Access Network Sharing between Core Networks with Different QoS Policies

NETWORKS 2008
13th International Telecommunications Network Strategy and Planning Symposium
SEPTEMBER 28 - OCTOBER 2, 2008
Danubius Health Spa Resort Margitsziget
Budapest, Hungary

Akihiro Okada, Akira Murashige,
Daisuke Tazawa, Shinichiro Chaki

NTT Network Service Systems Laboratories, Japan

Outline

- Background
- Objective
  - To cut down the cost and time in building NGN, we propose to share the access network.
- Causes of QoS degradation
  - Major QoS degradation caused by this network sharing
- Evaluation model & results
  - To confirm the effect of degradation causes
- Summary

Background

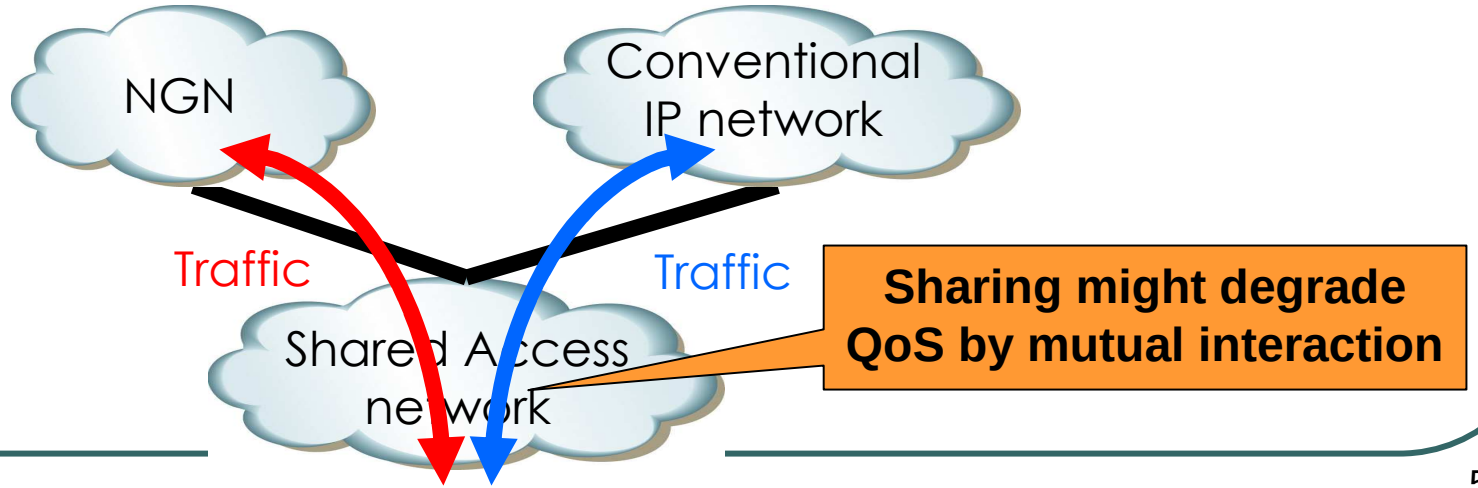
- Many countries have been planning or constructing their own NGNs.
  - For example,
    - In Japan, Nippon Telegraph and Telephone Corporation (NTT) started commercial service in March 2008.
    - British Telecom is migrating a new IP-based network known as 21st Century Network (21CN).
    - AT&T have defined an architecture called ‘common architecture for real-time services’ (CARTS).
  - NGNs are about to start service worldwide.

Background

- Communication carriers have two types of networks: NGN and conventional IP network.
  - NGN
    - NGN is a QoS-guaranteed network.
    - Each service is classified into a proper QoS class.
    - The ‘resource and admission control function’ (RACF) is used to ensure communication quality.
  - Conventional IP network
    - Conventional IP network is a best-effort-based network.
    - Majority is best-effort traffic. high-priority traffic is a minority.
    - Communication carriers manage network capacity to control communication quality.
- The difference will cause problems.

Objective

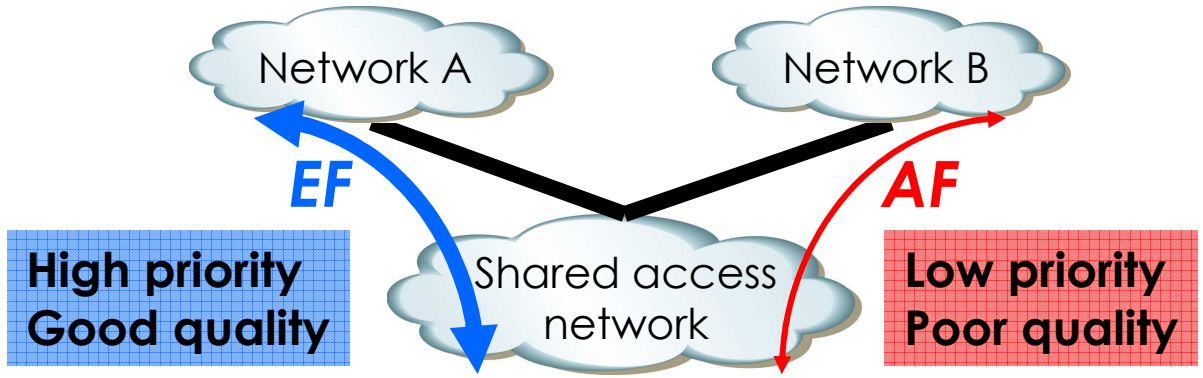
- The purpose of our study is
  - to reduce NGN construction cost and enable rapid migration
  - by sharing access network
    - Constructing an access network causes a bottleneck.
  - consequently, to evaluate the influence on conventional IP networks' QoS



Cause A of QoS degradation

A) Different priority class assignment to the same kind of service

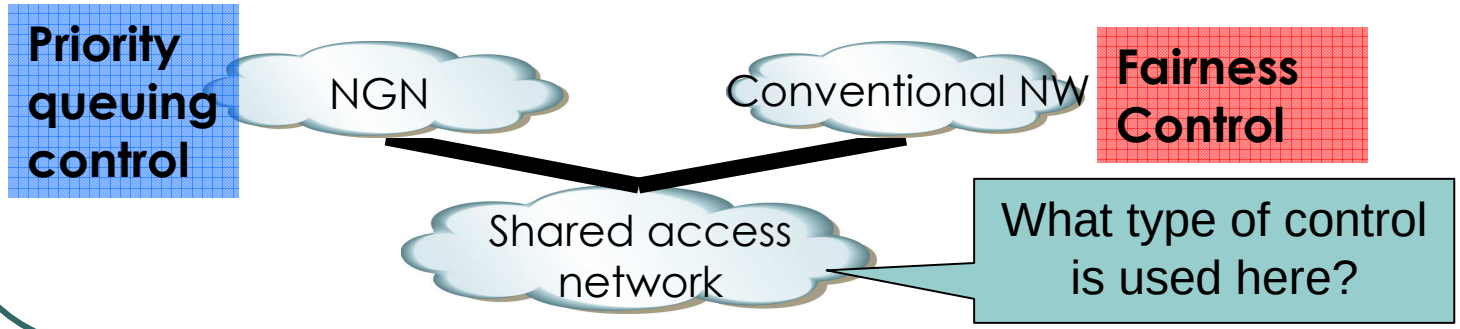
- An example
  - Network A sets IP telephony as EF (1st priority).
  - Network B sets IP telephony as AF (2nd priority).
  - Communication quality is different, although both networks provide the same service.



Cause B of QoS degradation

B) Multiple QoS control policies

- Priority queuing control (fit for an NGN)
  - It gives strict precedence to higher-priority traffic.
- Fairness control (fit for a conventional network)
  - The same bandwidth is allocated for each user.
- Only one control policy can be used.
  - control policy of the conventional network must be changed partly.

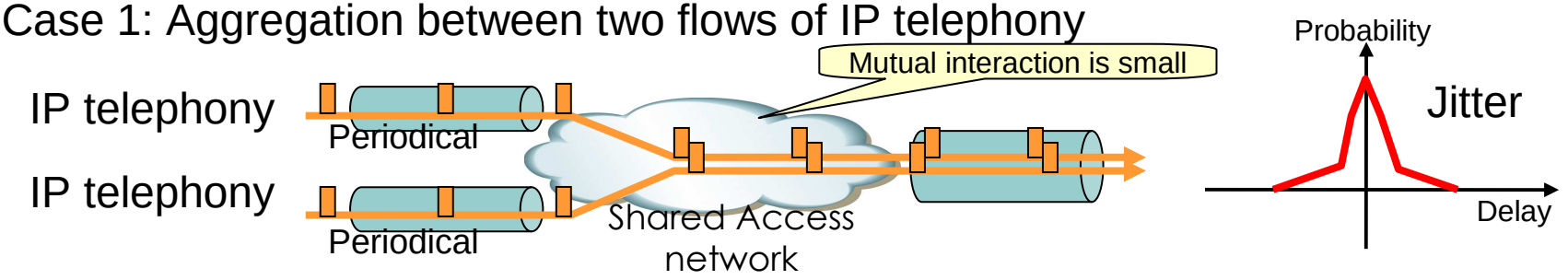


Cause C of QoS degradation

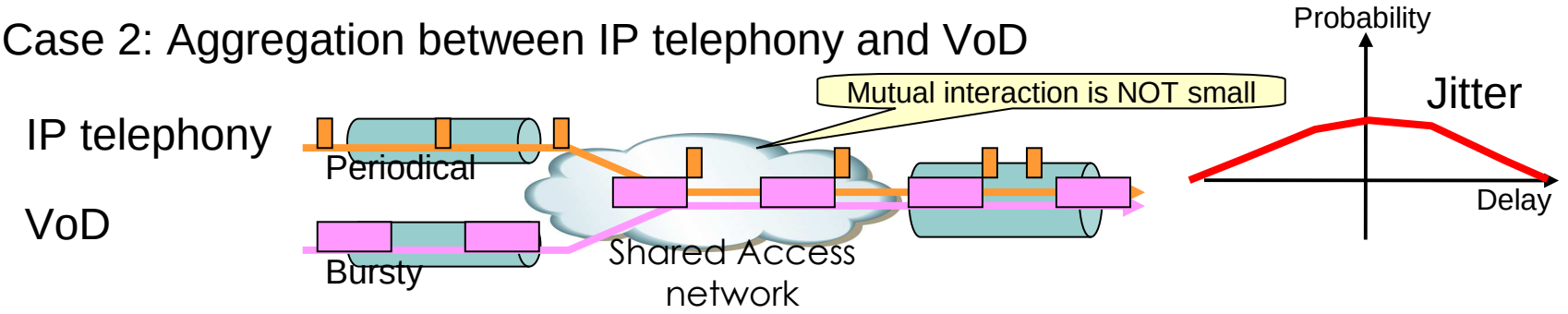
C) Characteristics of communication

- Amount of degradation depends on traffic characteristics

Case 1: Aggregation between two flows of IP telephony



Case 2: Aggregation between IP telephony and VoD



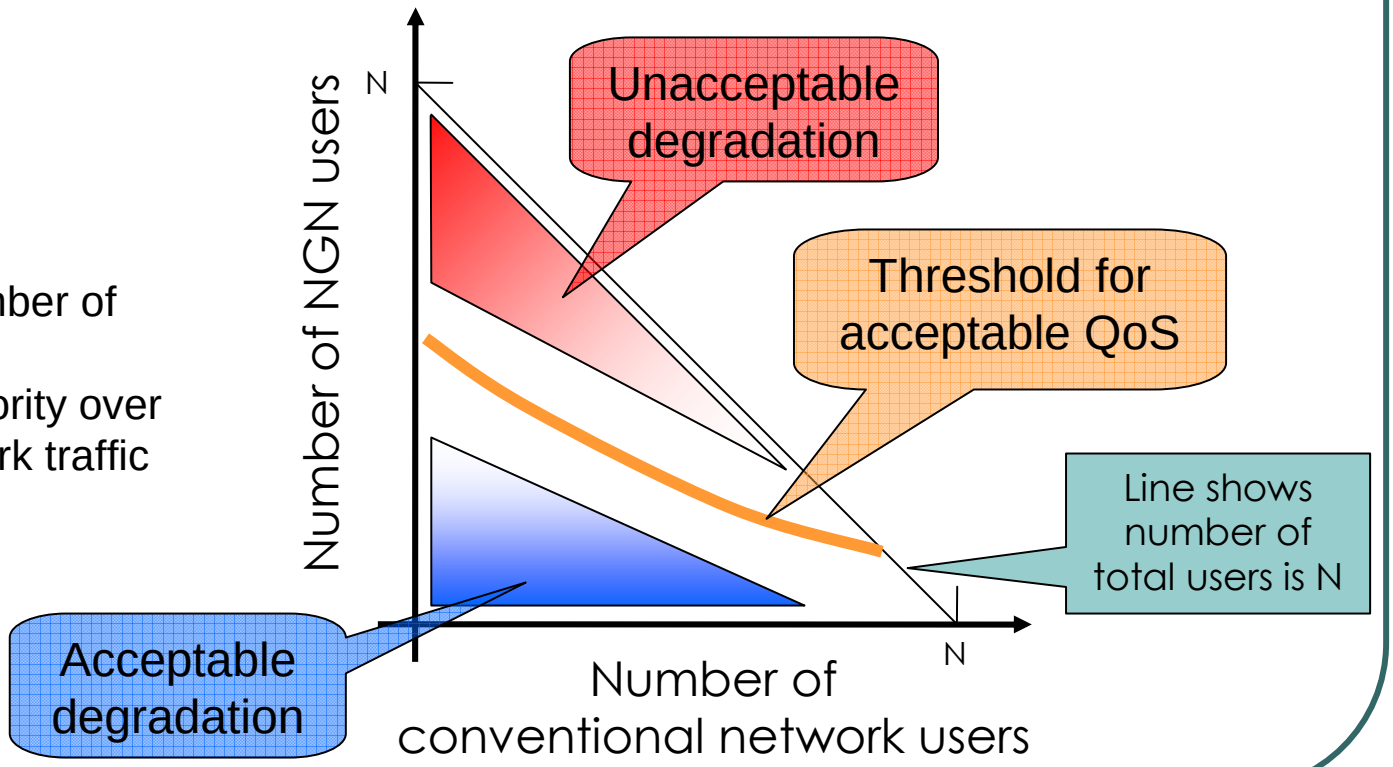
- Type of services influences quality.

Cause D of QoS degradation

D) Number of accommodated users

- Relation between the number of users and degradation

Assumptions
- Maximum total number of users is N
- NGN traffic has priority over conventional network traffic



Model and evaluation

- We evaluated QoS degradation
  - to confirm whether or not the 4 previously described causes lead to degradation
    - Just a qualitative analysis
  - by using real access network equipment and a traffic generator
  - by using estimated NGN traffic information

Model

- Basic concept of our traffic and network model
  - We used very heavy traffic to ease observation of degradation.
    - Very bursty traffic
    - High volume traffic
      - Total volume is over the access network capacity.
    - Large ratio of high-priority class packets
  - Priority queuing control is used at access network.
  - Ratio of numbers of both networks' users is used as a parameter.

Model

- Service model concerning QoS
  - IP telephony services are in different classes.
  - VoD and IP telephony are in the same class.
  - NGN provides video communication service.
  - Internet access service is marked as BE in both networks.

Services and priority classes

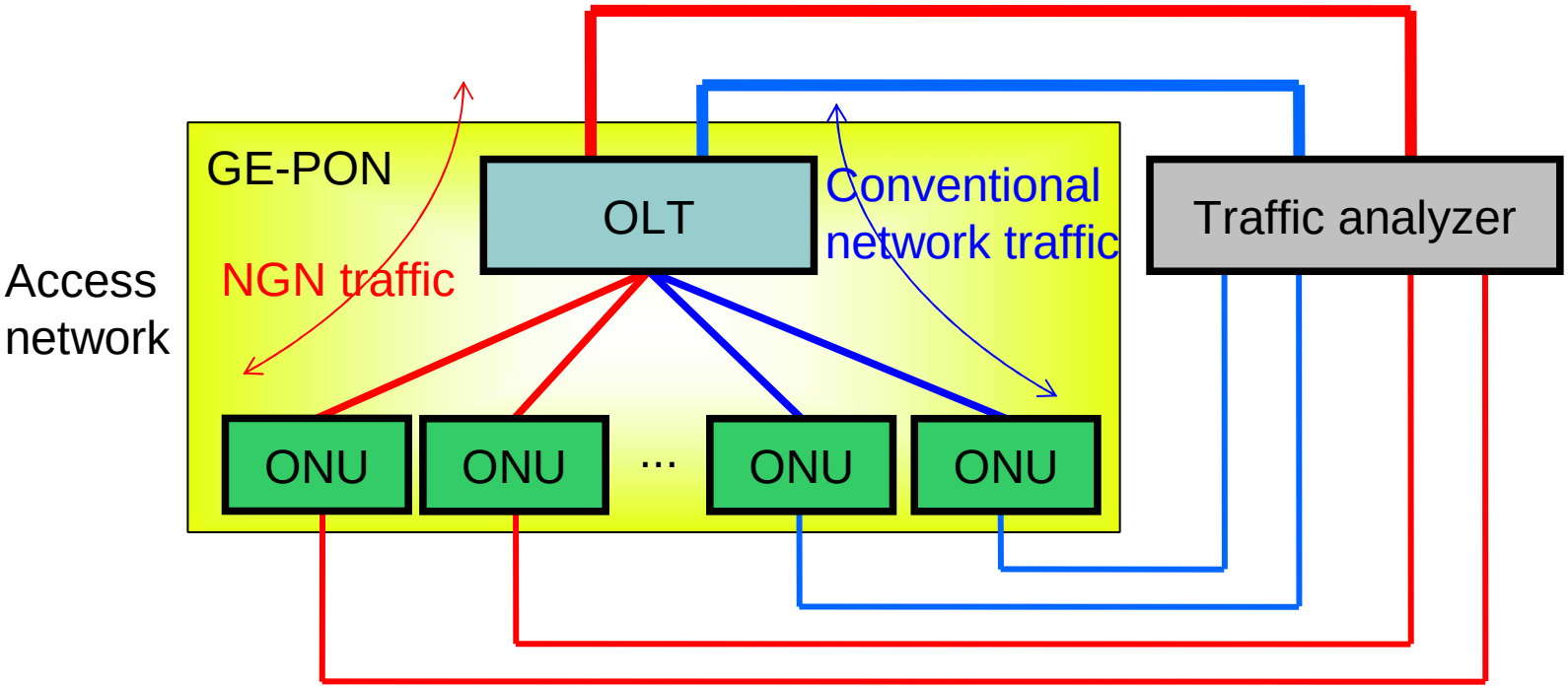
Priority class	NGN	Conventional NW
EF	**IP telephony** Video communication	None
AF	**Video on demand**	**IP telephony**
BE	Internet access	Internet access

Cause A

Cause C

Model

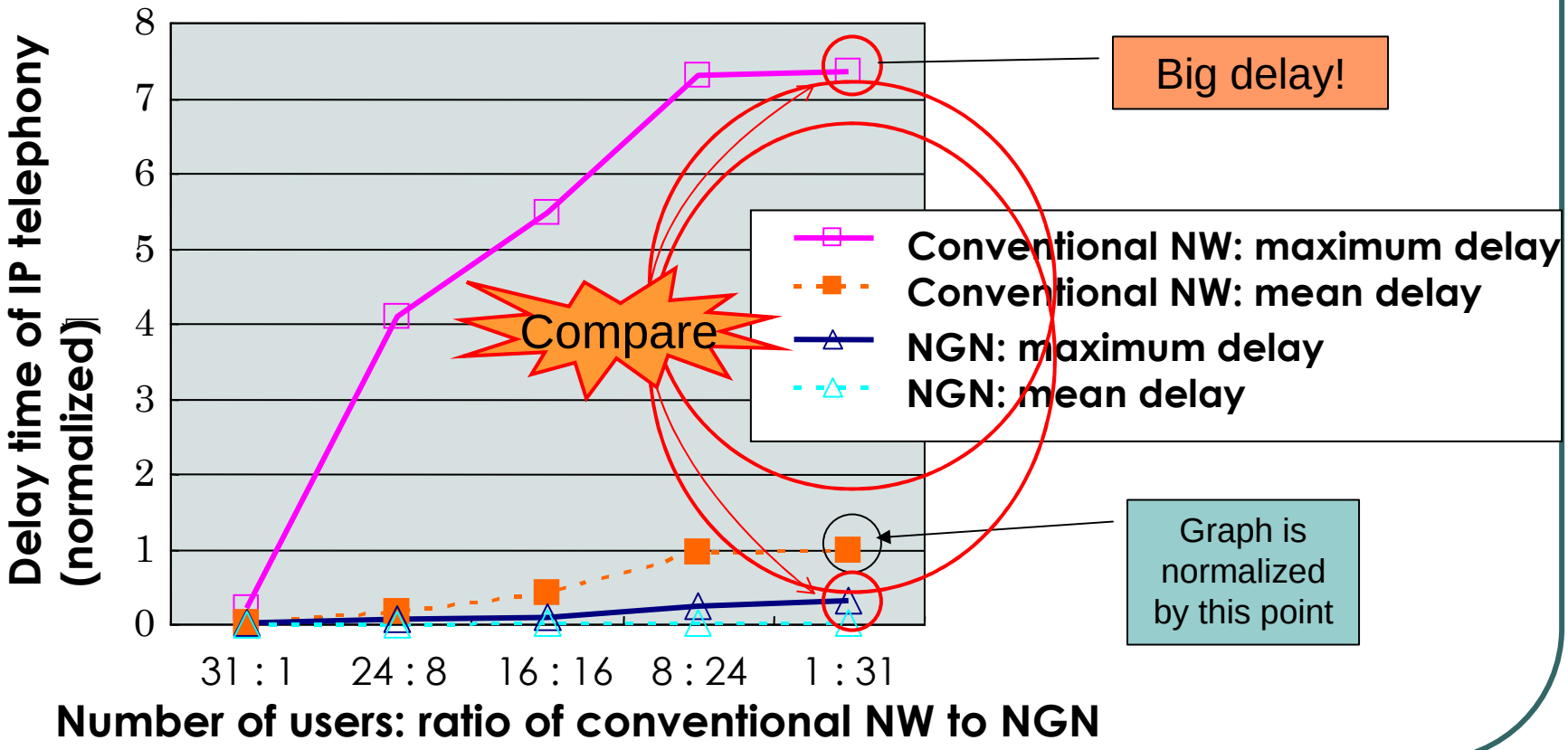
- Experimental equipment



GE-PON: Gigabit Ethernet - passive optical network
OLT: Optical line terminal
ONU: Optical network unit

Evaluation results

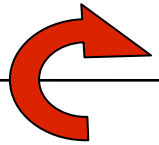
- Maximum delay of conventional NW is over 20 times as long as that of NGN.



Improvement method

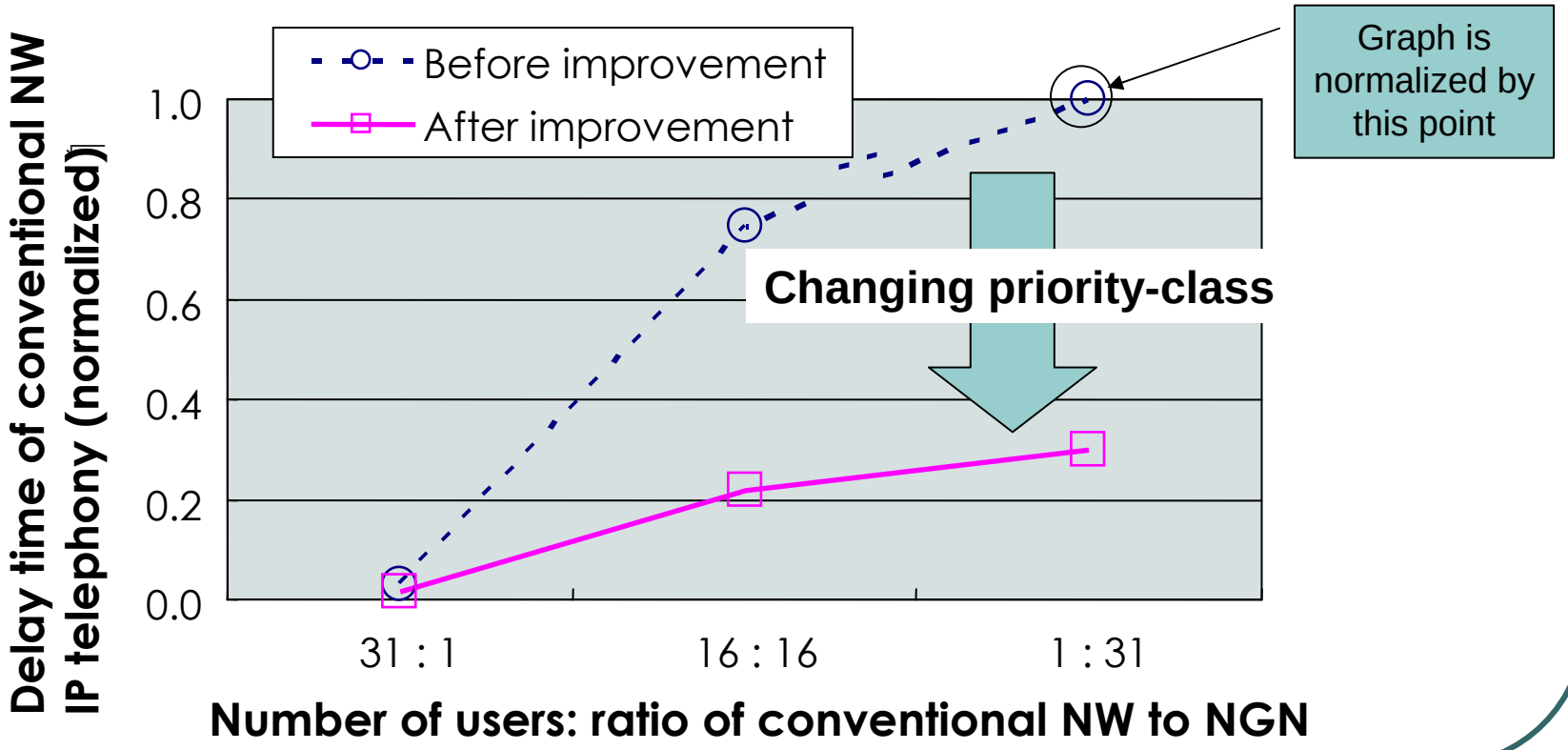
- One of the major root causes of this degradation is mismatch of priority class (i.e., Cause A).
- To reduce this degradation
  - We changed priority class within each access network device.
    - Conventional network IP telephony: from AF to EF

Priority class	NGN	Conventional NW
EF	**IP telephony, VoD**	**IP telephony**
AF	**Video on demand**	IP telephony



Result of improvement method

- Delay is reduced by the improvement
  - Degradation is certainly caused by Cause A.



Summary

- We discussed communication quality when using shared access networks.
- We listed causes of QoS degradation and confirmed degradation by examinations.
- Delay of a conventional network is over 20 times as long as that of an NGN.
- Delay is reduced to one third by adjusting priority class.

Thank you

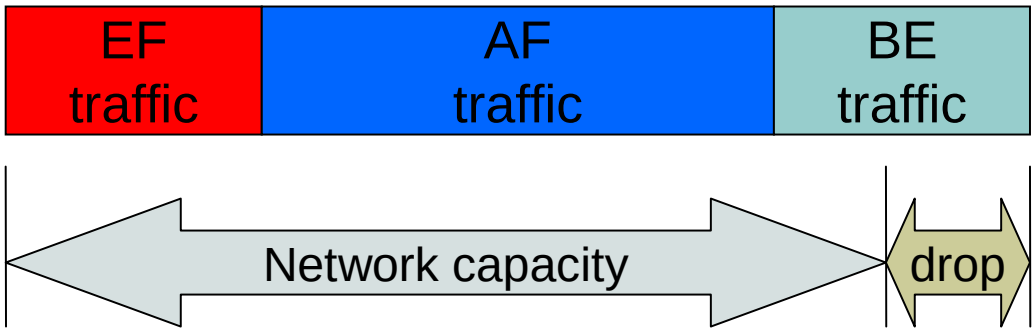
- for your attention.

Future work

- is to confirm the effect of degradation causes B, C, D.
- is to make an evaluation environment by using computer simulation.

Model

- Traffic model (volume of each service)
  - EF traffic: about 25%
  - AF traffic: about 50%
  - BE traffic: about 25%
  - Total volume is over the network capacity
    - A part of BE packets will be dropped



Objective

- Why did we select access network?
  - Which is better, core network or access network?
  - Total construction cost depends upon circumstances
  - Access network requires much time to construct because it must cover a large geographical area

	Number of equipments	Price of each equipment	Location
Core network	small	expensive	in some sites
Access network	large	cheap	large area

This is the reason

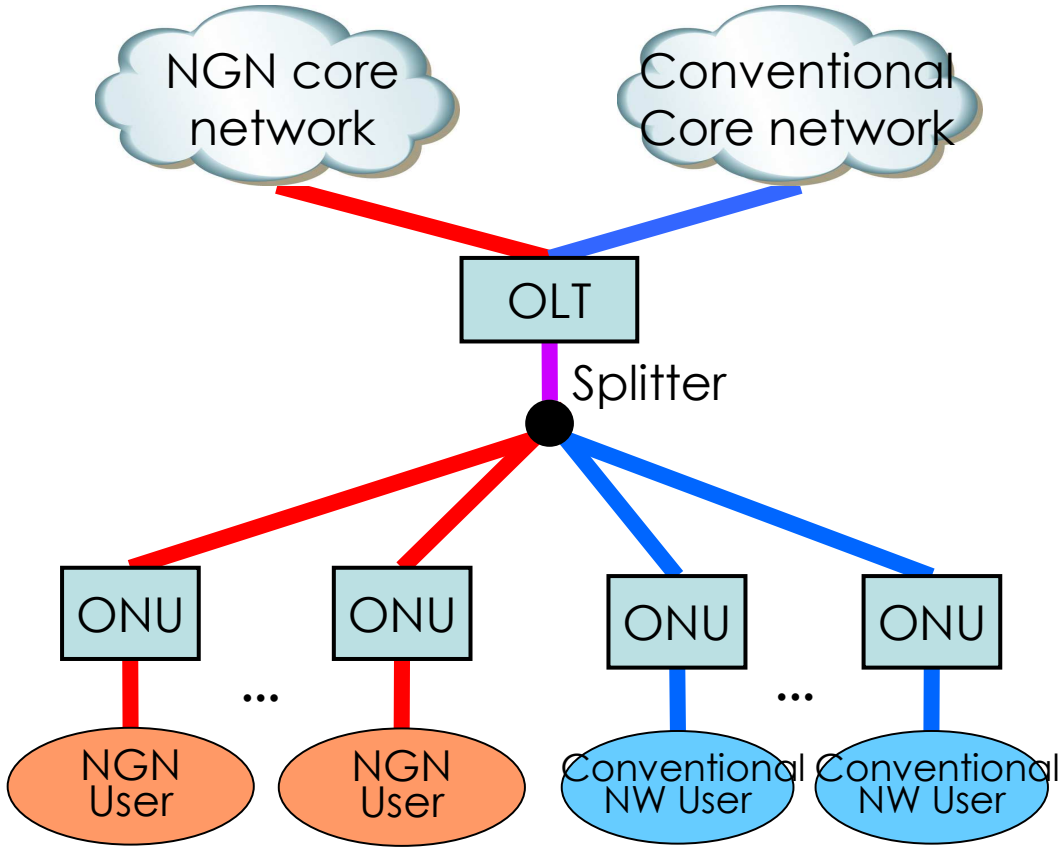
Model

- Traffic characteristics of services

Service type	Bandwidth	Packet length	Periodically or bursty
IP telephony	About 100 k bps	Short	Periodically (20ms)
Video communication	Around 1-4 M bps	Long	Bursty
VoD	Around 3-10 M bps	Long	Very bursty
Internet access	Remains of the others	Long	Bursty

Model

- An example of sharing access network



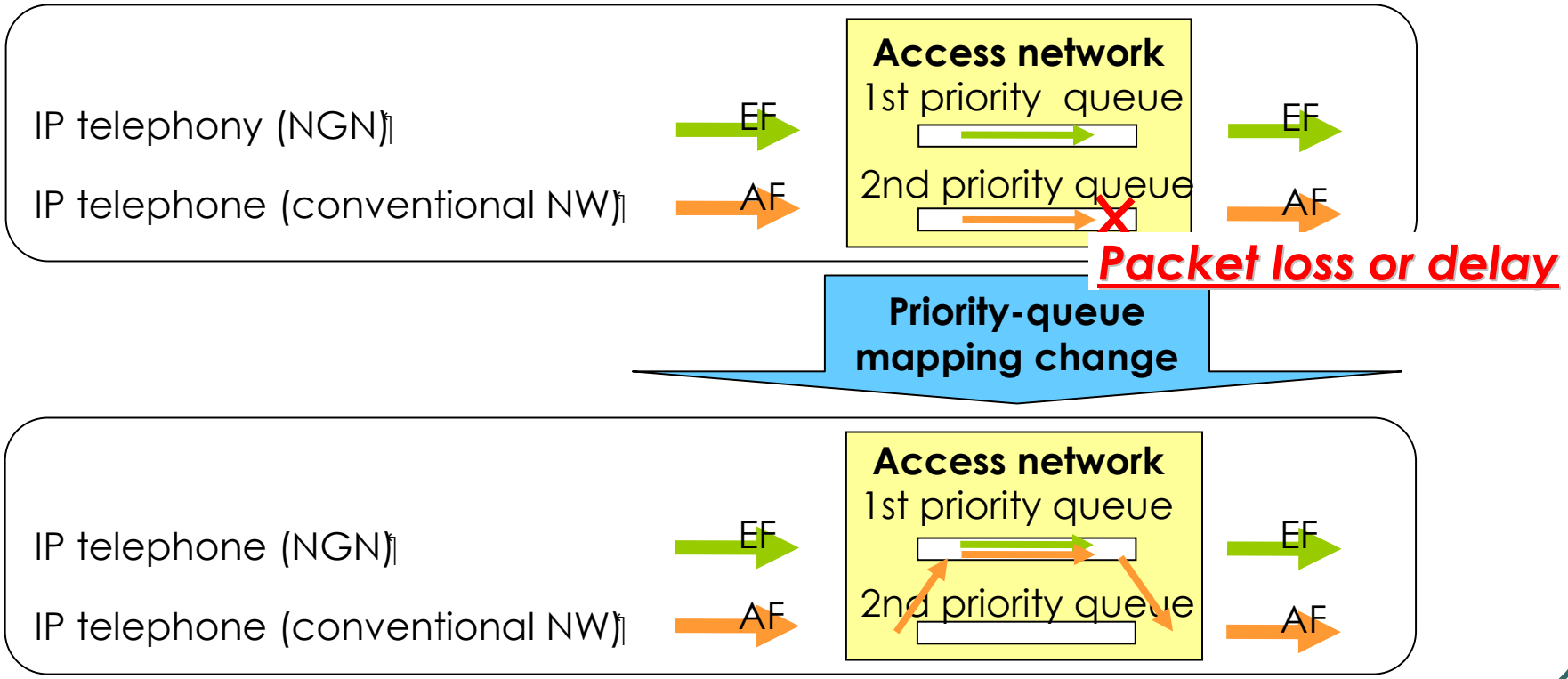
Model

- two types of networks below are used
  - QoS-guaranteed network (QoSg-NW)
    - NGN is a QoSg-NW
    - All services are fully controlled by DiffServ
  - Best-effort-based network (BEb-NW)
    - Conventional network is a BEb-NW
    - Only IP telephony is given priority to by DiffServ

Network type	QoS Control	Number of QoS Classes
QoSg-NW	- Using DiffServ to prioritize all services	- Many (4 or 3) QoS classes
BEb-NW	- Using DiffServ to give priority to IP telephony only - Managing network capacity	- One or two classes

Improvement method

- Changing priority-queue mapping in access network



Result of improvement method

- Deviation of delay becomes smaller after improvement.
  - Standard deviation reduced from 1 to 0.06.