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ConEx Based QoE Feedback to Enhance QoS

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QoS and QoE

- › Quality of service (QoS) :
 - Designates the objective measure of the quality of a network's service, usually in terms of bandwidth, latency, jitter, packet loss, availability.

- › Quality of experience (QoE):
 - Designates the measure of how satisfied the end-user is of a communication service. (subjective or objective)
 - › e.g. MOS and R factor (ITU G.107, E-Model)
 - QoE is greatly impacted by QoS parameters.

Question raised:



How to dynamically relate the QoE to QoS with the goal of fine tuning and adjusting the QoS in response to QoE degradation?

- › 1-Need to estimate QoE (MOS factor equivalent for various applications)
 - VoIP application: E-Model by ITU-T G.107
 - QoE evaluation techniques for video and web browsing
- › 2-Need to communicate the QoE information to QoS mechanisms
 - With scalability and synchronization challenges



QoE information transmission

- › Out-of-band signaling of QoE:
 - Scalability and synchronization issues
- › Application layer protocols (e.g. RTCP extended reports)
 - These are often at layer 7 while most QoS mechanisms are at layer 3
- › Options:
 - Develop new protocol at IP layer
 - Use existing feedback protocols



ConEx overview

- › ConEx is an experimental protocol defined at IETF
 - It allows the sender of a flow to convey the ECN information back towards the network
 - This extension aims at providing routers the information about congestion downstream towards the receiver and to provide accountability of senders that take part in congested routes.
- › ConEx with TCP : re-ECN (draft-briscoe-conex-re-ecn-tcp-01)
 - IPv4: uses the last unused bit (bit 48)
 - IPv6: new option header (draft-ietf-conex-destopt-03):

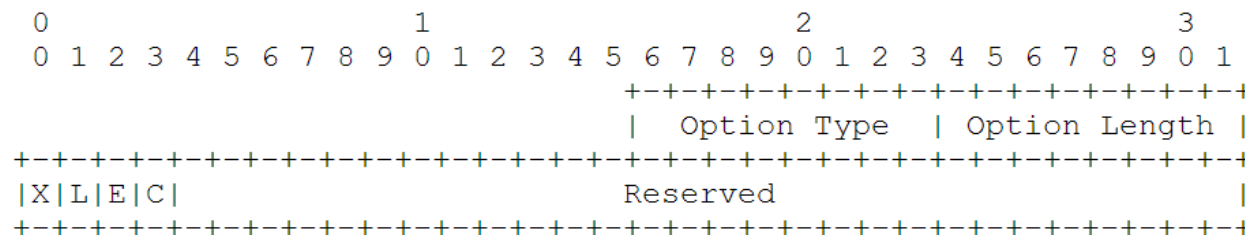
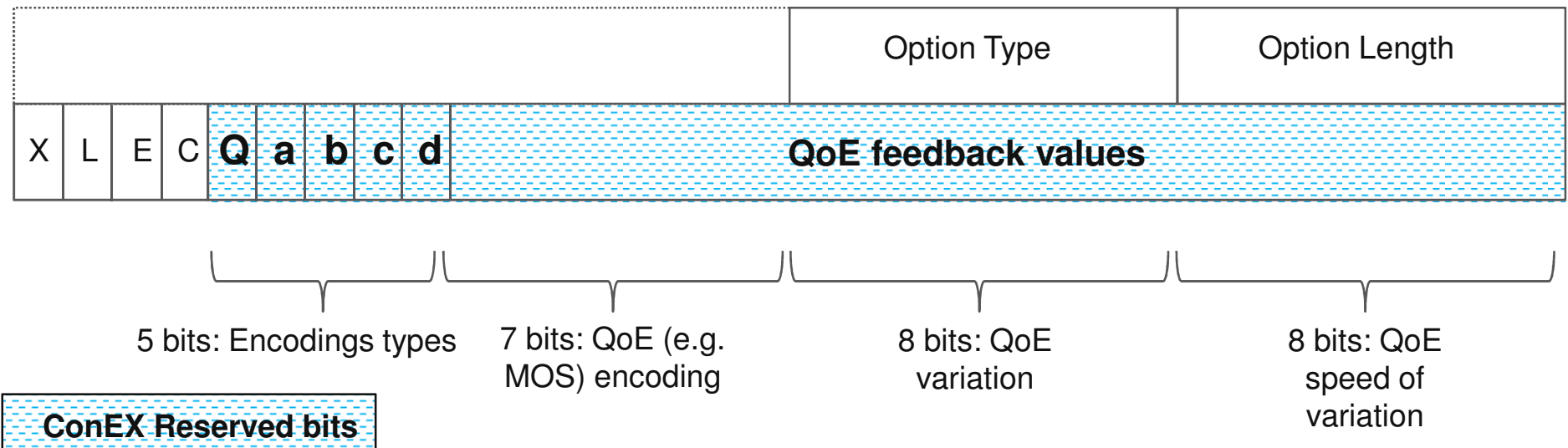


Figure 1: ConEx Destination Option Layout



QoE feedback using ConEx

- › IPv4: set the RE flag to convey QoE degradation information.
- › IPv6:

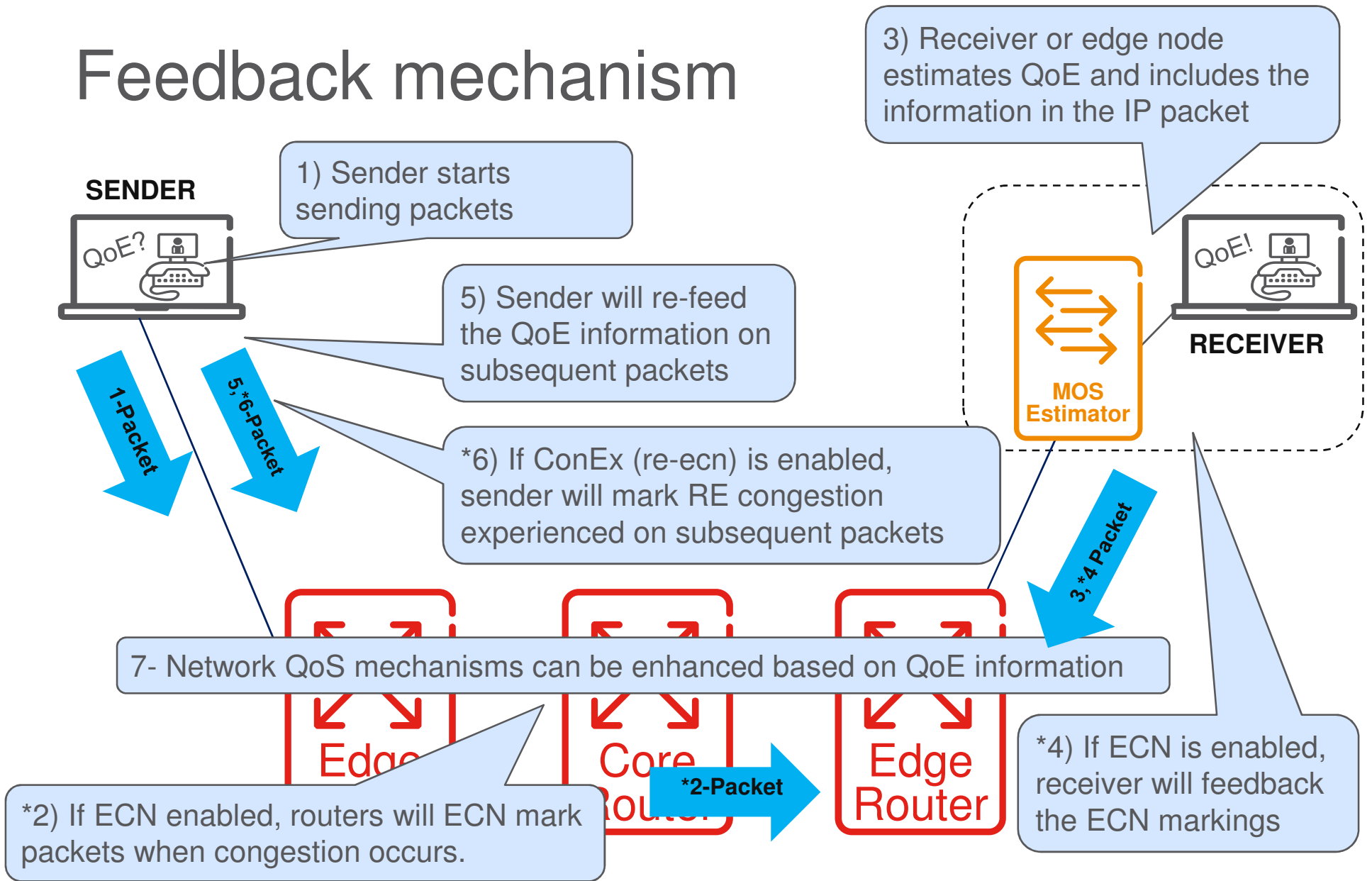




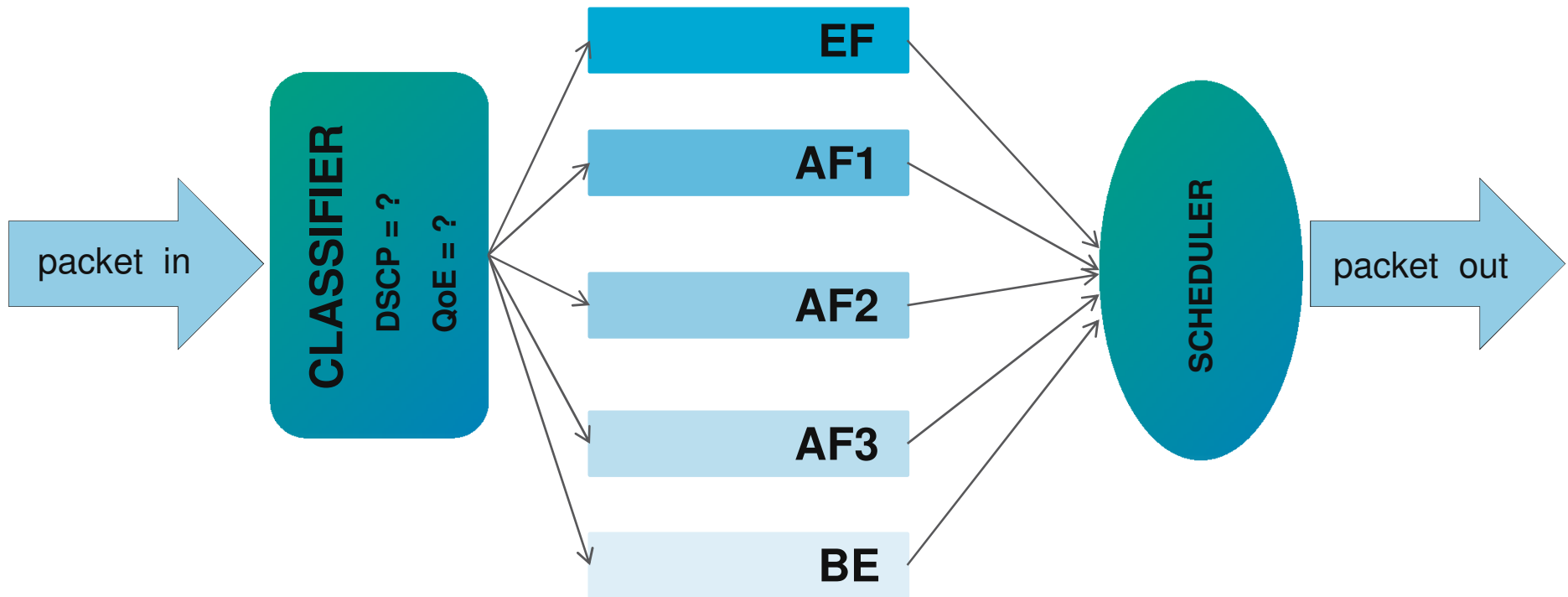
Example QoE formats in ConEx

- › Single bit QoE degradation signaling
 - Only possibility for IPv4
- › QoE plain value:
 - The actual MOS equivalent value (could be R-Factor)
- › QoE variation:
 - The variation of QoE between two computation point
- › QoE speed of variation:
 - The rate of change in a given time frame window

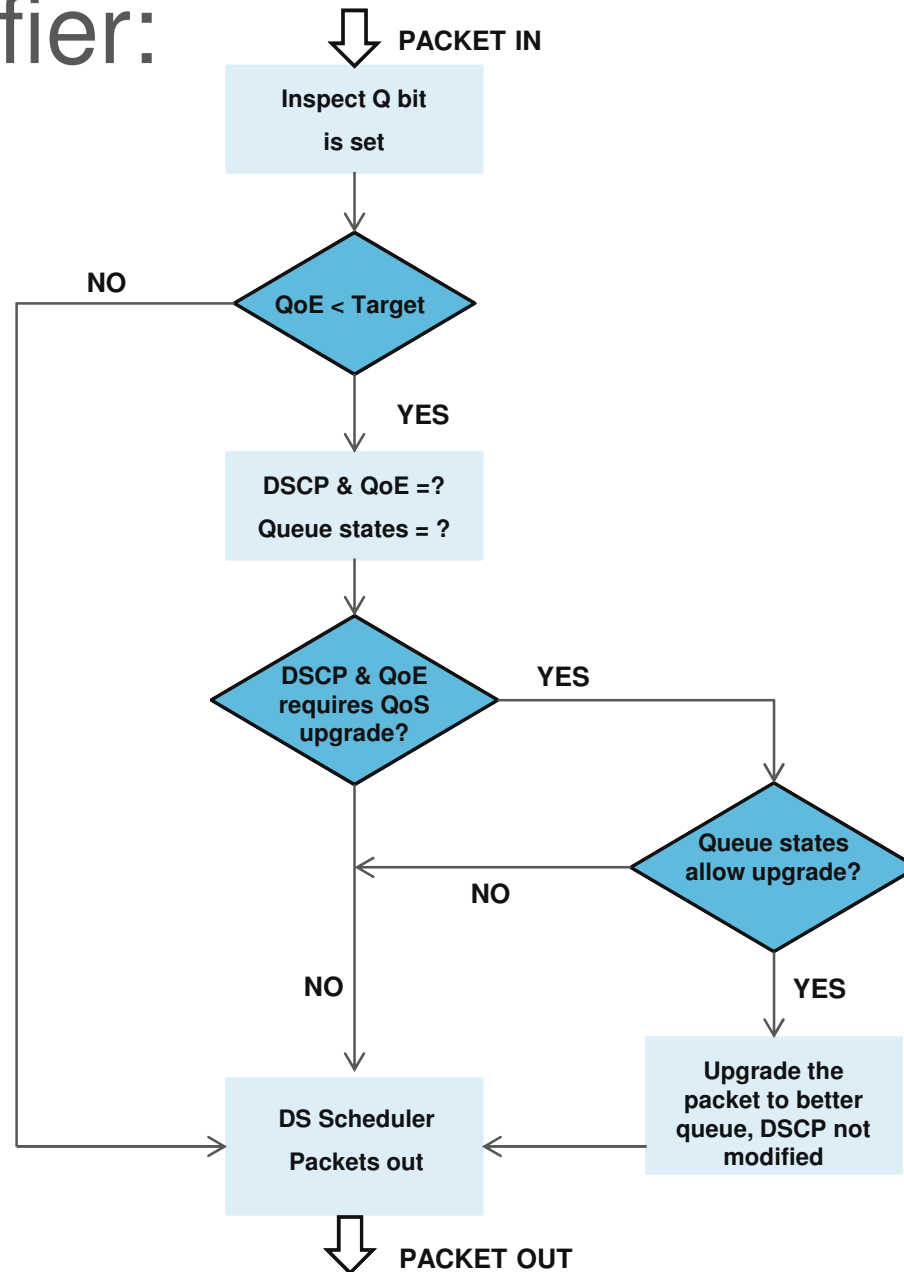
Feedback mechanism



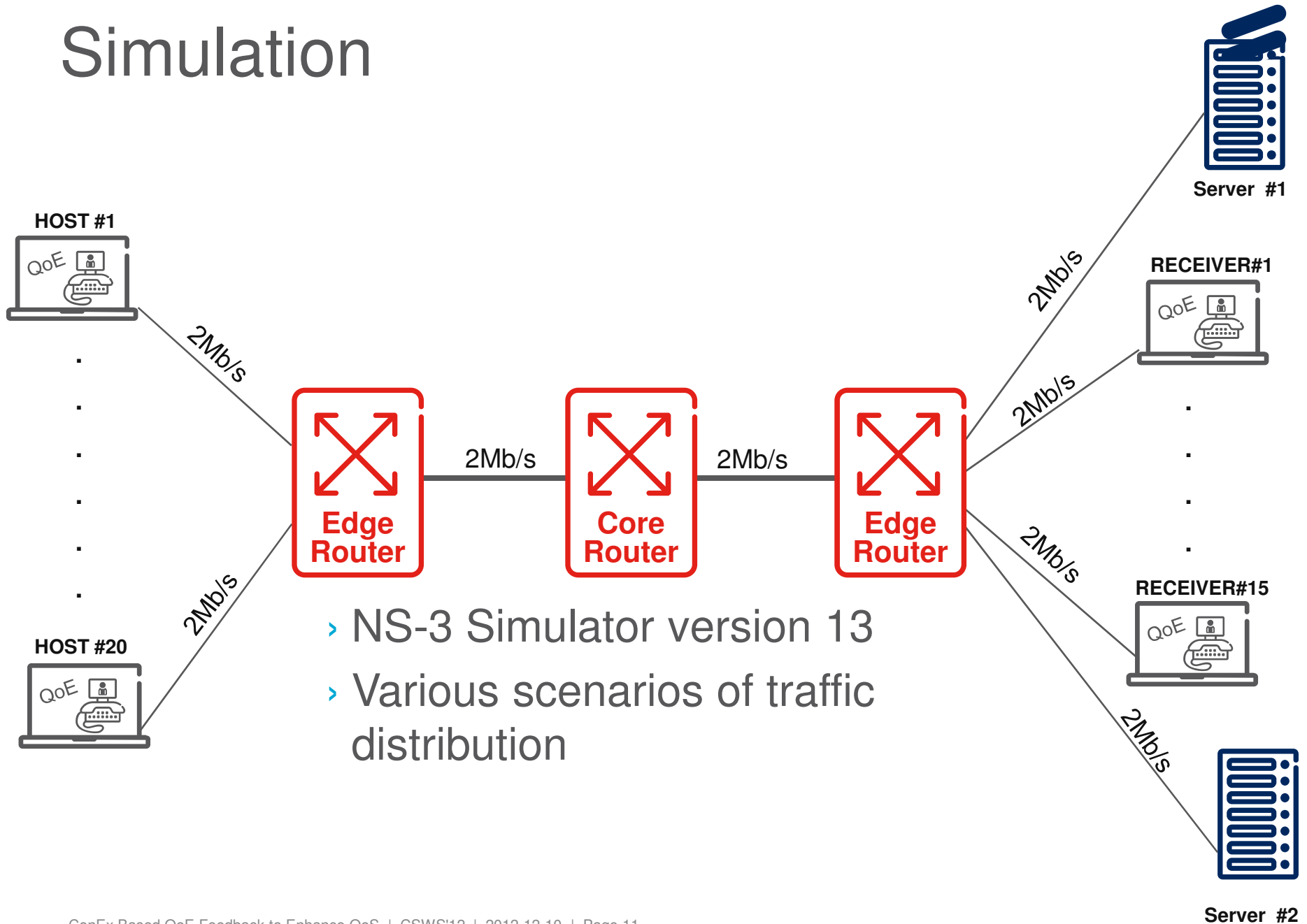
Multi-Field DiffServ Classifier



MF Classifier:



Simulation





Simulation Results

Table 4: QoE feedback QoS results- QoE gain

Scenario	average gain	MIN gain	MAX gain
1	0.98%	10.14%	-0.92%
2	1.45%	7.84%	-0.95%
3	5.40%	24.53%	-2.03%
4	2.29%	11.23%	-0.95%

Table 5: Measured MOS values

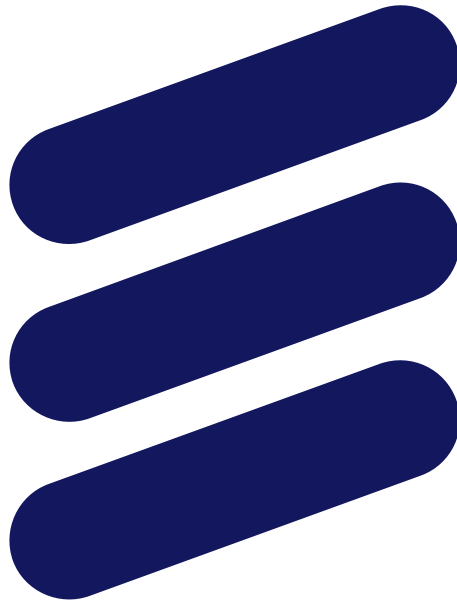
Scenario	MIN	MAX	AVG
1	2.1	4.1	3.2
2	2.2	4.1	3.3
3	1.8	4.1	3.1
4	2.1	4.1	3.2

- › Preliminary results presented in this paper
- › More tuning and performance testing is required
- › Overall the results show that QoE information can be used in feedback loop to influence QoS and help keep QoE at acceptable levels.



Conclusion

- › Presented a new method for in-band QoE feedback (using ConEx protocols).
- › Future work:
 - Enhance queuing schemes with QoE information
 - Enhance other QoS mechanisms with QoE information
 - Study overall architecture (malicious hosts etc.)
 - Develop simulator fully



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