



VoIP and Broadband Technologies

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IP Traffic design and Regulation

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IP Traffic Design and Regulation Content

- **Network design issues**
 - Flow types
 - Design criteria and traffic processes
- **IP Traffic Characterization**
 - Statistical properties
 - Dimensioning
- **Regulation issues in NGN flows**
 - Regulation issues
 - Proposal for multiservice traffic unit



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Traffic flow types for Quality of Service based dimensioning

- **QoS constant stream:** bandwidth transmission at a constant speed with a specified delivery and jitter (ie: video distribution)
- **QoS variable stream :** bandwidth transmission at a variable speed derived from a user information and coding algorithm which requires guaranteed quality and specified jitter (ie: VoIP, Video streaming, audio streaming, etc.)
- **QoS elastic:** bandwidth transmission at a variable speed without jitter restrictions and asynchronous delivery (ie: browsing, file transfer, mail, UMS, etc.)



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Traffic elements in IP Networks for QoS

- **Traffic Engineering Module**

- Traffic Engineering refers to the process of selecting the paths (LSPs) in order to balance the traffic load on the various links, routers, and switches in the network. A major goal of Traffic Engineering is to facilitate efficient and reliable network operations with guarantee of QoS while simultaneously optimizing network resource utilization and traffic performance

- **CAC**

- Call Acceptance Control function in order to accept/reject traffic in the network that allows guarantee of QoS for services with a given Service Level Agreement

- **CoS**

- Class of Service. A feature that provides scalable, differentiated types of service across a label switched network. MPLS CoS offers packet classification, congestion avoidance, and congestion management



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The Network Design Criteria

- A) Match realistic service demands and workloads for a given time
 - Node and links loads based on proper multiservice flow **characterization**, measurements and projections
- B) Consider equilibrium between QoS and cost
 - **Statistical behavior** for the flows
 - Traffic modeling for given **quality, efficiency and protection**
 - **Overload** protection and control
- C) Anticipate capacity as a function of service grow rate and needed installation time. **Reserve capacity**
- D) Follow **SLA** when different service classes coexist



IP Traffic Design and Regulation Network Design and Dimensioning

Service demand Characterization

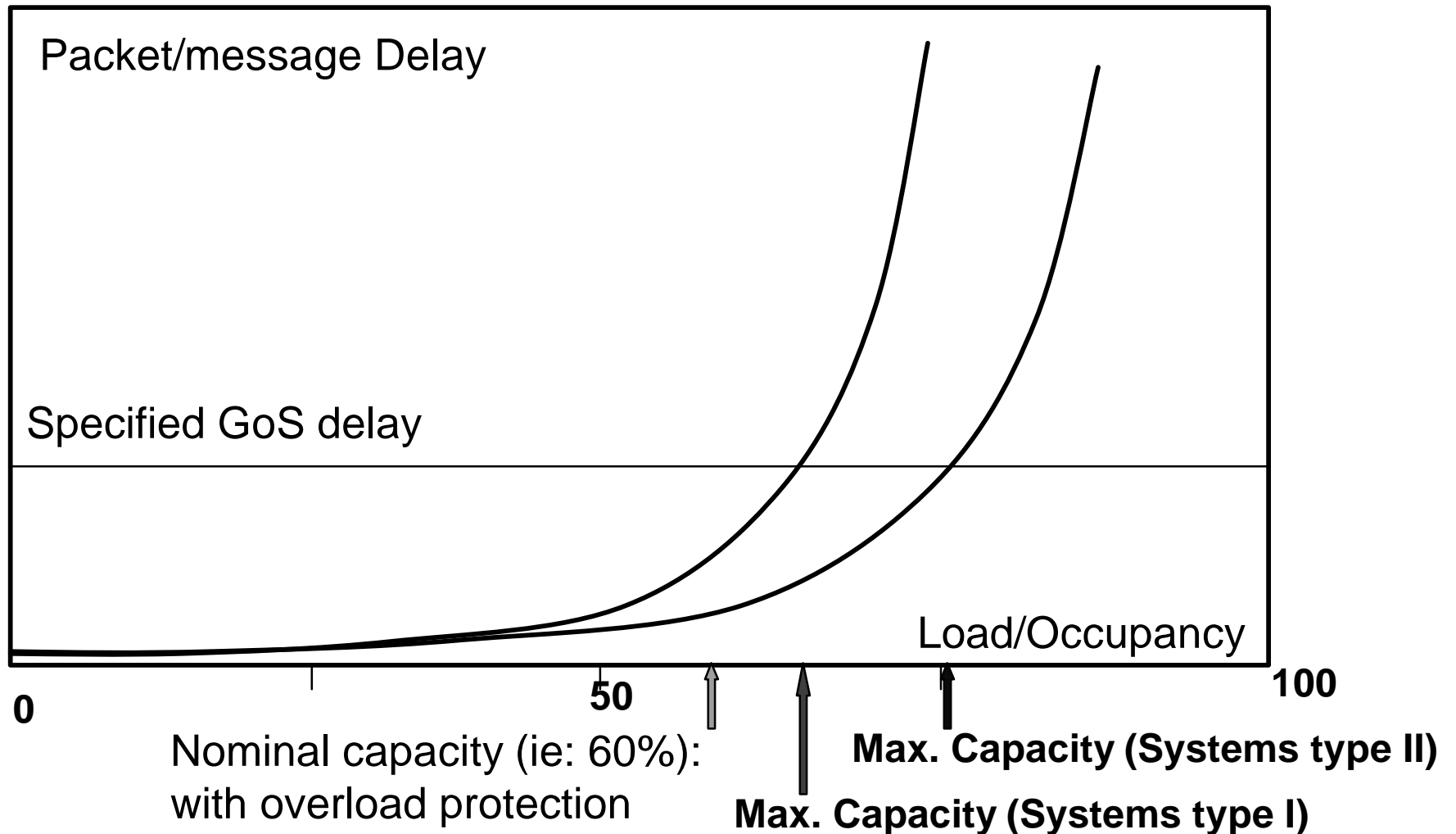
- By a profile through days in a year/week
- By a busy period within a day
- By superposition of non-coincidence of busy periods (for inter-country traffic in different time zone)
- By aggregation or convolution of flows for different services
- By interest factors between areas (adjusting matrices in the two dimensions ie: Kruithof, affinity, correlation)



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Traffic Characterization for NGN Planning

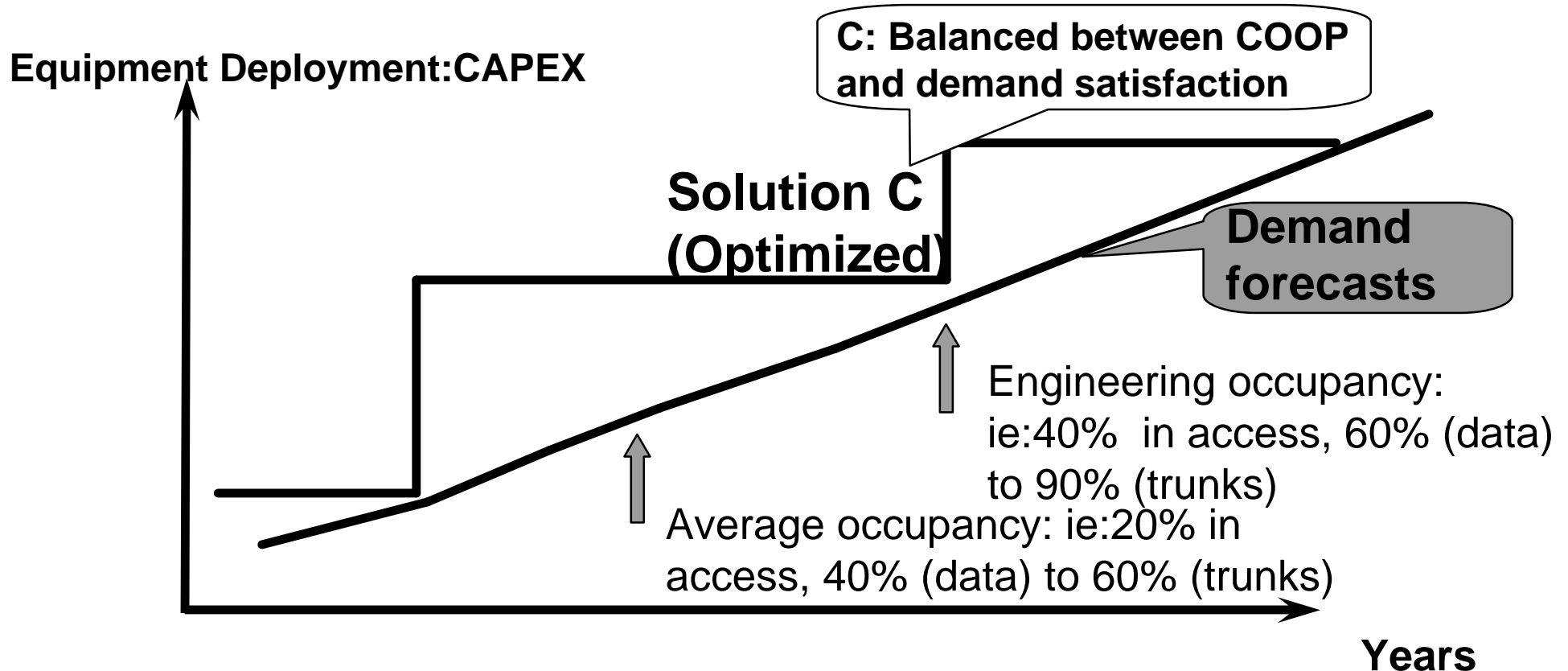
Typical dimensioning curves for delay based systems





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Model Utilization Factors through Time



Note: b) Average occupancy through time is different per network segment and is lower than engineering capacity in order to maintain QoS and economical optimum



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Network activities needing traffic characterization

- Traffic **Characterization** for Services and network flows
- Traffic **Demand** forecasting and aggregation at the user and Network interfaces
- Traffic **Dimensioning** for all network elements
- Traffic **Measurements** and Validation for SLA
- Traffic **Management** in focussed and generalized overload



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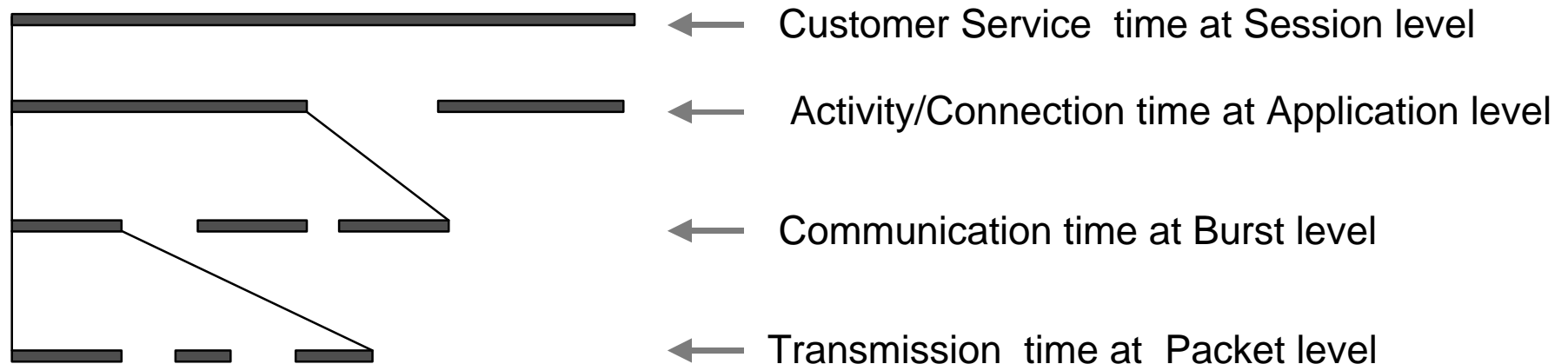
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Traffic Characterization

- Generalized utilization time and levels per user activity in the busy period : Example for IP mode



- Aggregated average traffic per level as a weighted average of the services categories (i) and customer classes (j) at that level.



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Traffic Characterization for NGN Planning

Units

- **Which** units used to predict traffic demand ?

Traditional

- Customers for given project (operator, country, region, worldwide)
- Ports associated to customers per class
- Calls generated at user interface
- Erlangs originated/terminated at user interface

New

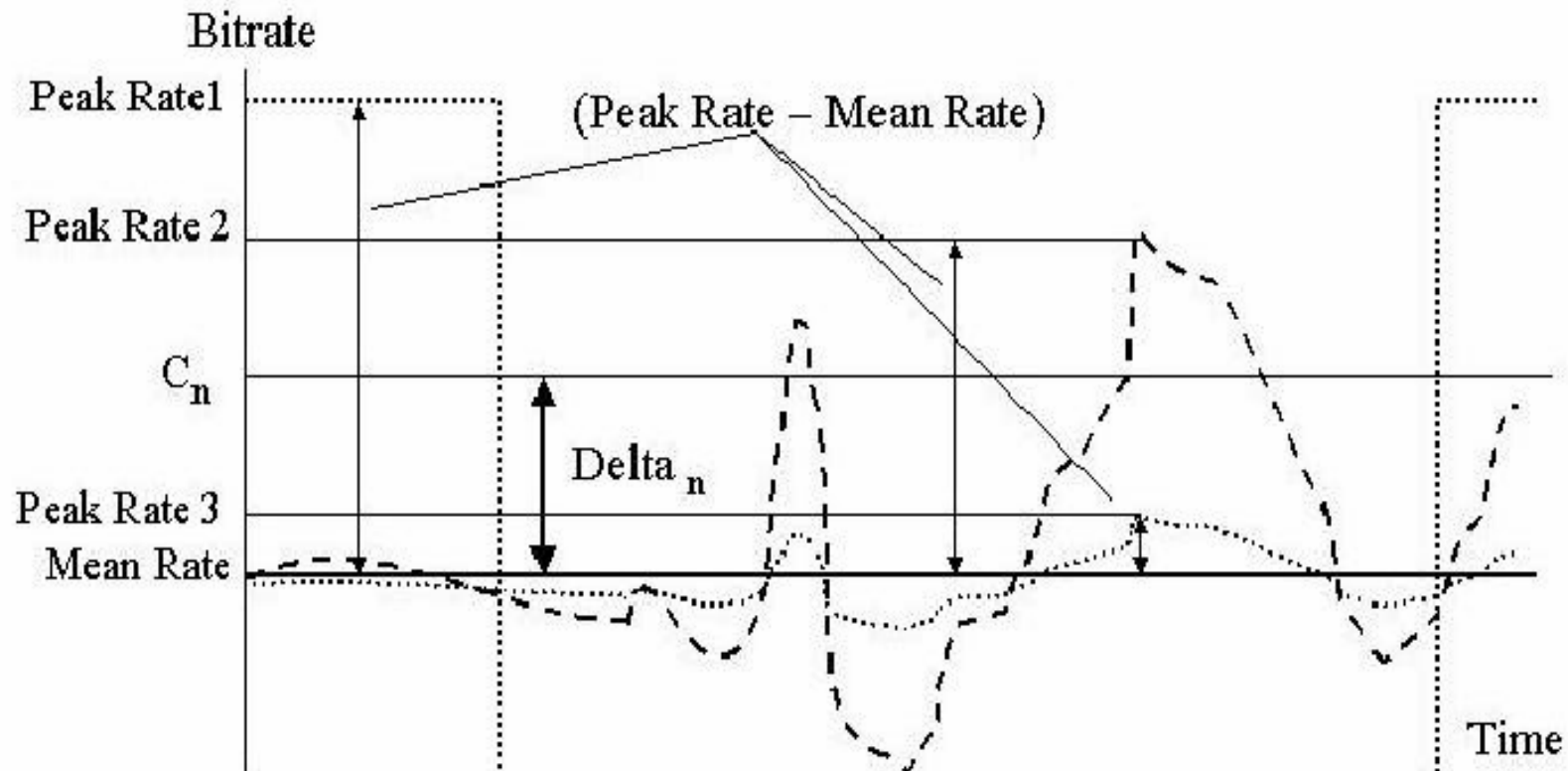
- Sessions/Information/requests generated at user interface
- Packets handled at a given resource through the network
- Mbits transported through a given network link/path



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Traffic Characterization

- Different relation between peak traffic and average traffic per service classes:
CBR (1), VBR(2), VBR(3)

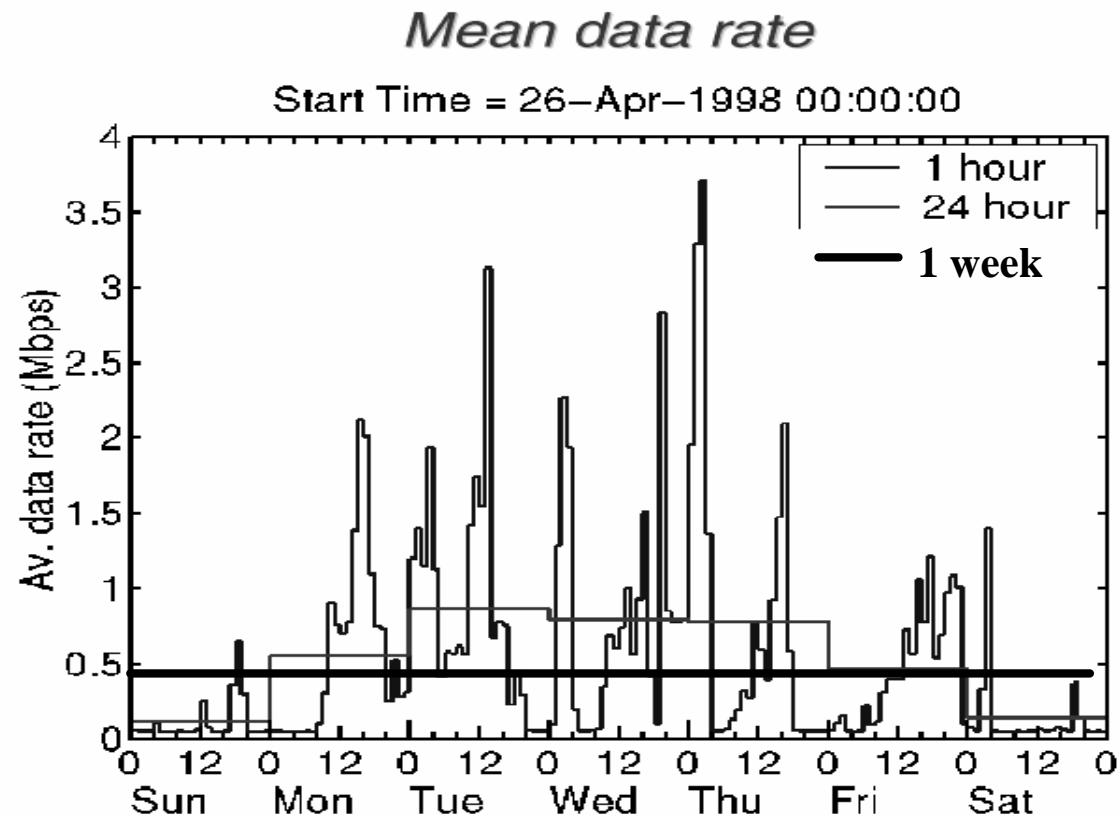




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Ejemplos del impacto del periodo de medida en el significado de valor medio en trafico IP

Medidas para Tráfico agregado de Datos en el SERC IP LAN - Australia



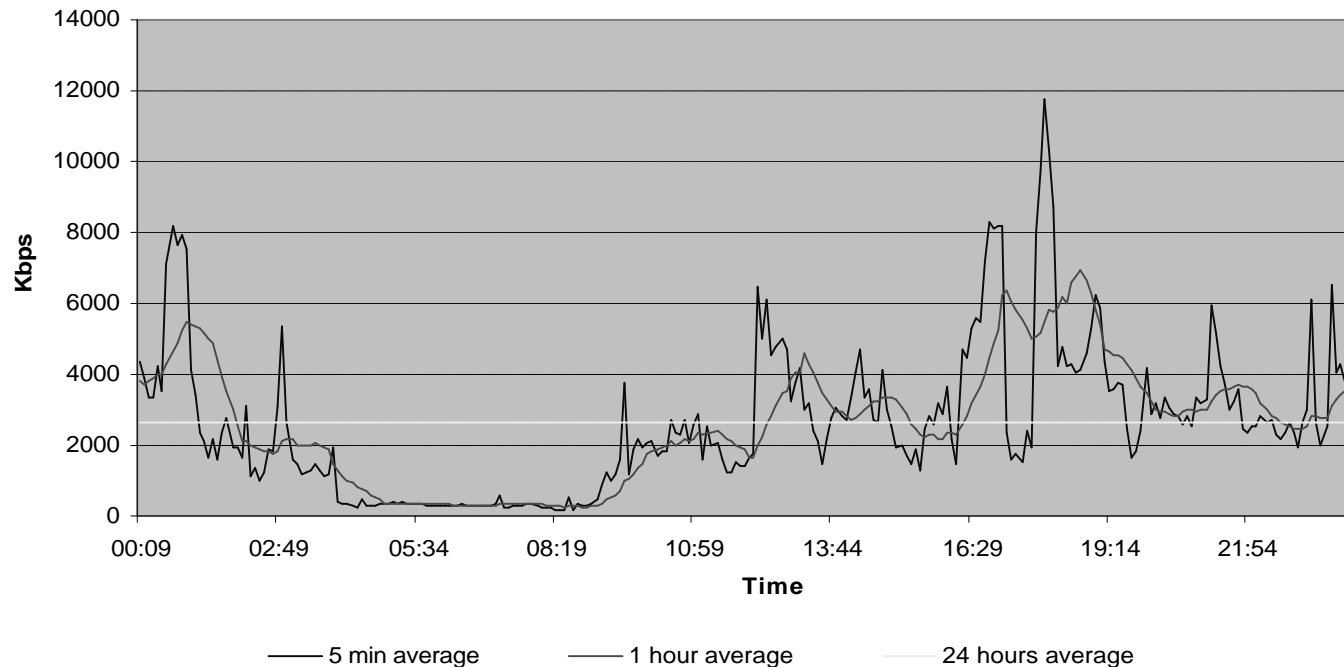


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Example of time-scale measurements and issues

Variation per measurement averaging period

ENST campus measurements in 2001 for advanced internet applications



- Impact of averaging period
 - 1,8:1 ratio between “5 min” and “1 hour”
 - 2,3:1 ratio between “1 hour” and “24 hours”



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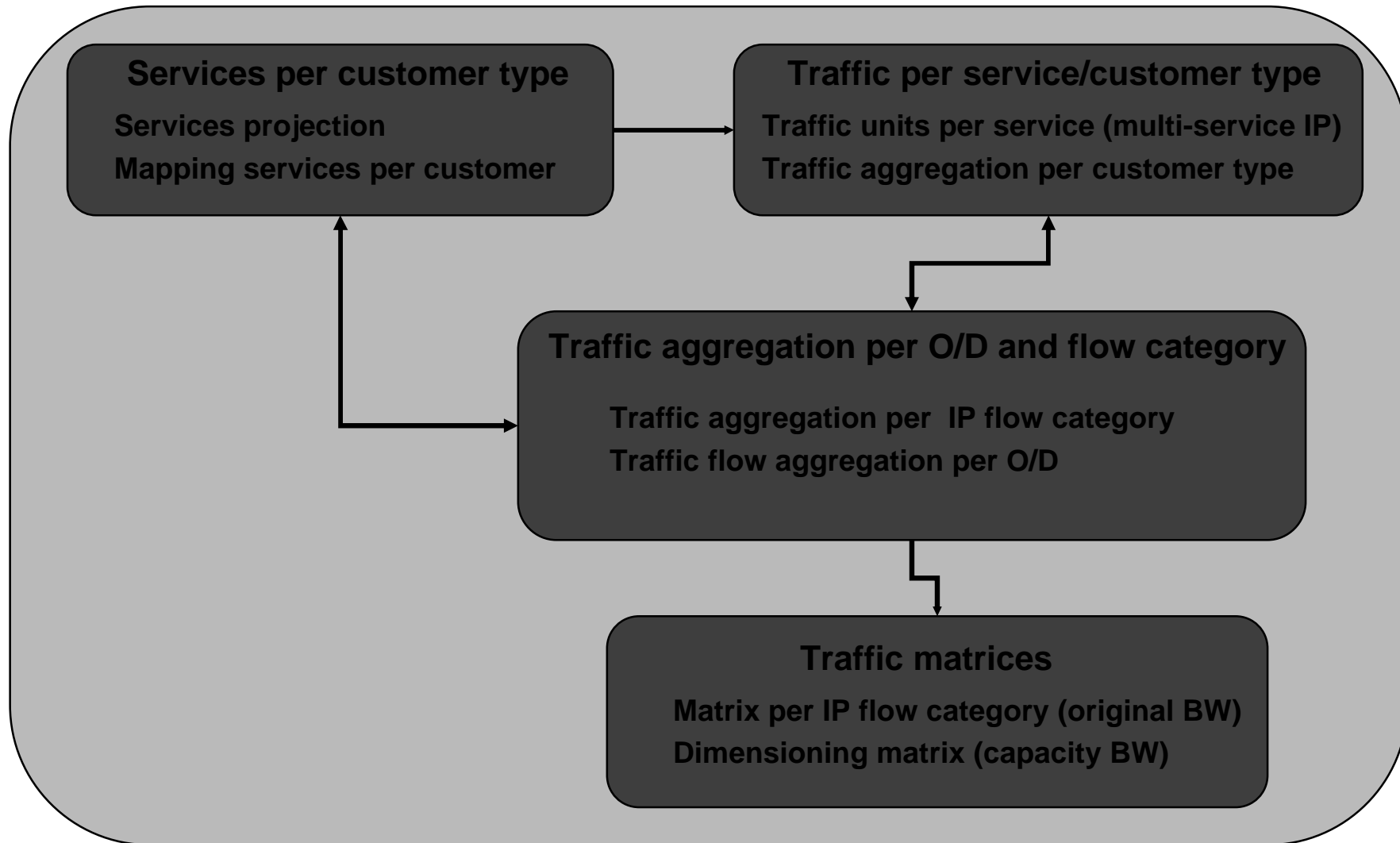
Traffic units for aggregated flows

- Traffic Units definition for network dimensioning
 - Equivalent Sustained Bit Rate (ESBR) or aggregated equivalent rates for same QoS category flows in a common reference busy period (ie. 5 minutes)
 - Computed as weighted average of the services at QoS category (i) and customer classes (j) at each network element: $\sum_i \sum_j ESBR_{ij}$



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NGN Service demand evaluation process





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Traffic Characterization for NGN Planning

Dimensioning Criteria

- Stream traffics need reserve capacity procedures like MPLS and Call Acceptance Control (CAC) in the access and may be modeled with equivalent bandwidth methods.
 - ➔ Available multi-rate formulas with different peakness factors for a given quality.
- Elastic traffics may be modeled with resource shared models.
 - ➔ Available “processor-sharing” one that provide a minimum capacity and a delivery speed as a function of simultaneous users
- Constant rate traffics need to be aggregated and reserved on top of the others with a given protection factor
- Overall dimensioning will be a combination of the previous procedures with different degrees of detail as a function of the model granularity



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NGN regulation issues

- How to follow quick evolution of technology and services ?
- How to regulate multiservices including simultaneously voice/data/video ?
- How to define new reference networks, architectures and interfaces to new players?
- How to define and quantify dimensioning and costing units for interconnection ?
- How to ensure consistency for regulation principles when different network types coexist in the migration phases ?
- How to regulate different network players in the value chain at physical, equipment and services layers ?



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NGN regulation trends

- Maintain fundamental principles for regulation objectives and decrease degree of detail for services
- Simplify application processes at “macroscopic” level
- Converge regulation for the different service categories
- Ensure solid, consistent and proved techno-economical modeling with cost/revenue drivers
- Maintain technological neutrality
- Have a vision of market evolution and overall services and business development



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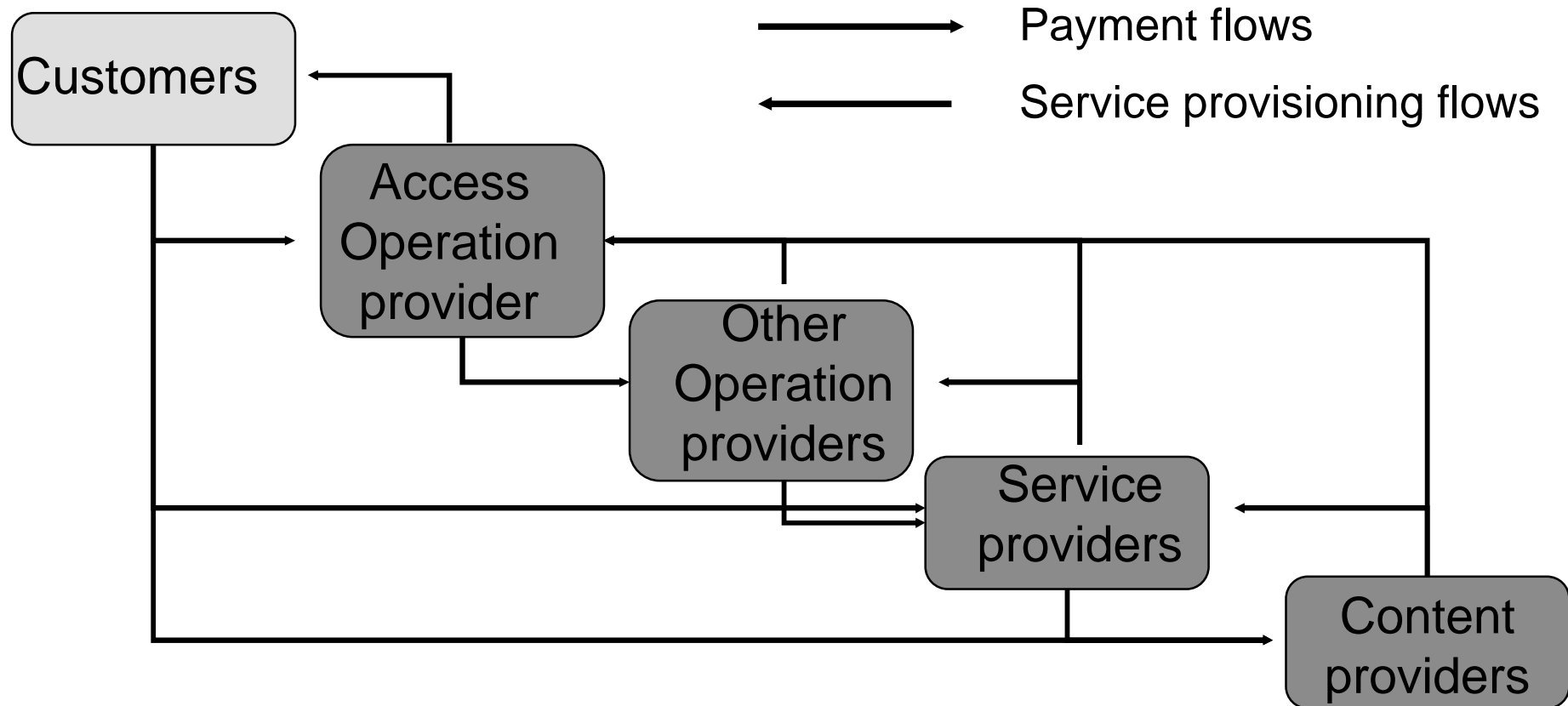
NGN regulation principles

- **Fairness:** The regulatory rules should be neutral and fair so that all players will be treated equally.
- **Transparency:** the regulatory rules, decisions making process and results should be made public and open to all.
- **Independence:** the regulatory bodies should be independent of any business interests as well as protected from any political influences.
- **Quality and consistency:** Quality evaluations with experts in market, laws, economics, engineering etc. to maintain valid rules and consistent among players and solutions.
- **Effectiveness:** the regulatory bodies should be able to implement rules by penalizing those who break the rules thus help to create the expectation that all rules will be observed.
- **Accountability:** the regulatory bodies should be made accountable for their decisions by the regulatory procedures and through appeal clauses.



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NGN regulation trends. Players interrelation



Regulation will affect all players involved in the value chain



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How to define dimensioning and costing units for interconnection ?

- Which units to be used for dimensioning ?
- Which units to be used for billing ?
- Which units to be used for interconnection and termination taxes ?
 - Usage time?
 - Bandwidth?
 - Information Volume?
 - Interface or link capacity?



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How to define dimensioning and costing units for interconnection ?

- Requirements for service flow units:
 - Quantifiable with defined engineering rules
 - Useful for interrelation between demand/dimensioning/costing for a given QoS and SLA
 - Reflecting service provisioning and market value across multiple networks
 - Applicable to multiservice/multimedia flows



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How to define dimensioning and costing units for interconnection ?

Common units for dimensioning and costing applicable at different network interfaces and interconnection points

Proposal for NGN multiservice networks:

Equivalent Sustained Bit Rate (ESBR) effectively carried at the network interface or interconnection point for a given Quality level or Service Level Agreement (SLA)



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Summary of Key Concepts

- Network design for quality is a main factor for customers, operators and regulators.
- Correct traffic characterization is needed for all network processes
- New reference networks, units and processes needed for the regulatory activities
- A new multiservice reference traffic unit proposed for NGN dimensioning and interconnection