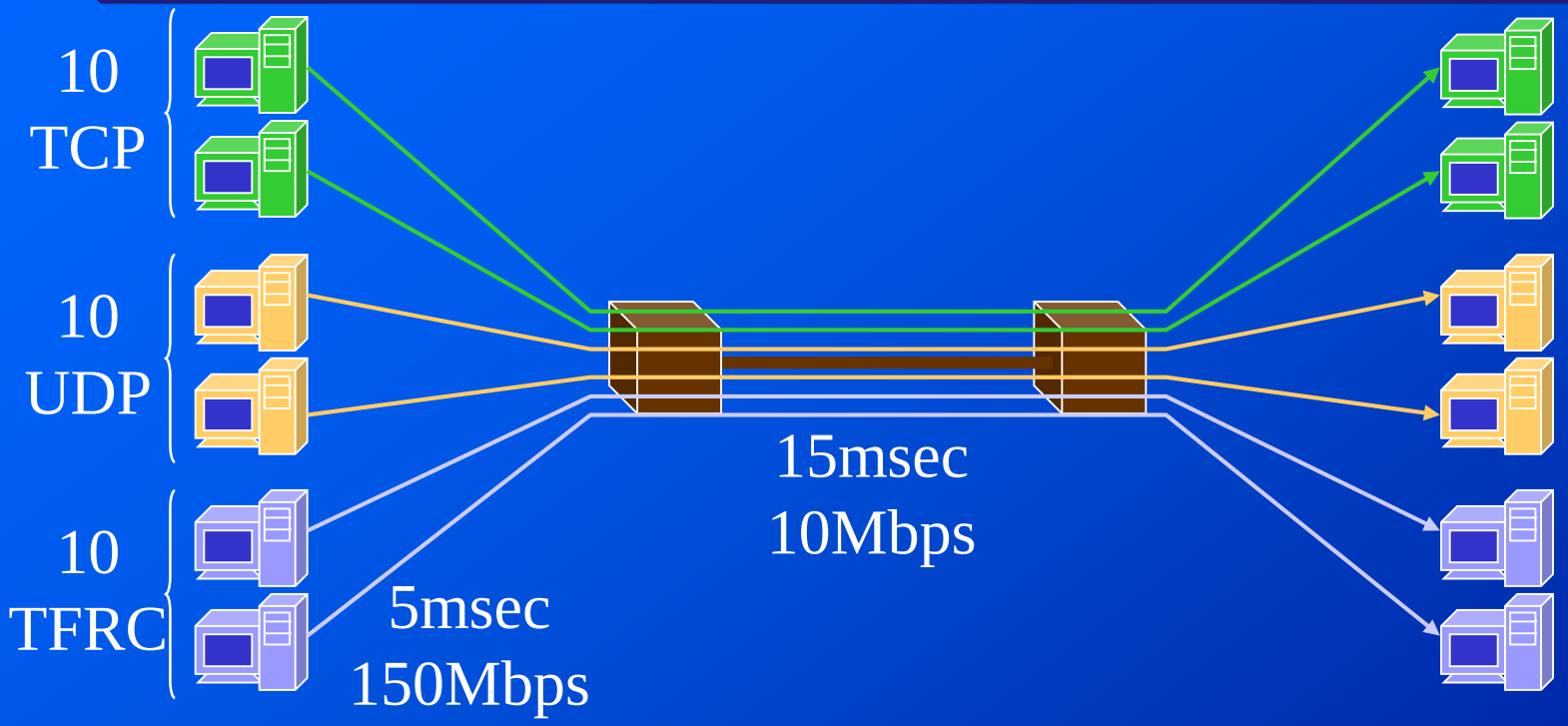
Example: G-V method

FGS video rate control methods

- Possible combinations are,

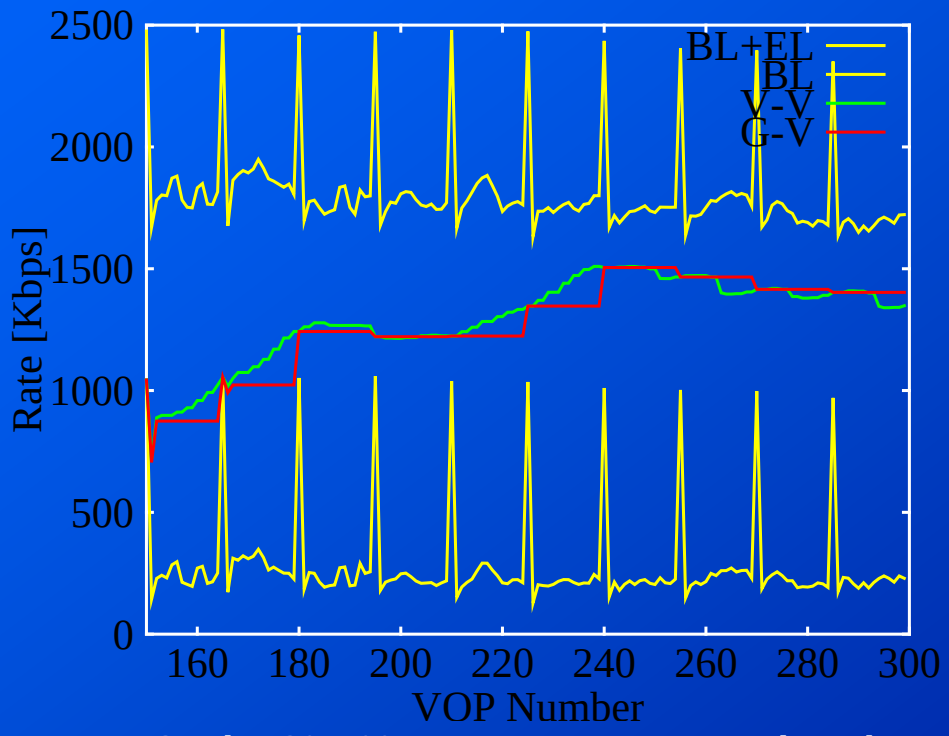
	Target rate	Rate adjustment	Excess canceller
V-V early	VOP-based	VOP-based	Early
V-V smooth			Smooth
G-V early	GOV-based		Early
G-V smooth			Smooth
G-G smooth		GOV-based	Smooth

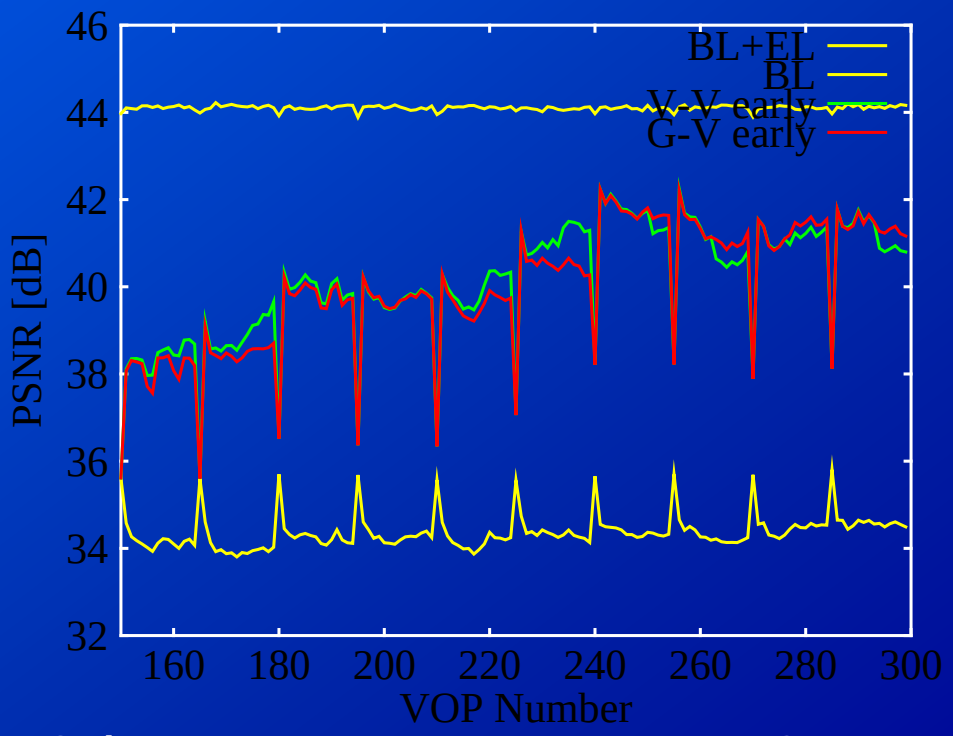
Simulation experiments



Comparison: Target rate determination

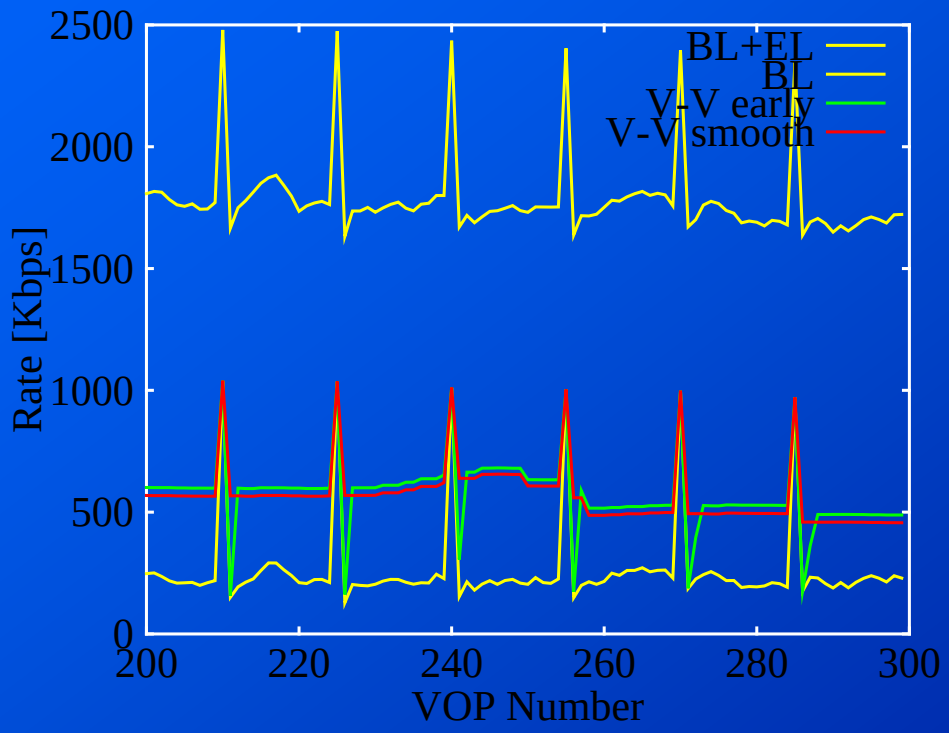
	Target rate	Rate adjustment	Excess canceller
V-V early	VOP-based	VOP-based	Early
G-V early	GOV-based		

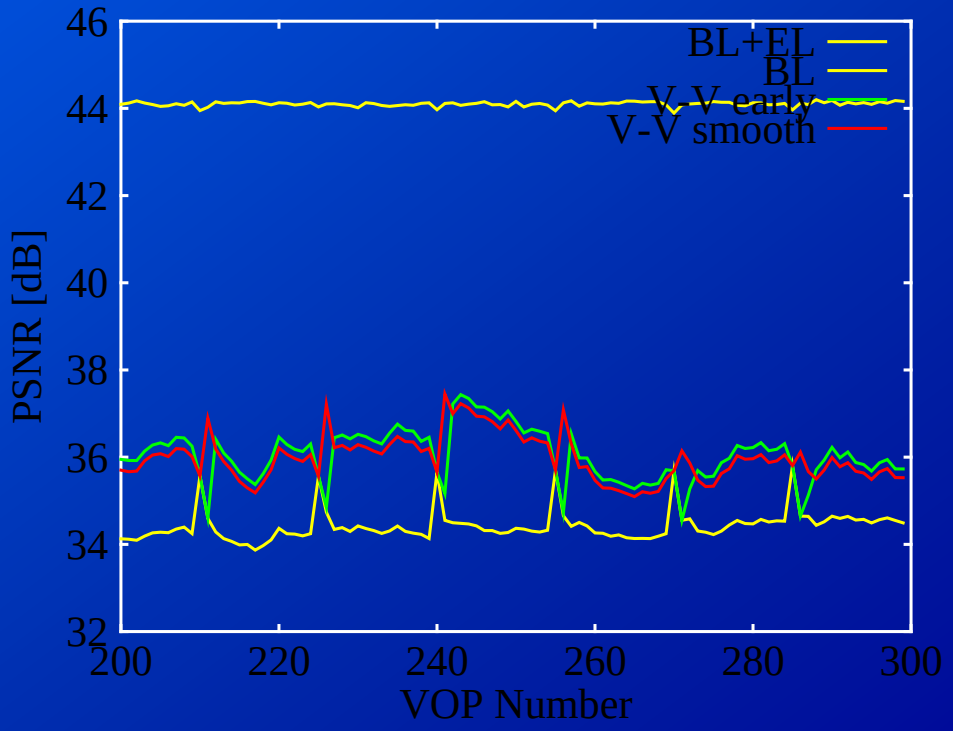




Comparison: BL violation

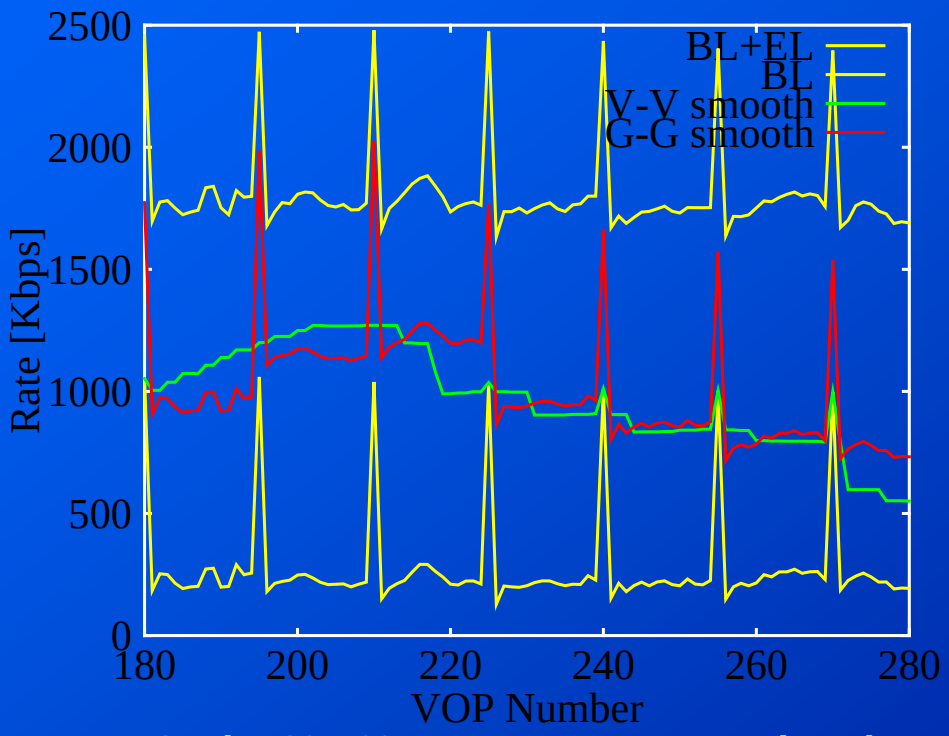
	Target rate	Rate adjustment	Excess canceller
V-V early	VOP-based	VOP-based	Early
V-V smooth			Smooth

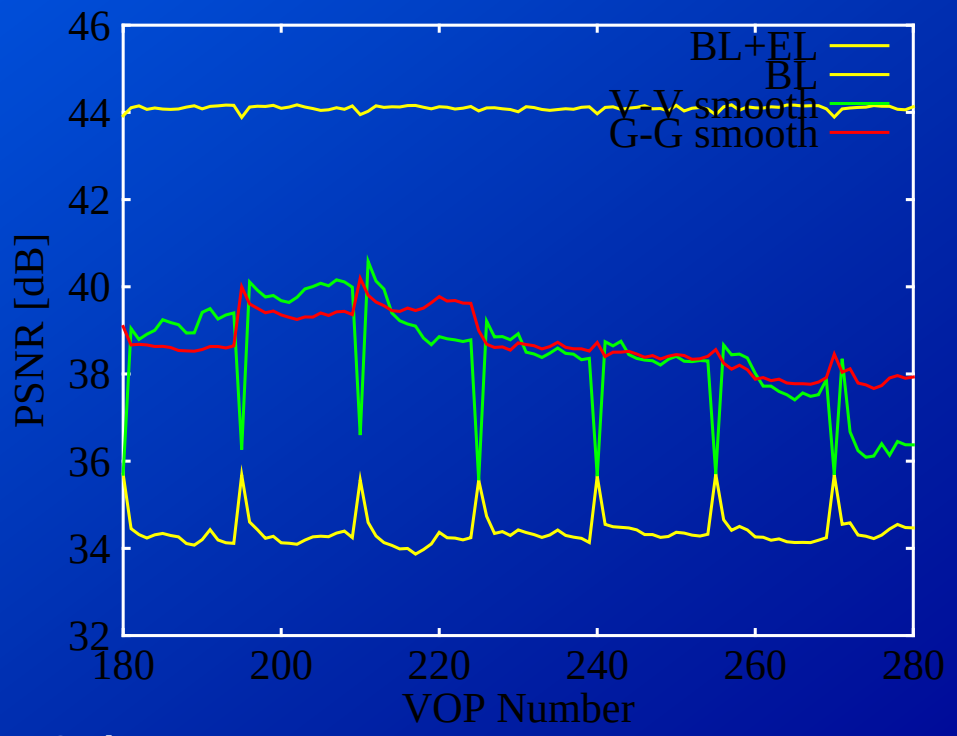




Comparison: Control granularity

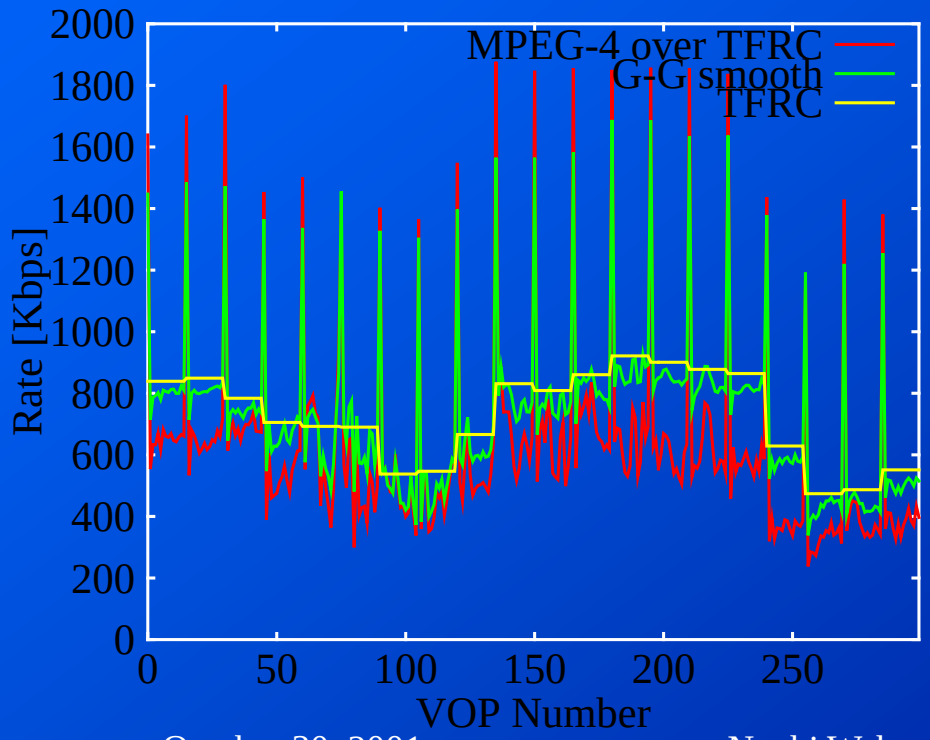
	Target rate	Rate adjustment	Excess canceller
V-V smooth	VOP-based	VOP-based	Smooth
G-G smooth	GOV-based	GOV-based	

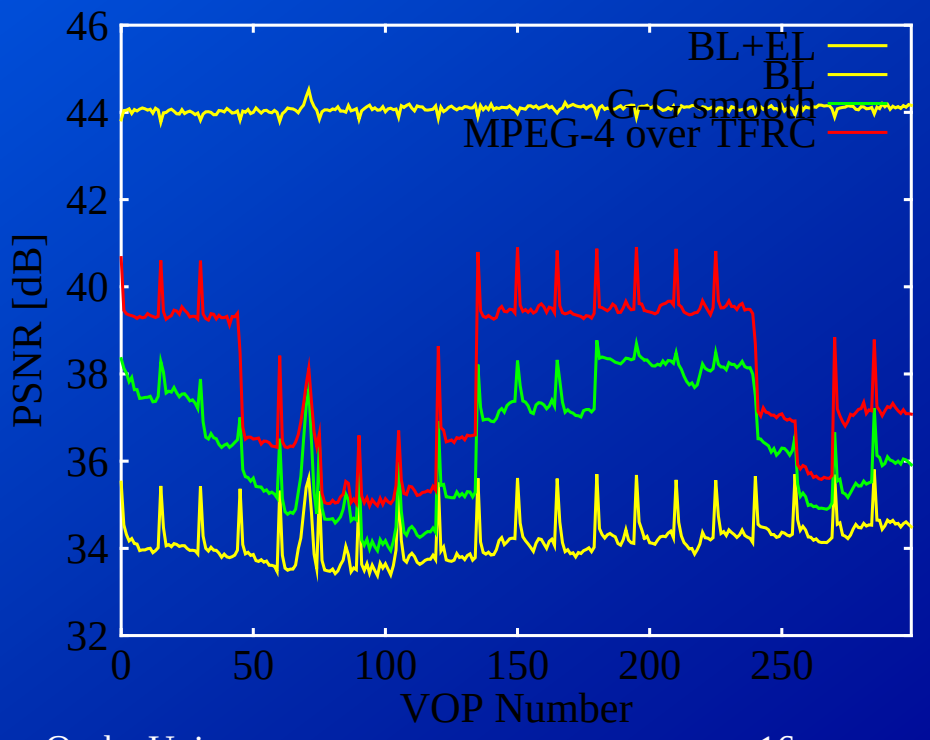




Comparison: FGS vs. MP4

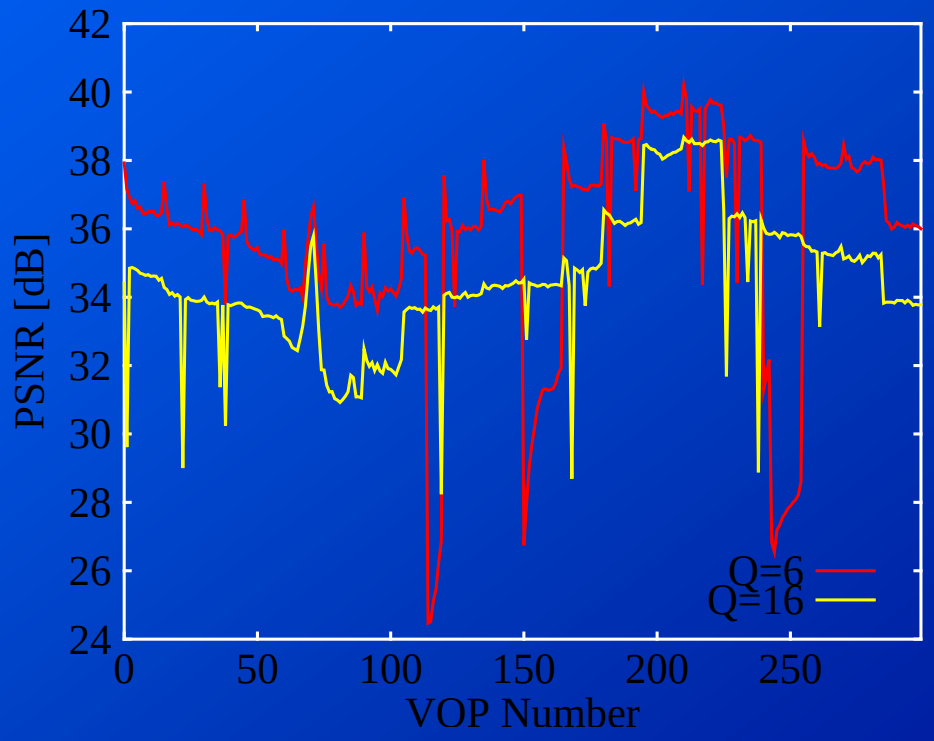
- Quantizer scale based rate control for conventional MPEG-4
  - Averaged rate over GOV fits to the target rate.





Under lossy condition

- Uniform probability 10^{-3}
- Dynamic quantizer scale based control is required.



Conclusion

- Proposed and evaluated mechanisms for TCP-friendly transfer of FGS video
- G-G smooth is the most preferable method ..... whereas rate variation is inherently unavoidable
- As future works,
  - Rate and quality control mechanisms under lossy condition
  - Implementation issues