A Congestion-Sensitive Model to Manage a NGN Environment with Heterogeneous Mobile Customers

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□ Agenda:

- Motivation

- How to deal with Congestion

- Work Plan

- NGN Model

- Business Model

- Network Selection

- Conclusions

- References

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Motivation (1)

- Next Generation Network (NGN) is a highly dynamic & competitive environment

- Increase on the data traffic transported by mobile broadband networks creates a huge stress on the deployed network infrastructure

- I aim to address the NGN congestion on the edge of the network

- The scenario is a public area (e.g. train station) covered by a heterogeneous wireless network that suddenly becomes congested due to a flash crowd of users that are commuting

Motivation (2)

- If the deployed network infrastructure could not conveniently support traffic congestion, then

  - Unsatisfied users choose an alternative operator

  - Operator's reputation is degraded

  - Operator's profit is reduced

How to deal with congestion

- Some possible solutions
  - New access cellular technology (e.g. LTE [1])
  - Dynamic spectrum [2]
  - Problem: Both very expensive because force operator to buy new equipment

- So, …

Work Plan

❑ For modelling and solving the congestion problem in the NGN environment:

- Develop a model to understand how operators and users should interact [3]

- Study a new business model [4]

- Study a new network selection scheme [5]

NGN Model (1)

- Develop a NGN model using Game Theory [3]
  - Operators and users have opposite goals
  - Identify the strategies for each player
    - operator accepts or blocks user
    - user stays attached, handovers or leaves
  - Handover management
    - signaling overhead
    - latency
    - trigger (network vs. terminal)
  - After the network becomes congested
    - new user ⟹ user's perceived quality ⟹ user churn ⟹ operator's reputation ⟹ operator's profit

NGN Model (2)
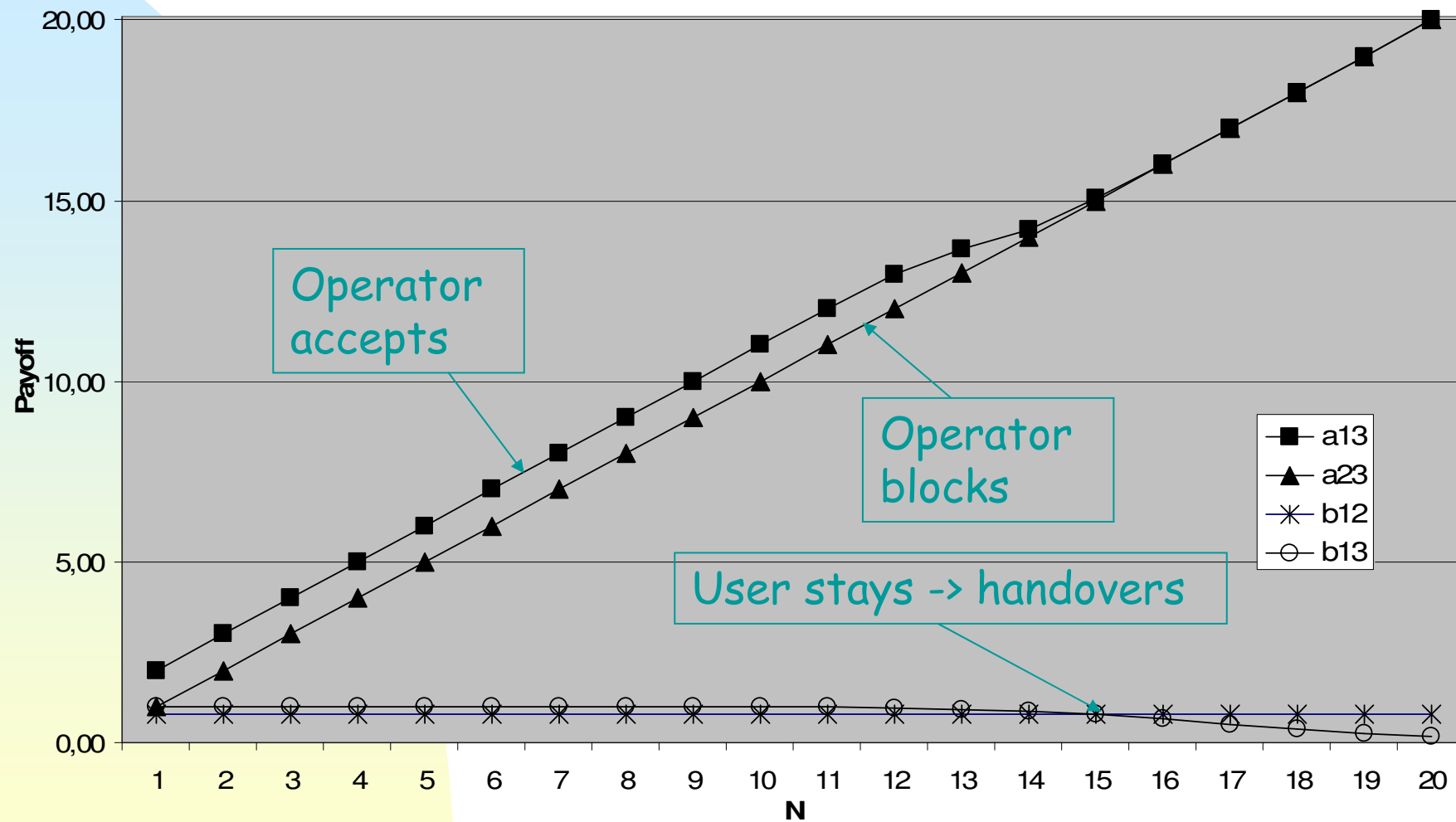
NGN Model (3)

- ❑ Model results [3] pointed out some stable vector of players' strategies, from which no player has any incentive to choose a different strategy, but its stability depends on several aspects, namely network congestion

- ❑ Results suggest that network stability depends on the way the congestion is controlled

- ❑ How to control the congestion?

Business Model (1)

❑ Business model characteristics [4]:

- uses a dynamic tariff sent to each user through a DHCP/DNS/IPv6 header option mechanism

- there is an incentive to enhance user cooperation essentially when network becomes congested

- supports heterogeneous users (leisure and business users). Leisure users are price sensitive and business users are quality sensitive

- finds the user distribution, constrained by channel capacity, which optimizes operator's profit

- models how channel access contention at MAC layer influences the user's quality and operator's profit

Business Model (2)

- Results [4] shown that
  - dynamic tariff offers a maximum operator's profit for a specific channel capacity
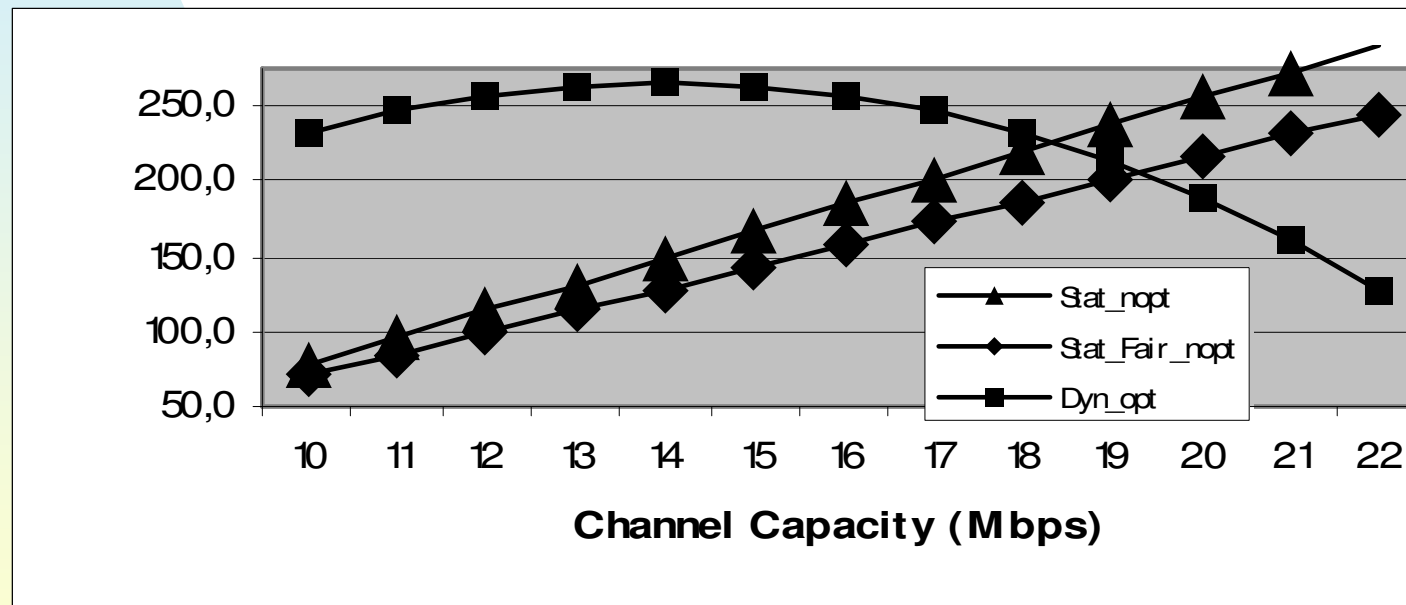
Operator profit for distinct channel capacity (40/60% of user churn)

Network Selection

□ Alternative way to attenuate the congestion problem [5]

- cooperation between operators + stored historic data ⇨ predicts congestion occurrence

  o handover of multimode handsets freeing some strategic Network Attachment Points (NAPs)

  o some connections downgrade their mode of access technology (e.g. from 3G to GSM)

  o new customer's admission is managed between operators

- network selection (alternative to signal strength) based on a quality parameter used on each host

  o distribute the traffic load as best as possible between all local available network attachment points not necessarily from the same technology

    • For example, beacon delay inspired in SIGCOMM paper [6]

Conclusions

- Current conclusions
    - GT identifies the best strategies for operators and users when they interact in a NGN environment
    - Wireless congestion could be controlled by
        - business model
        - network selection scheme

- Future work
    - We are evaluating how the network selection based on quality deals with the congestion problem
    - We aim to model and study a business model with two operators

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Thank you for your attention!

Any questions?

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