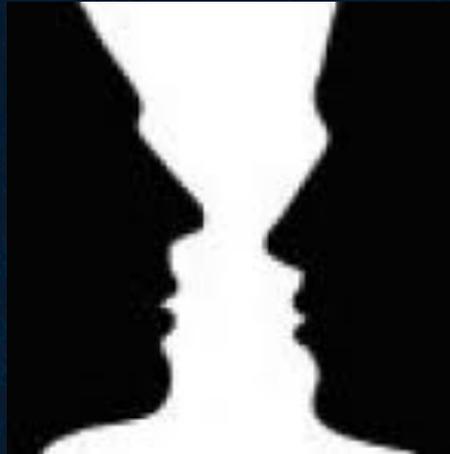


# Network Economics

*Some thoughts and several questions*



*Nikolaos Laoutaris*

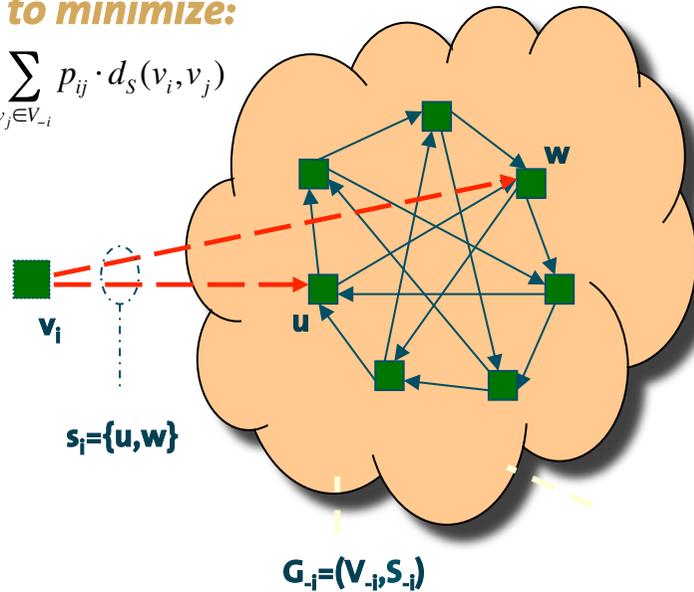
*nikos@tid.es*

*Telefonica Research*

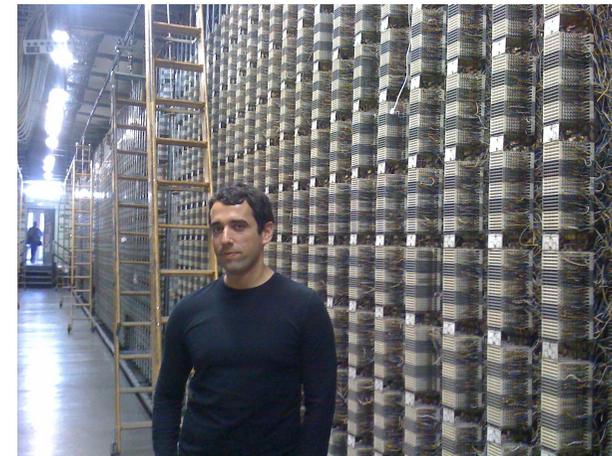
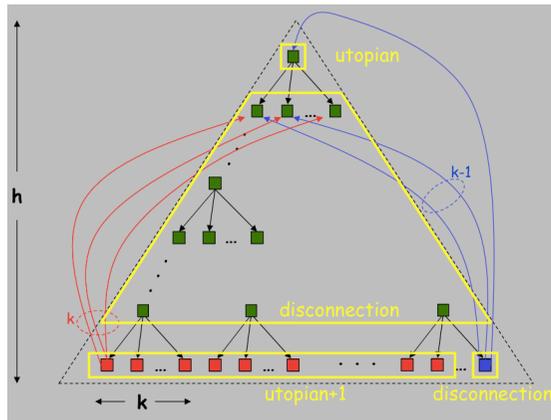
# Heavily biased by my own trajectory

**$v_i$  wants to minimize:**

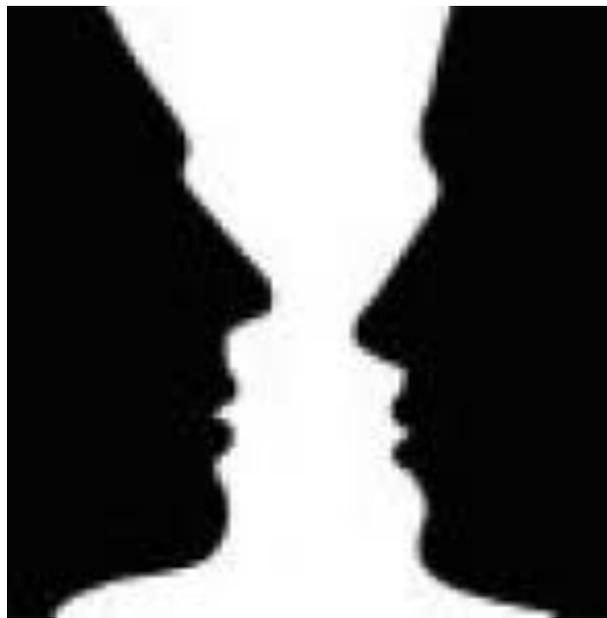
$$C_i(S) = \sum_{v_j \in V_{-i}} p_{ij} \cdot d_S(v_i, v_j)$$



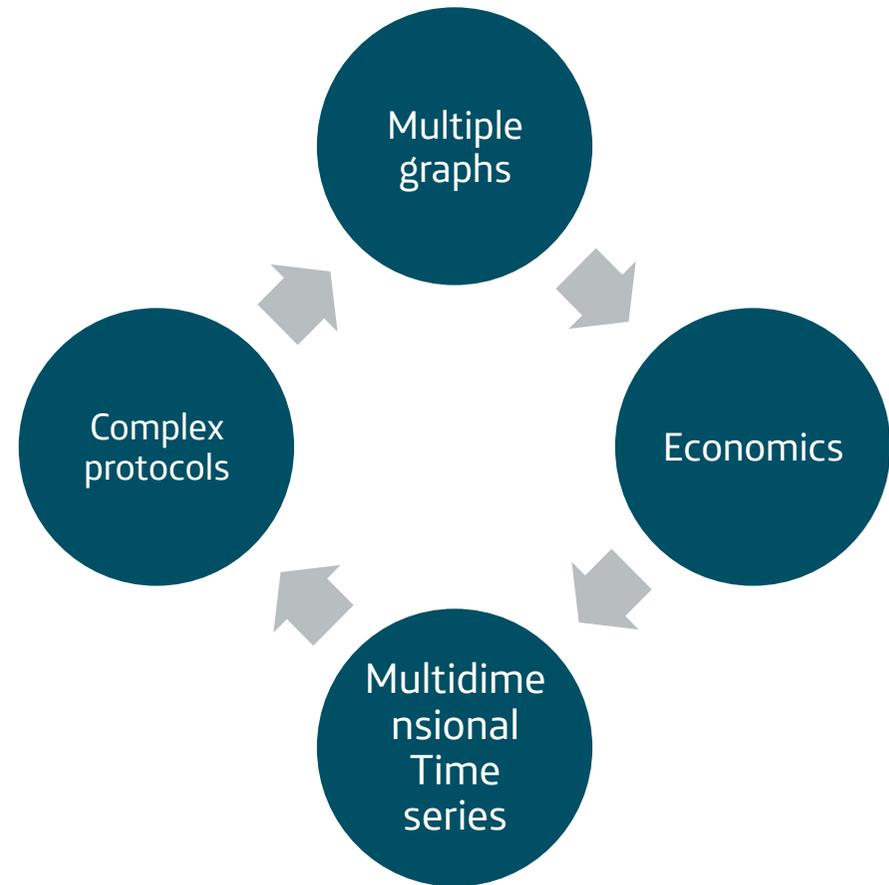
from Network Formation Games to CAPEX, OPEX, 95-percentiles, etc



# Thought 1: Network economics is an interesting area



Economics      Technology



**Many research challenges and a potential for impact**

Thought2:  
feels like there's a missing link in our understanding of net. economics

### Scholarly research



- ✓ Can handle complexity (graph theory)
- ✓ Can handle dynamicity (game theory, economics)

- ✗ Misses the data
- ✗ Misses the operating practices

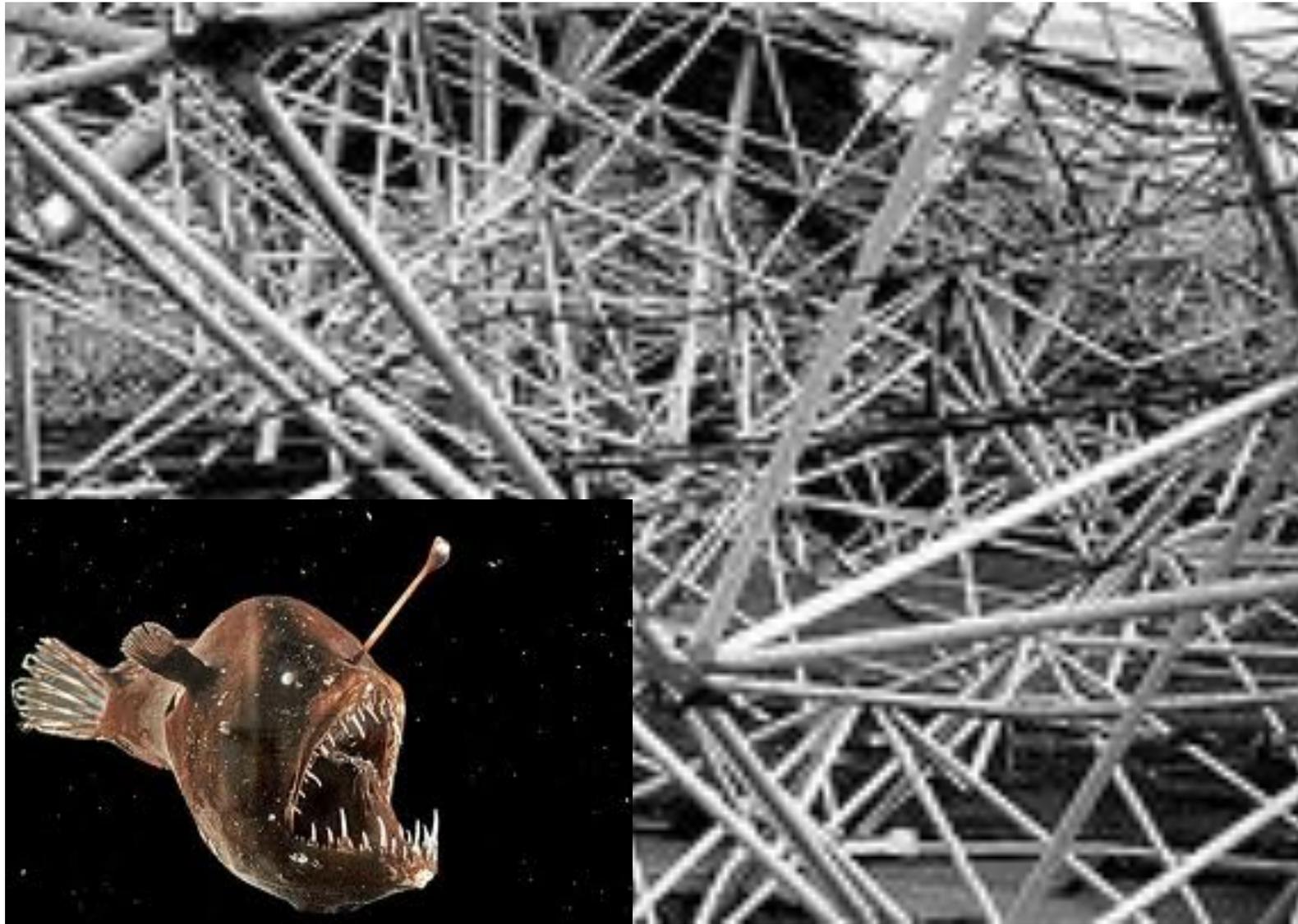
### Real Ops



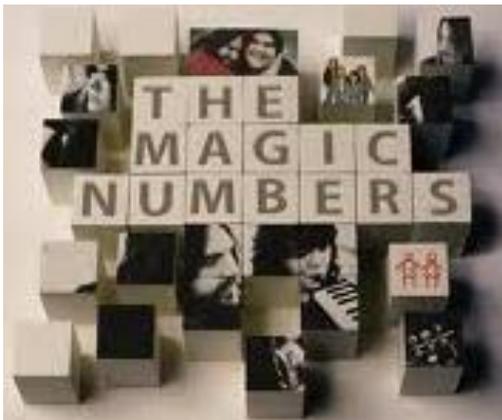
- ✓ Has the data
- ✓ Defines the operations

- ✗ But can it connect the dots?

Lot's of ugly complexity hiding the truth from us



# Thought3: Many of our discussions lack Quantification



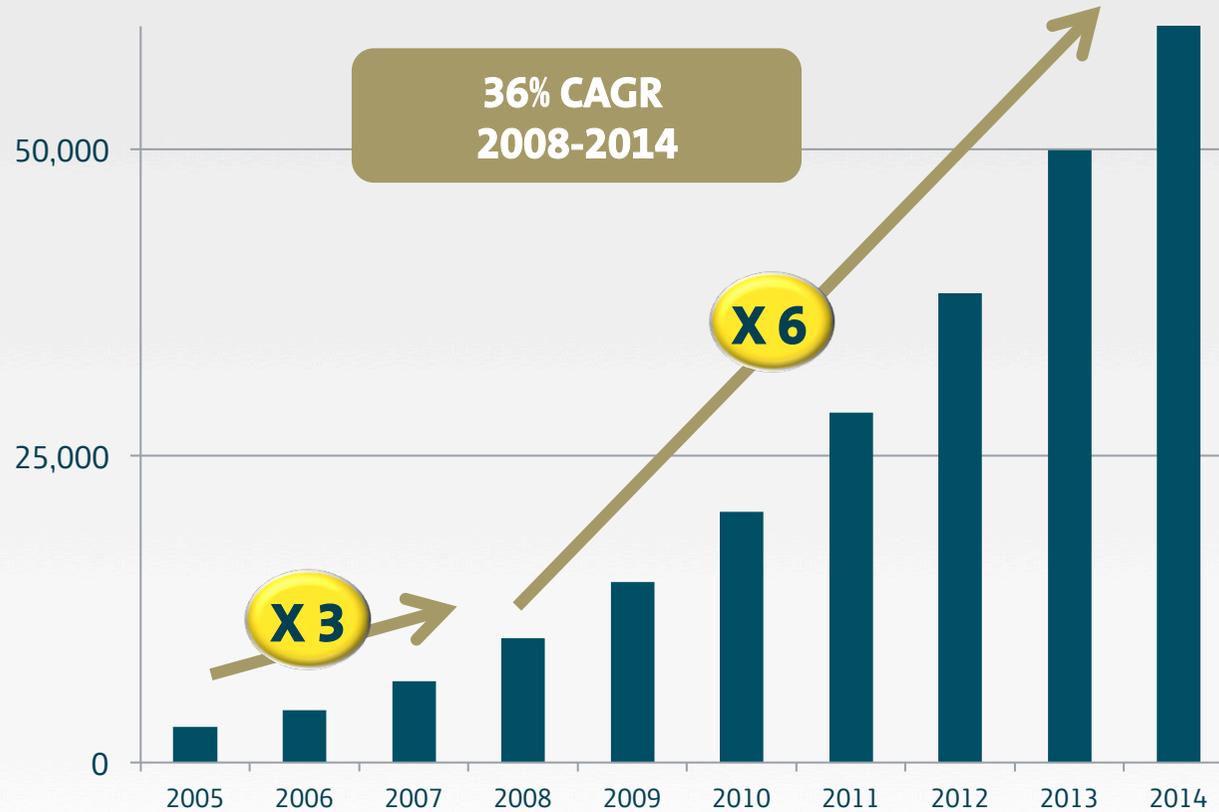
**numbers vs. the rest**

-  Rumors
-  Speculations
-  Gossip
-  Guesses
-  Beliefs
-  Hopes
-  Oversimplification

For example



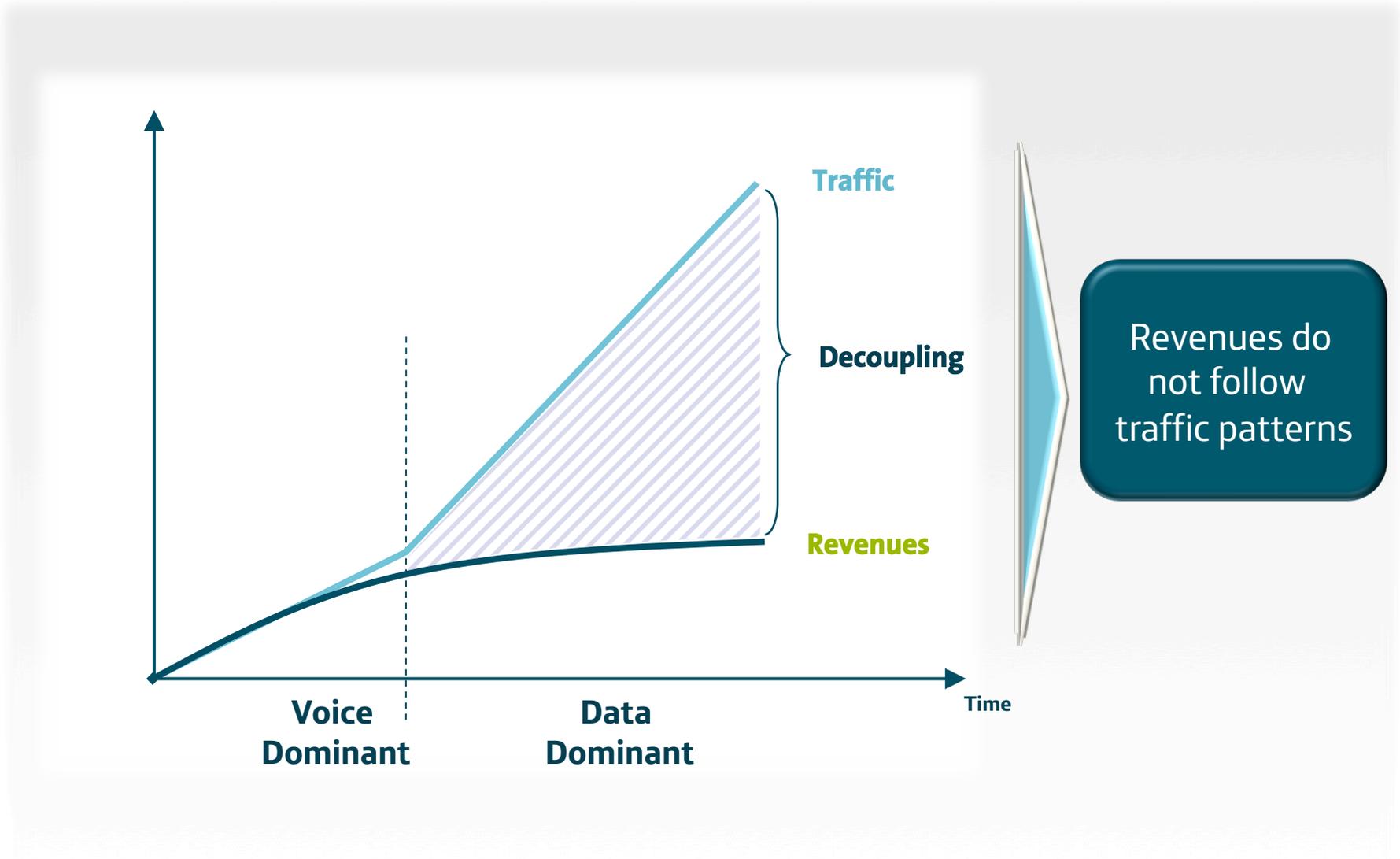
## Volume of traffic grows annually by almost 36%



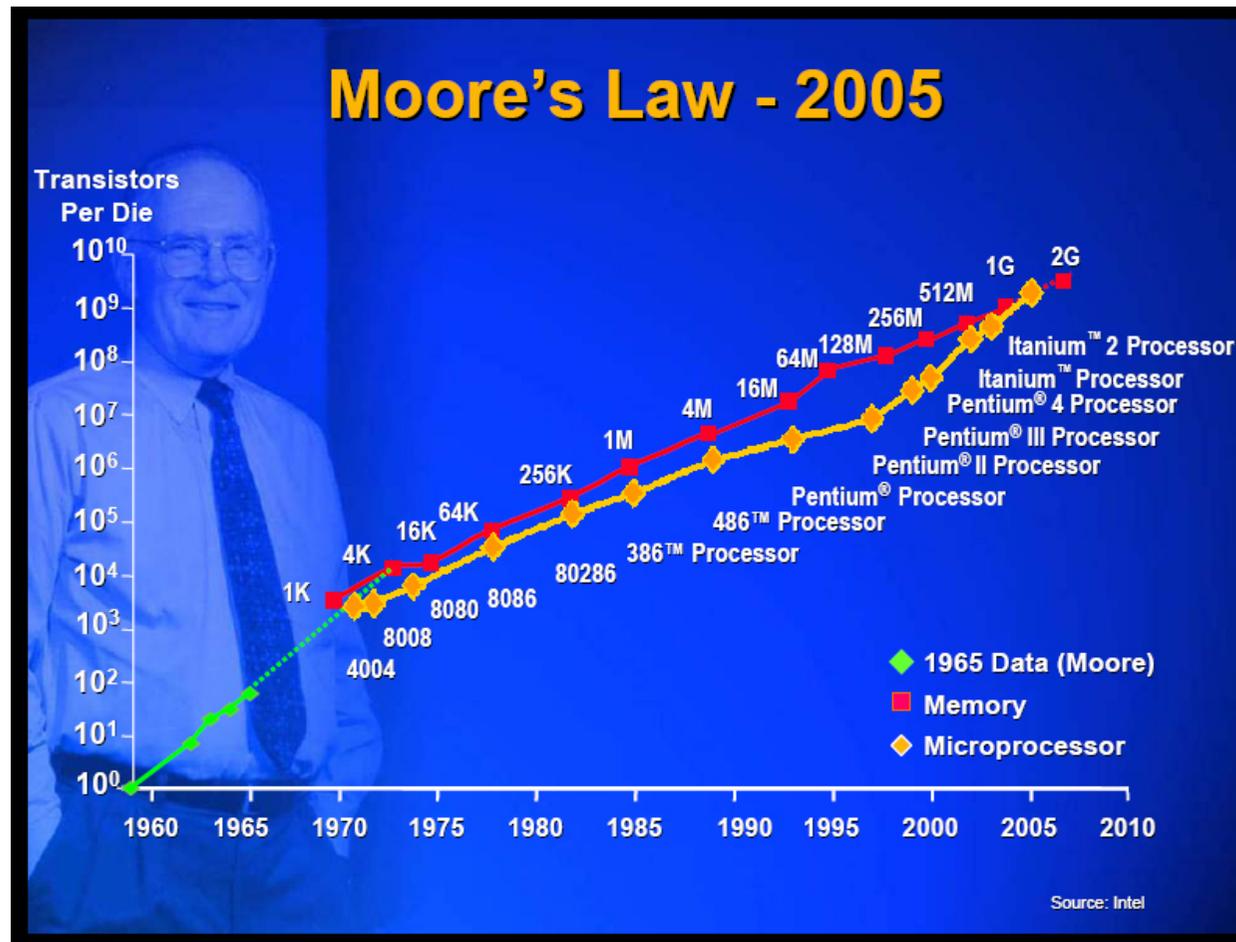
Source: Cisco Visual Networking Index – Forecast, 2009-2014

**Global IP traffic growth is threatening networks capacity**

# Costs increase but revenues remain fixed because of flat rates



The Net Neutrality position → technology can absorb the growth



ML → digital devices x2 faster in 18 months at same cost

40% CAGR of traffic → x 1.96 efficiency improvement in 24 months – So we're OK!

# Question 1: What is the efficiency improvement of networks?

## **Moore's law & Networks**

- covers switching & routing
  - traffic growth is continuous whereas efficiency improvement come in jumps
- does not cover channel capacity
- does NOT cover OPEX
  - Energy
  - Real estate costs
  - Personnel costs (tech support, retraining administrators, technicians, etc)
  - OPEX > CAPEX and improvement is more like 30% in 5 to 10 years
  - Especially in the access

# If technology cannot absorb the traffic growth

## Options

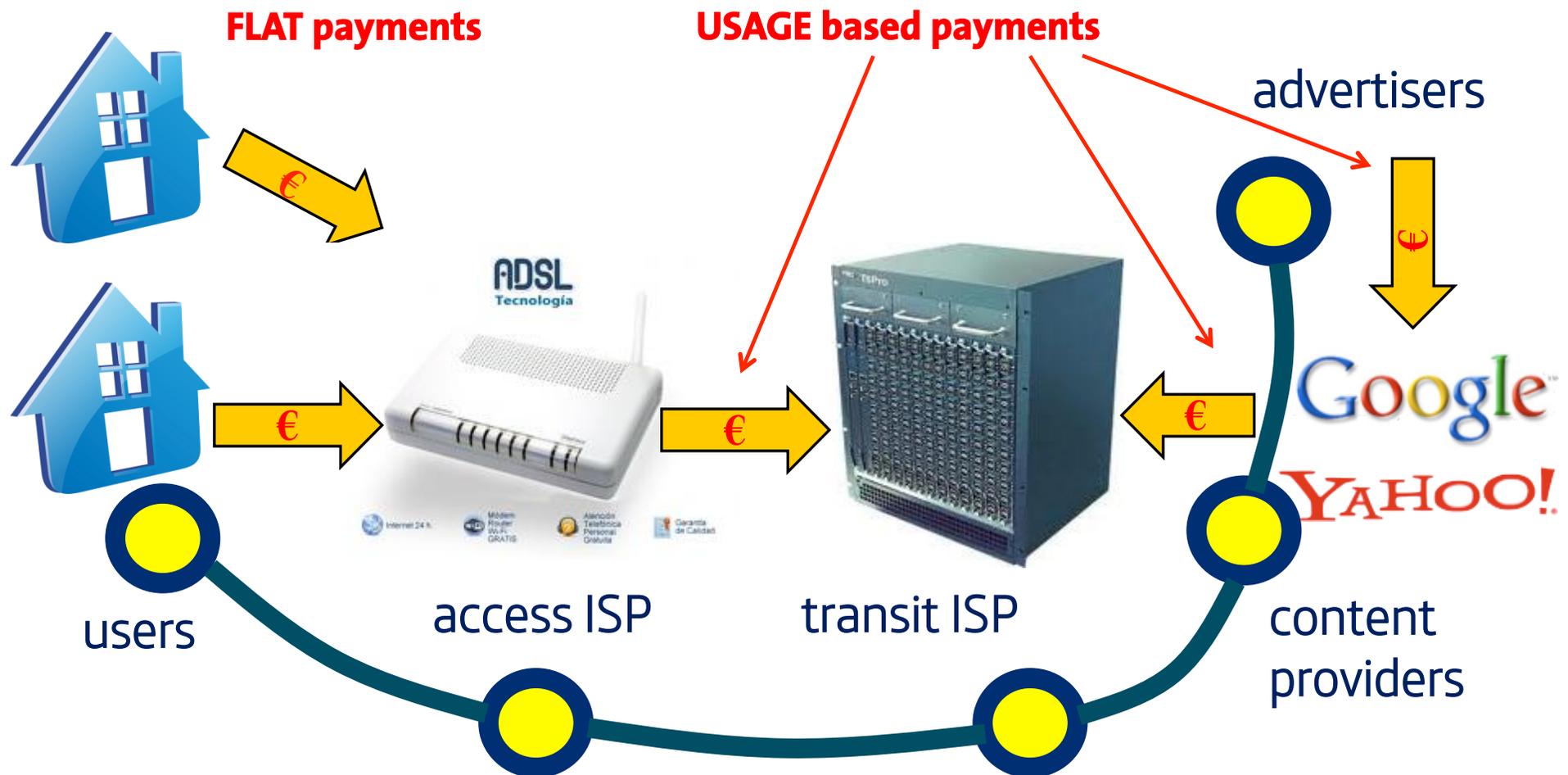
1. Do not upgrade (or upgrade as fast as investors are willing to go)
  - An investment bottleneck on network capacity would be harmful to all
2. Agree on a way to share the costs

# Our starting point

Richard T.B. Ma, Dah Ming Chiu, John C.S. Lui, Vishal Misra and Dan Rubenstein.

On Cooperative Settlement Between Content, Transit and Eyeball Internet Service Providers.

*IEEE/ACM Transactions on Networking, Volume 19, Issue 3, June 2011.*



# Cost/Profit sharing under a Premium Service model



Our main additions to Ma et al.

1. Customer churn at the ISP and the Content Provider end
2. Advertiser churn at the Content Provider end

Quantify the power of different stakeholders

# Questions: How well do we understand customer churn?

- Why do people purchase broadband connections?
  - How much do we value Search vs OSNs vs Email vs Online Gaming vs ...?
- How loyal are users to a given Video or VOIP provider?
  - Do we care about the video or the video site?
- Would users switch to an alternative Video or VOIP provider that gets them higher QoE by having purchased premium connectivity from ISP?
- Would users that are loyal to a video site stay with an ISP that does not offer premium connection to their favorite site?

# Take-away message

- Research on network economics is squeezed between big interests
- Adding credible quantification is key to decision making
  - both at a policy
  - corporate strategy levels

*Telefónica*

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