ACROSS
Autonomous Control for a Reliable Internet of Services

On the Cost/Efficiency and Cost/Efficacy ratios in telecommunication service systems with QoS guarantees

S. Poryazov[1,2], E. Saranova[2,1]

[1]Institute of Mathematics and Informatics, BAS, Bulgaria
[2]University of Telecommunications and Posts, Bulgaria

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Generalized VNET with Overall QoS Guaranties

- We consider VNET carrying Class 0 traffic - Real – time, jitter sensitive, high interaction (VoIP, Video Teleconference) [ITU-T Y.1541, 2006].
- The VNET is with virtual channels switching, following the main method for traffic QoS guaranties – resource reservation [ITU-T E.360.1, 2002].
- We consider parameter values of a system in stationary state (observed interval duration: from 15 min to 1 hour).

Overall Service Network Performance Prediction Model: General Input-Output (1/2)

General Input 1: Users Behavior Parameters

- Number of Users;
- Calls frequency from a user;
- Probability for call attempt abandoning;
- Probability for unsuccessful call attempt repetition;
- Probability of B-party absence;
- Durations of communication, signals reception, etc.

General Input 2: Technical Characteristics

- Network Capacity;
- Duration of switching;
- Probability of Interruption, etc.

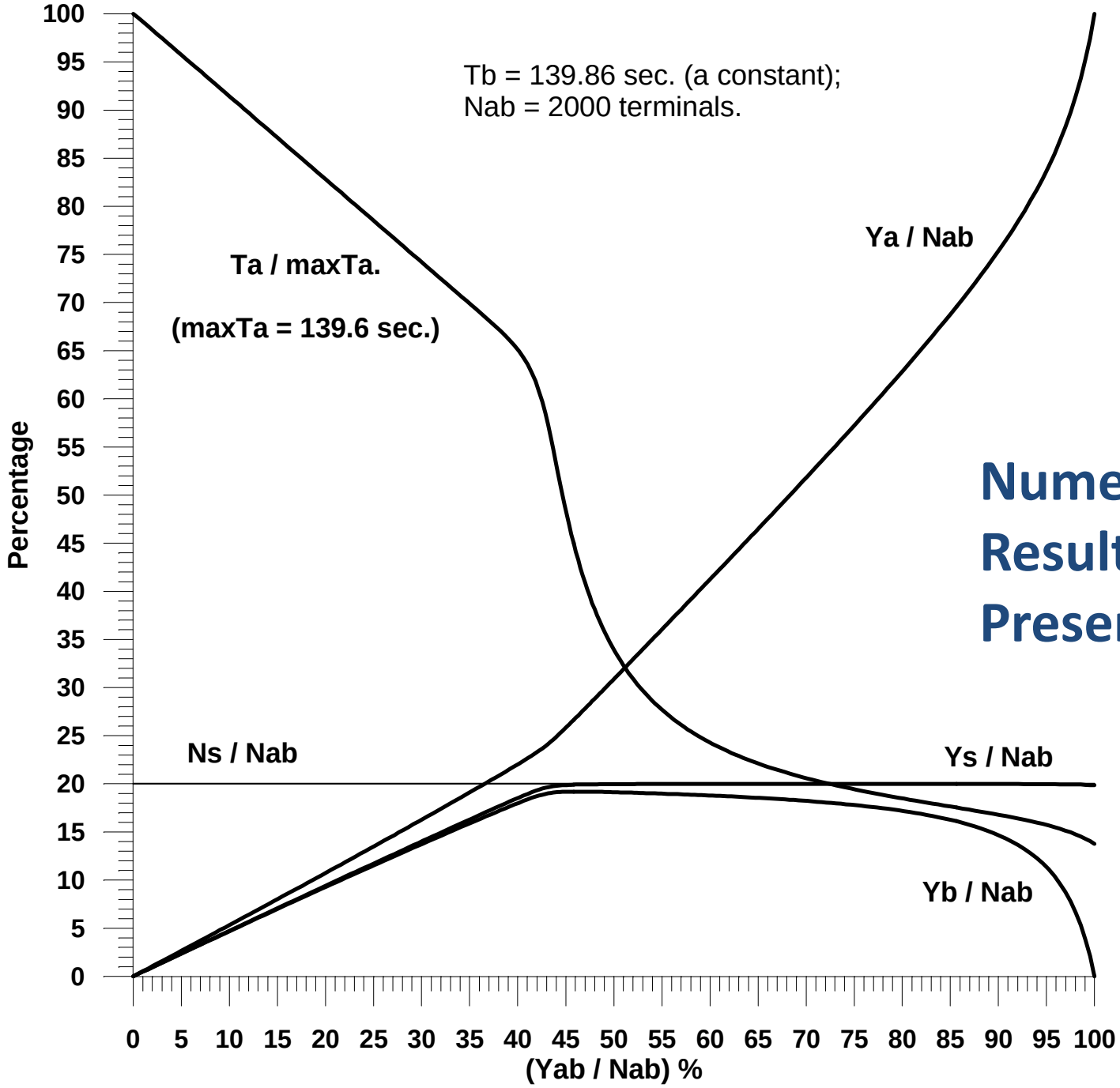
Overall Service Network Performance Prediction Model: General Input-Output (2/2)

General Output 1: Predicted QoS Parameters

- Probability of Call Attempt Blocking (Pbs), due to insufficient Network Capacity;
- Probability of Call Attempt Blocking, due to B-terminal busy;
- Network Call Efficiency (Ec);
- Network Time Efficiency;
- Network Traffic Efficiency.

General Output 2: Predicted Relative Financial Indicators

- Relative Network Traffic Intensity Cost;
- Cost/ Efficiency Ratio;
- Cost/Effectiveness Ratio.



Numerical Results Presentation

Relative Traffic Intensity Cost (1/3)

Network Costs Intensity = NCI

$$NCI = \frac{Mean\ Network\ Full\ Cost}{Mean\ Interval\ Between\ Payments}\left[\frac{Euro}{\Delta t}\right]$$

Traffic Intensity Cost = TIC

$$TIC = \frac{Network\ Costs\ Intensity\ (NCI)\ \left[Euro/\Delta t\right]}{Network\ Paid\ Traffic\ Intensity\ \left[Erlang\right]}$$

Relative Traffic Intensity Cost (2/3)

$$\frac{TIC}{NCI} = \frac{1}{paid.Y} = RTC$$

RTC = Relative Traffic Cost

$$TIC = \frac{Network\ Costs\ Intensity\ (NCI)\ \left[Euro/\Delta t\right]}{Network\ Paid\ Traffic\ Intensity\ \left[Erlang\right]}$$

TIC = Traffic Intensity Cost

Relative Traffic Intensity Cost (3/3)

RTC = Relative Traffic Cost

- *RTC* means : The cost of one paid erlang, as a part of the Network Cost Intensity (*NCI*).

- It is independent from the absolute Service Provider's expenditures;

- It depends of Network Performance and Network Administration Policy.

Cost/ Efficiency Ratio

Cost/ Efficiency = (*Relative Traffic Cost*)/ Ec,

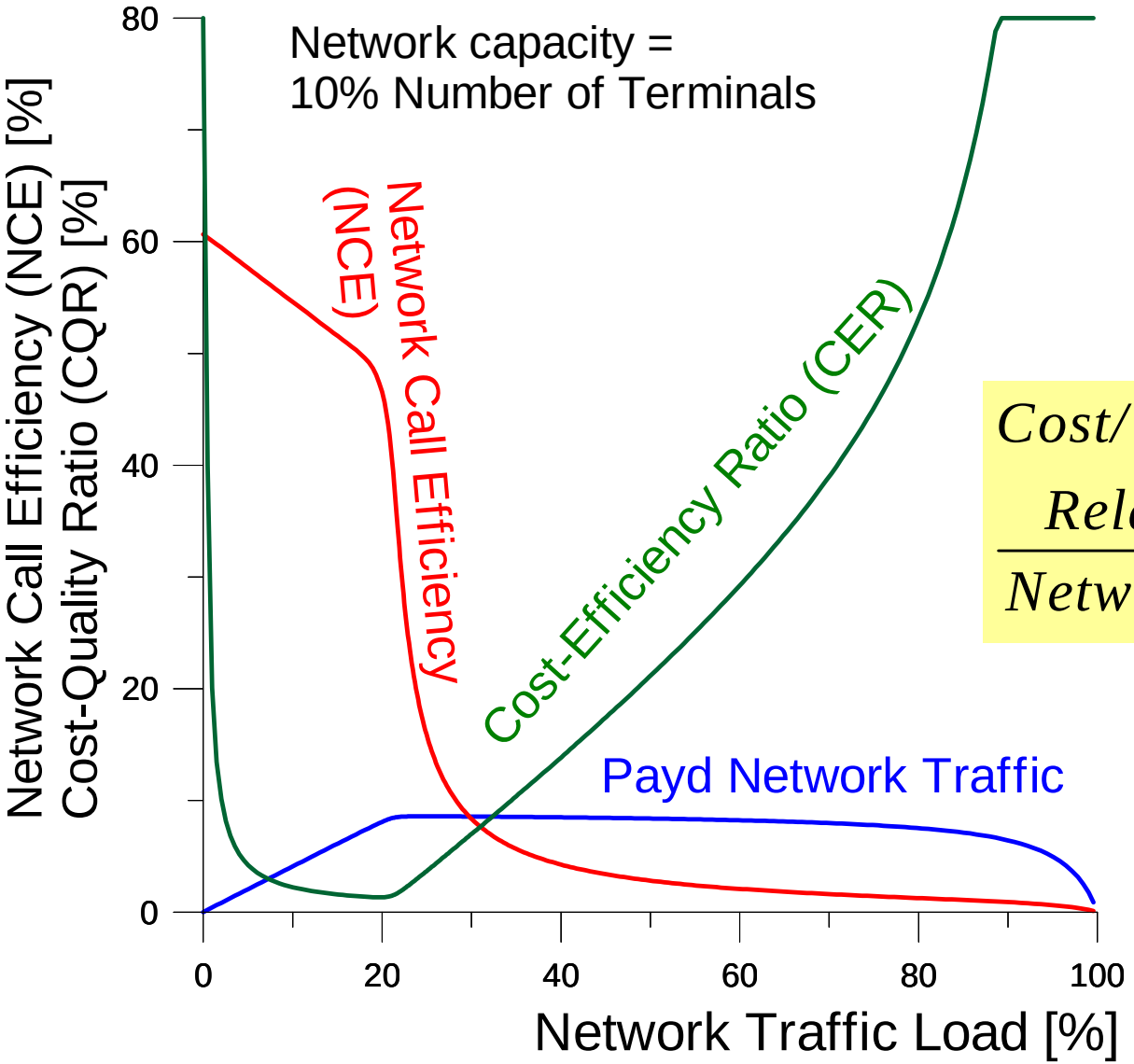
Ec = Network Call Efficiency =
successful call attempts/ all call attempts.

Ec = (1-Pad)(1-Pid)(1-Pbs)(1-Pis)(1-Pns)(1-Pbr)
(1-Par)(1-Pac).

(An example QoS of service composition!)

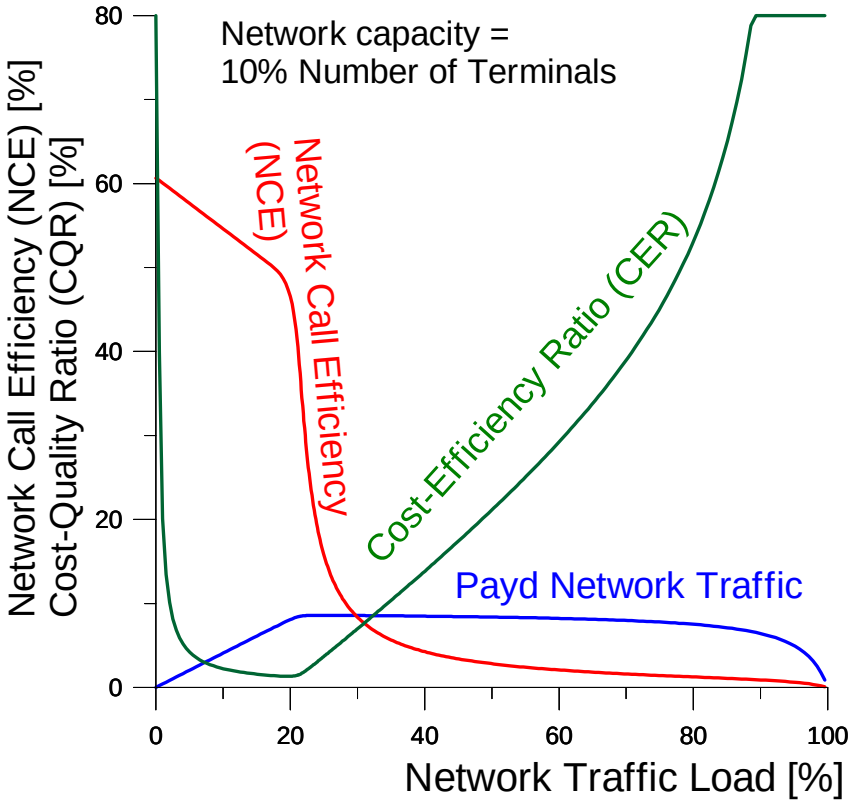
- In the following numerical examples, paid traffic is the Successful Communication Traffic of the A-party.
- Paid B-party traffic and the price of the transferred information are not considered.

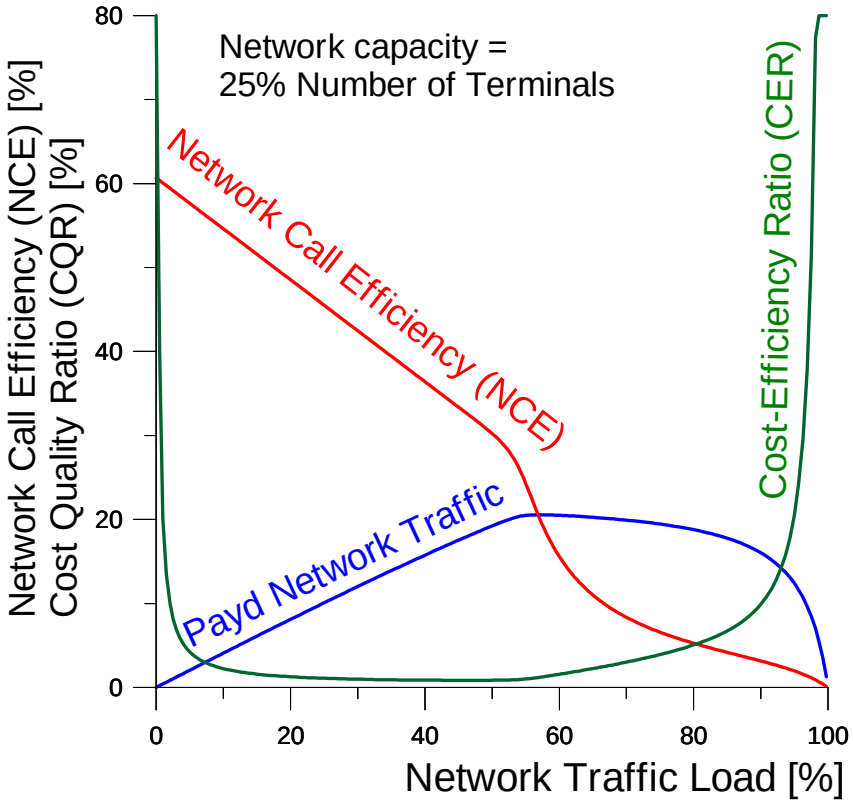
Cost/ Efficiency Ratio



$$\textit{Cost/ Efficiency Ratio} = \frac{\textit{Relative Traffic Cost}}{\textit{Network Call Efficiency}}$$

Cost/ Efficiency Ratio dependence from network capacity





Cost/Effectiveness Ratio

Following ITU-T Recommendation E.600 (03/93):

5.7. effective traffic is: The traffic corresponding only to the conversational portion of effective call attempts,

the Cost/Effectiveness Ratio is:

Relative Traffic Cost/Effective Traffic =

$$= \frac{1}{paid.Y\ conversational.Y} \approx \frac{1}{(paid.Y)^2}.$$

Therefore, the Cost/Effectiveness Indicator is not more expressive than Relative Traffic Cost Indicator $\left(\frac{1}{paid.Y}\right)$ *and we will not use it.*

Conclusion and Open Issues

1. An integrated Network Performance Model, including human factors and technical characteristics, and allowing prediction of QoS values of key indicators is proposed;

2. The results allow prediction of quality of the Service Network, providing composite services;

Conclusion and Open Issues

3. The predicted indicator values include:

- Relative Traffic Cost of the one paid erlang, from Service Providers' point of view;
- Cost/Efficiency Ratio;
- Cost/Effectiveness Ratio.

4. Models and computer programs for these indicators prediction are developed .

Conclusion and Open Issues

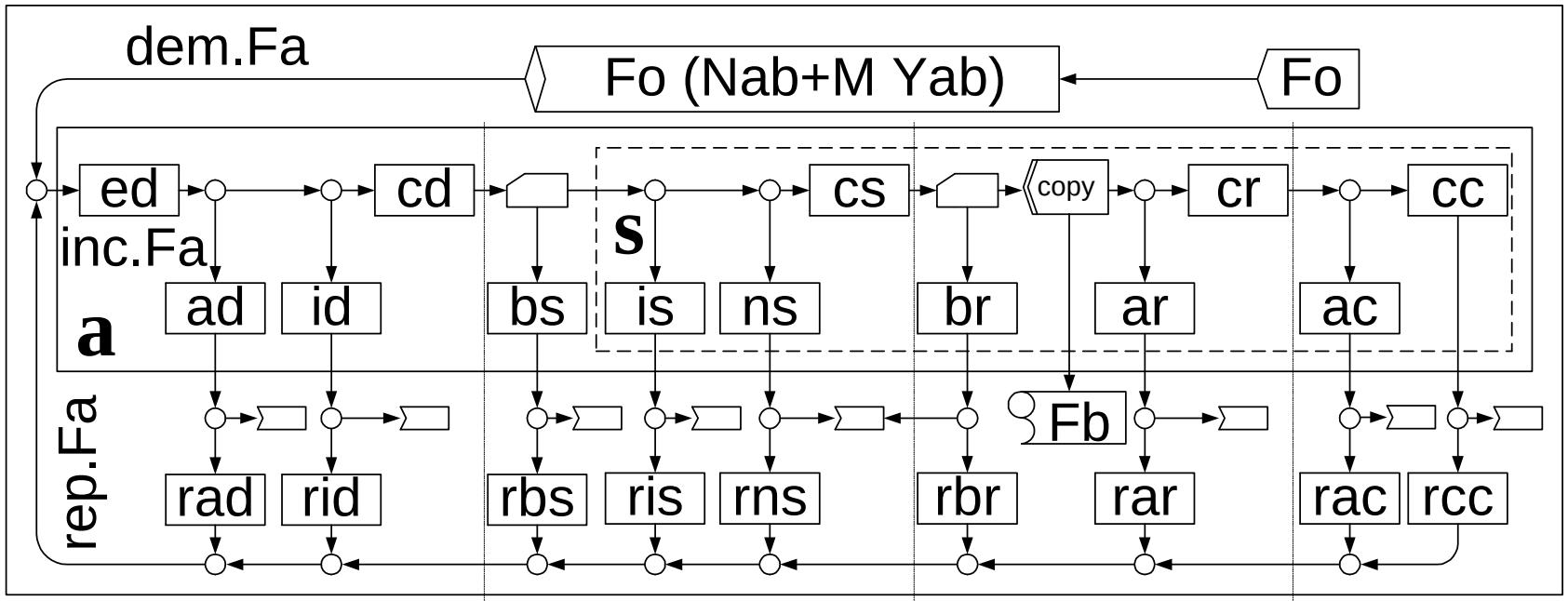
5. The Cost/Effectiveness Indicator is not more expressive than Relative Traffic Cost Indicator.

6. Some QoS indicators are not monotonic functions from the network load.

THANK YOU

Questions and remarks are welcome

Detailed Conceptual Model of the system.

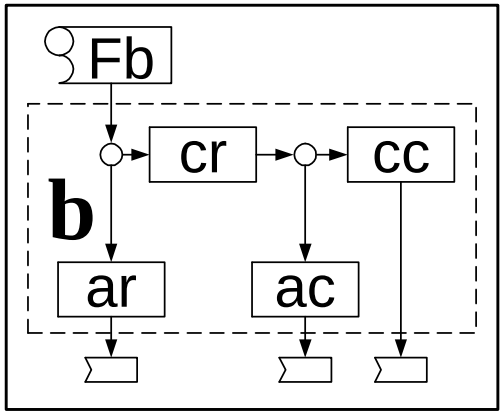


STAGE: **d**ialling; **s**witching; **r**inging; **c**ommunication.

BRANCH EXIT:
r = repeated;
t = terminated
= not considered.

BRANCH:
e = enter
a = abandoned;
b = blocked;
i = interrupted;
n = not available;
c = carried.

Generator;
Terminator;
Modifier;
Server;
Enter Switch;
Switch;
Fb Graphic Connector.



Virtual Device Name = <BRANCH EXIT><BRANCH><STAGE>