

# Differentiated Services - Panacea of Networking?

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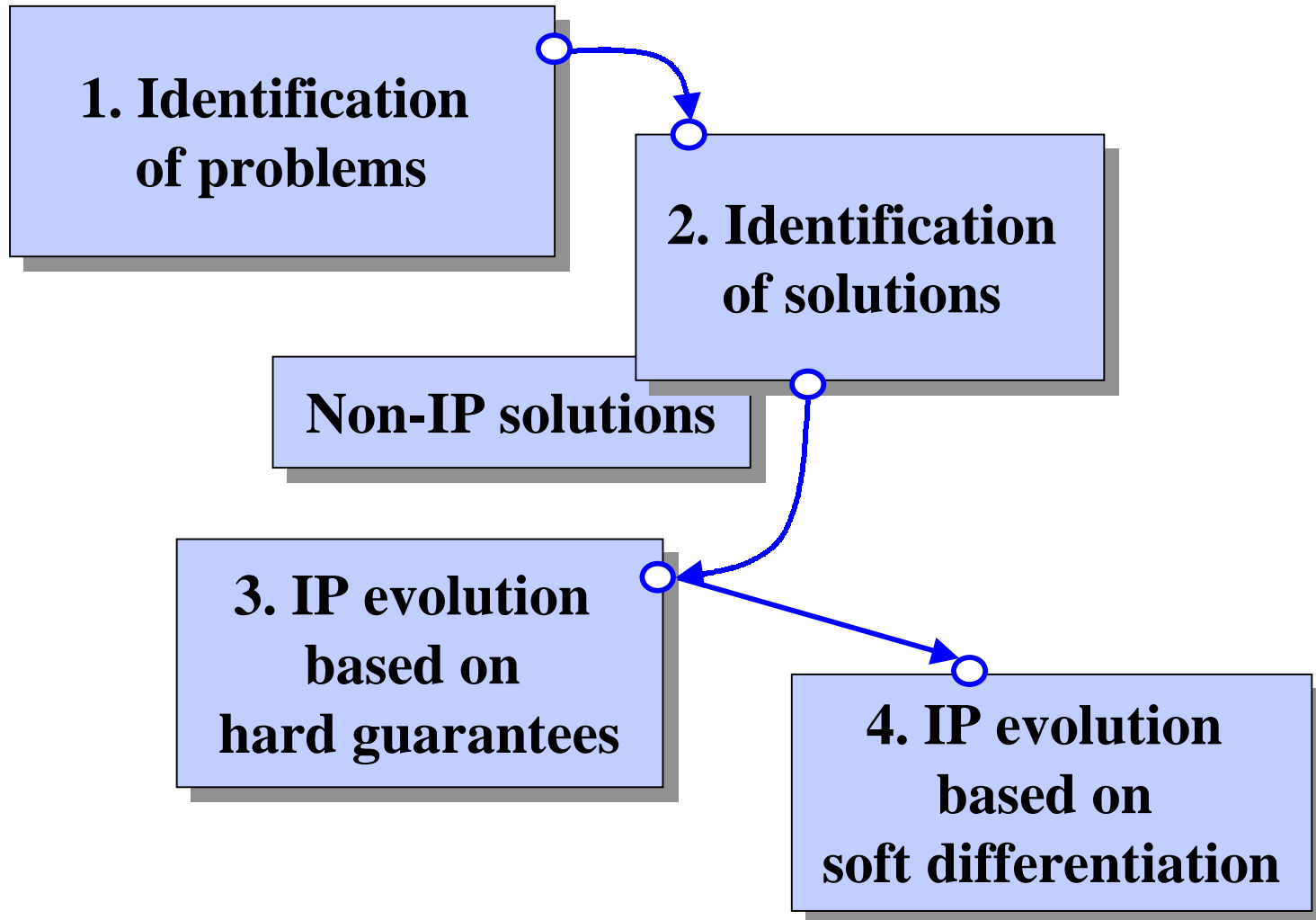
*Principal Scientist, Nokia*

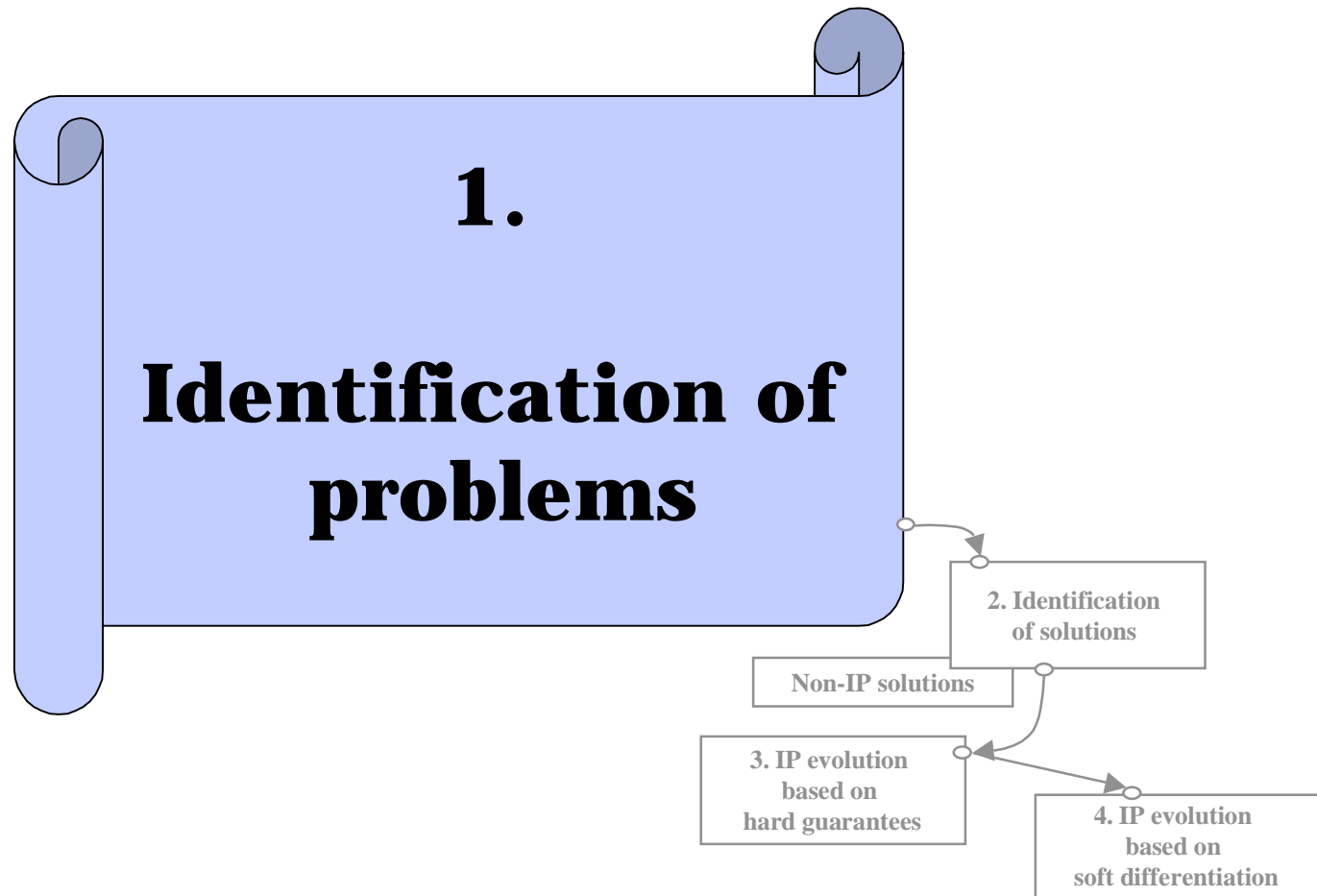
*Docent, HUT*

# Panacea

- **pan-a-ce-a** (p<sup>2</sup>n” ...-s¶“ ...) *n.* A remedy for all diseases, evils, or difficulties; a cure-all. [Latin *panac ¶a*, from Greek *panakeia*, from *panak ¶s*, all-healing]
- **Diseases to be cured**
  - overall weakness of end-to-end services
- **Evils to be tamed**
  - those who try to exploit network resources in unfair manner
- **Difficulties to be overcome**
  - implementation and management of complex networks

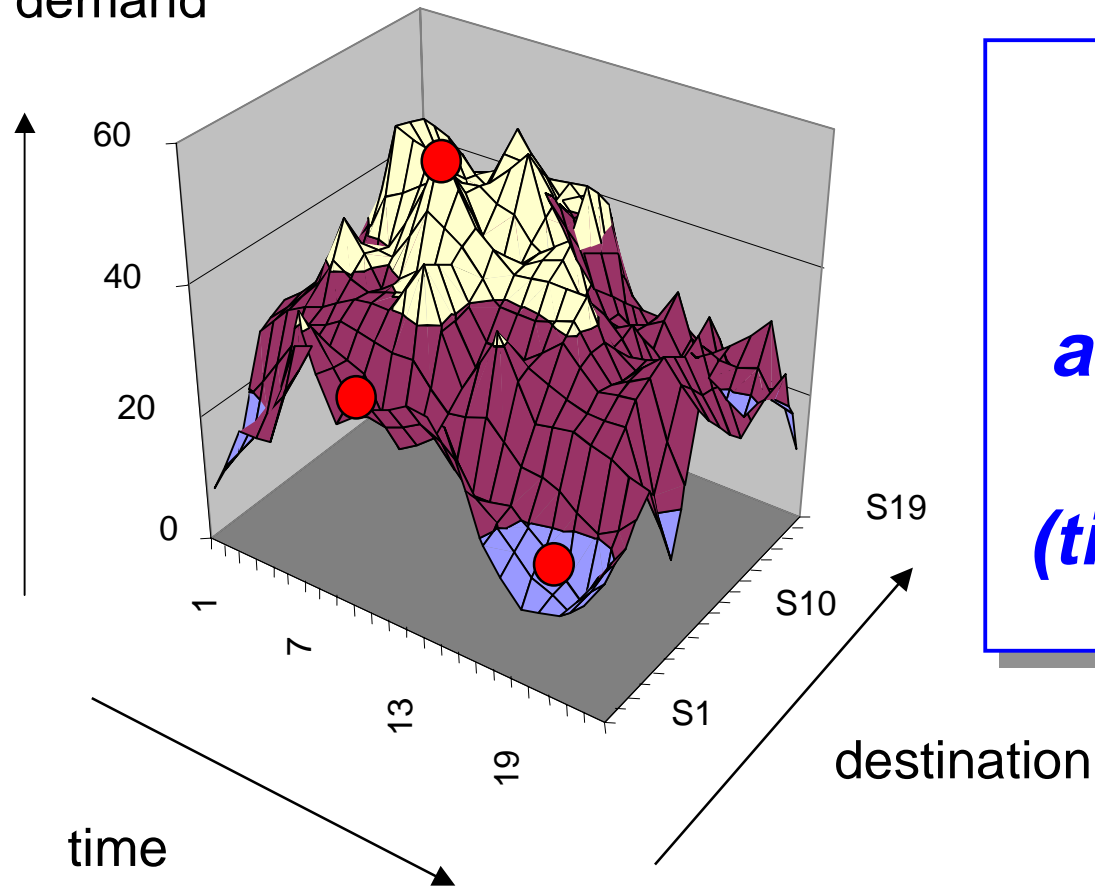
# Outline





# Problem: Demand

Service demand



***Intrinsic Problem  
unpredictable  
and highly variable  
service demand  
(time & destination)***

# Question: QoS vs. Demand

- *Should QoS be independent of service demand?*

- **Telephone network**

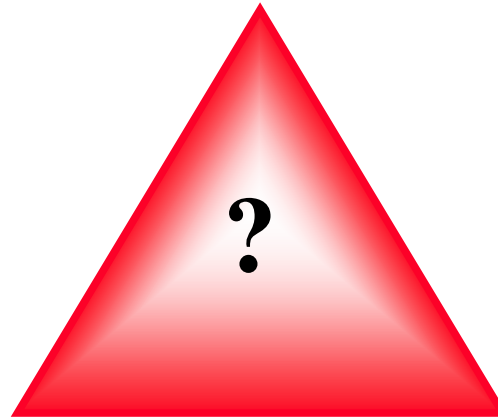
- **YES**, quality is, by and large, independent of demand
  - too many customers at the same time in the same place ⇒ some customers get service while others get nothing

- **Internet**

- **NO**, quality depends essentially on demand
  - too many customers at the same time in the same place ⇒ everyone gets poor service

# QoS vs. Demand vs. Price

**Quality**  
(technology)

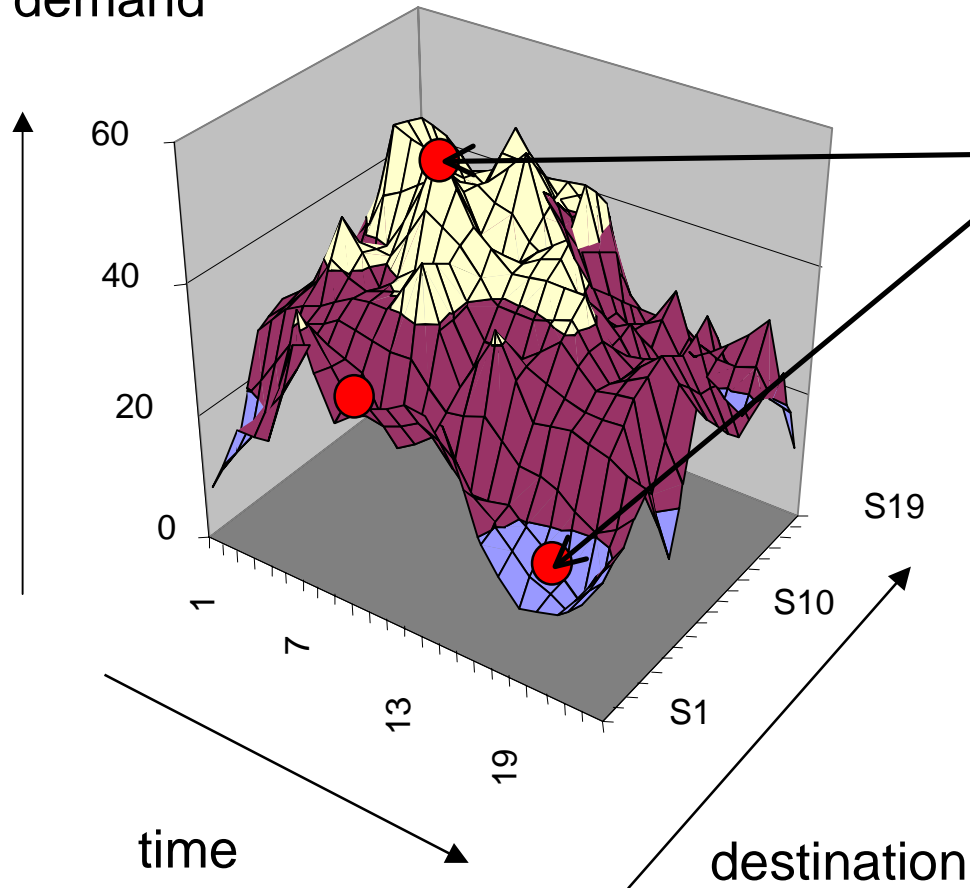


**Demand**  
(behavior)

**Price**  
(business)

# Operator's choices

Service demand



- 1 -

"Throw bandwidth" approach:  
Put enough capacity to  
make everyone content

- 2 -

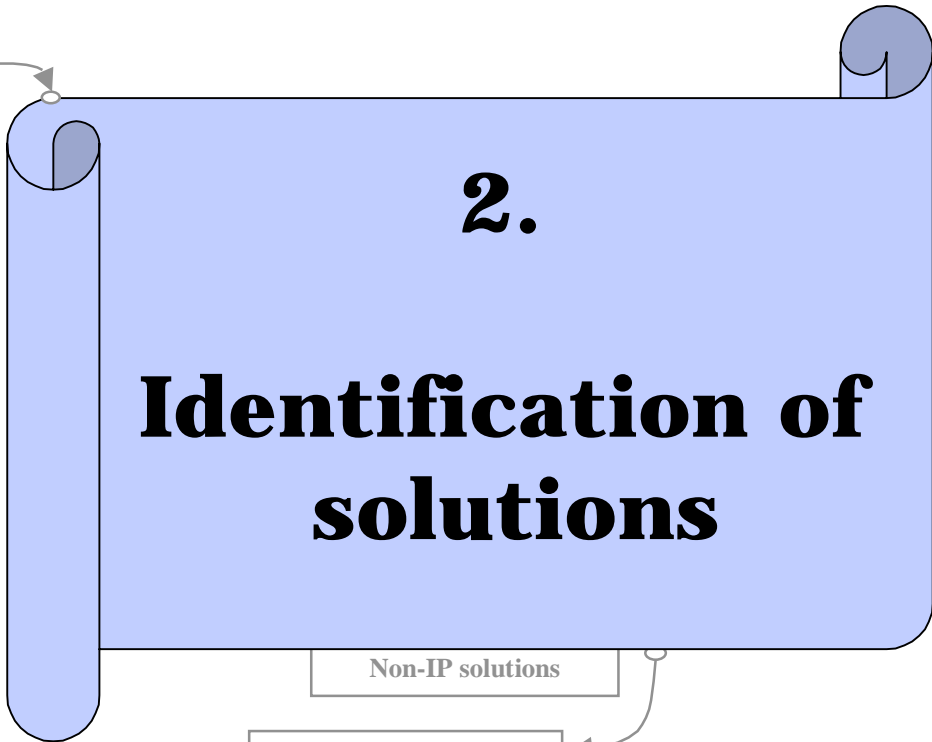
Business approach:  
Try to control the  
demand by price

- 3 -

Technology approach:  
Share what is available  
as fairly as possible



1. Identification of problems

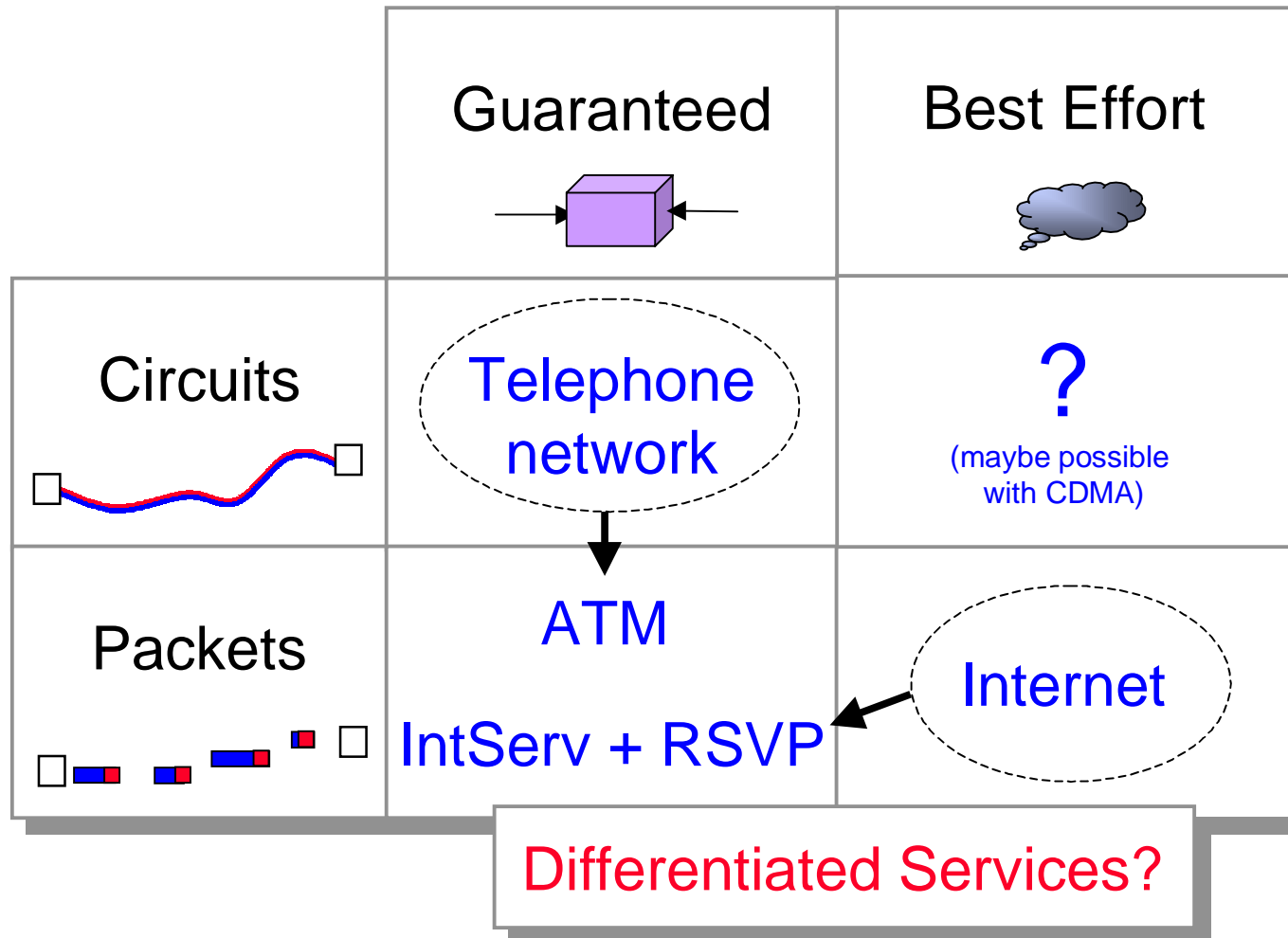


Non-IP solutions

3. IP evolution based on hard guarantees

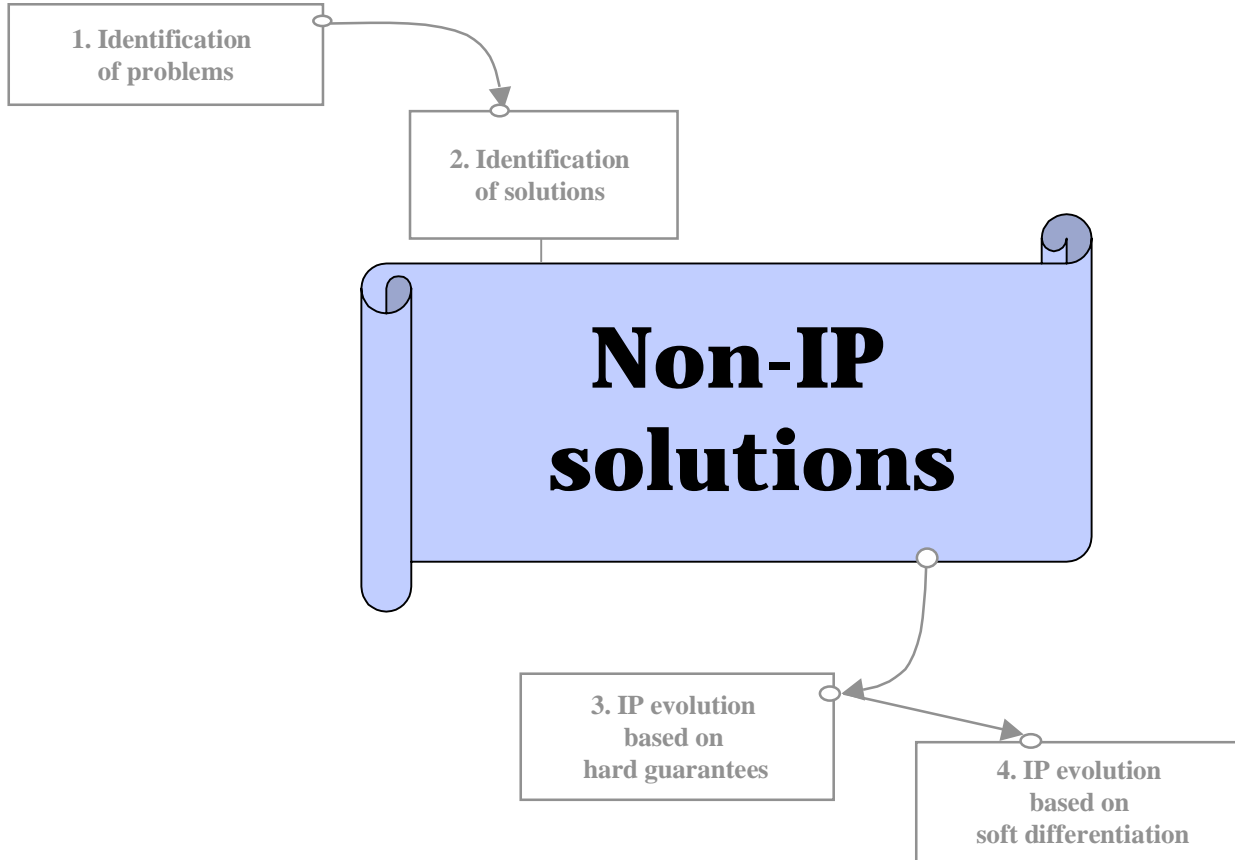
4. IP evolution based on soft differentiation

# 2 Networks \* 2 Service Models



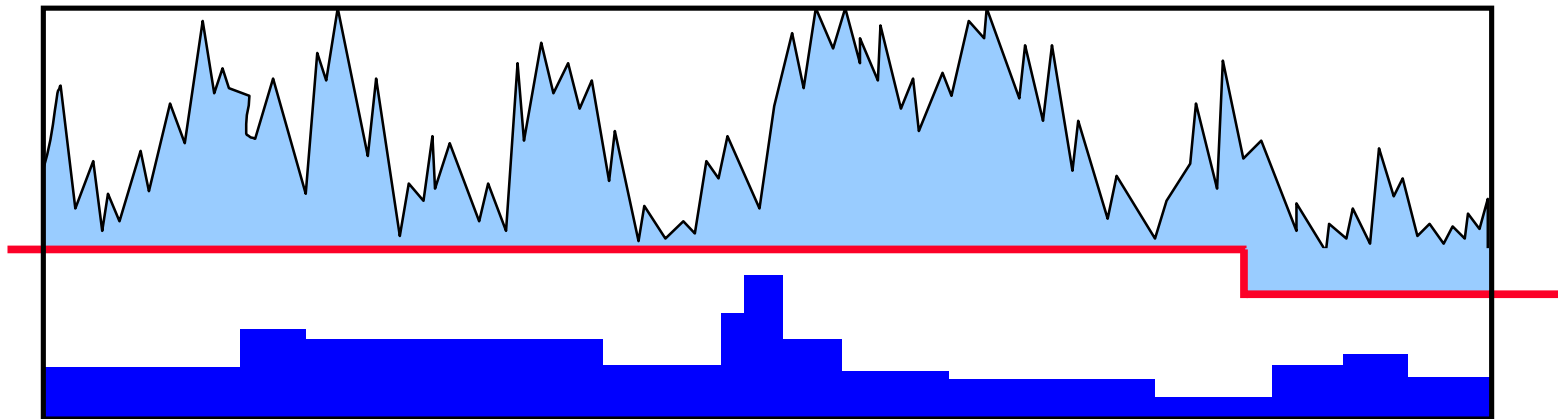
# Best Effort & Guarantees - 3 Ways

- **Two separate systems**
  - **On the basis of circuit model**
  - **On the basis of packet model**



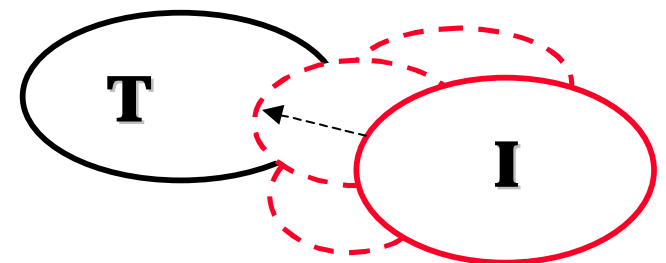
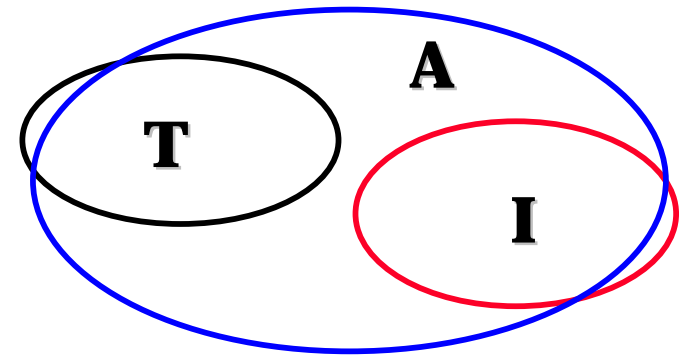
# Start 1: 2 separate systems

- **Each application uses circuit or packet network**
  - seems to work - so we should not omit this approach totally!
  - however,
    - some applications need features not provided by one network
    - no efficient, dynamic multiplexing
    - double trouble (services, interfaces, management, billing)



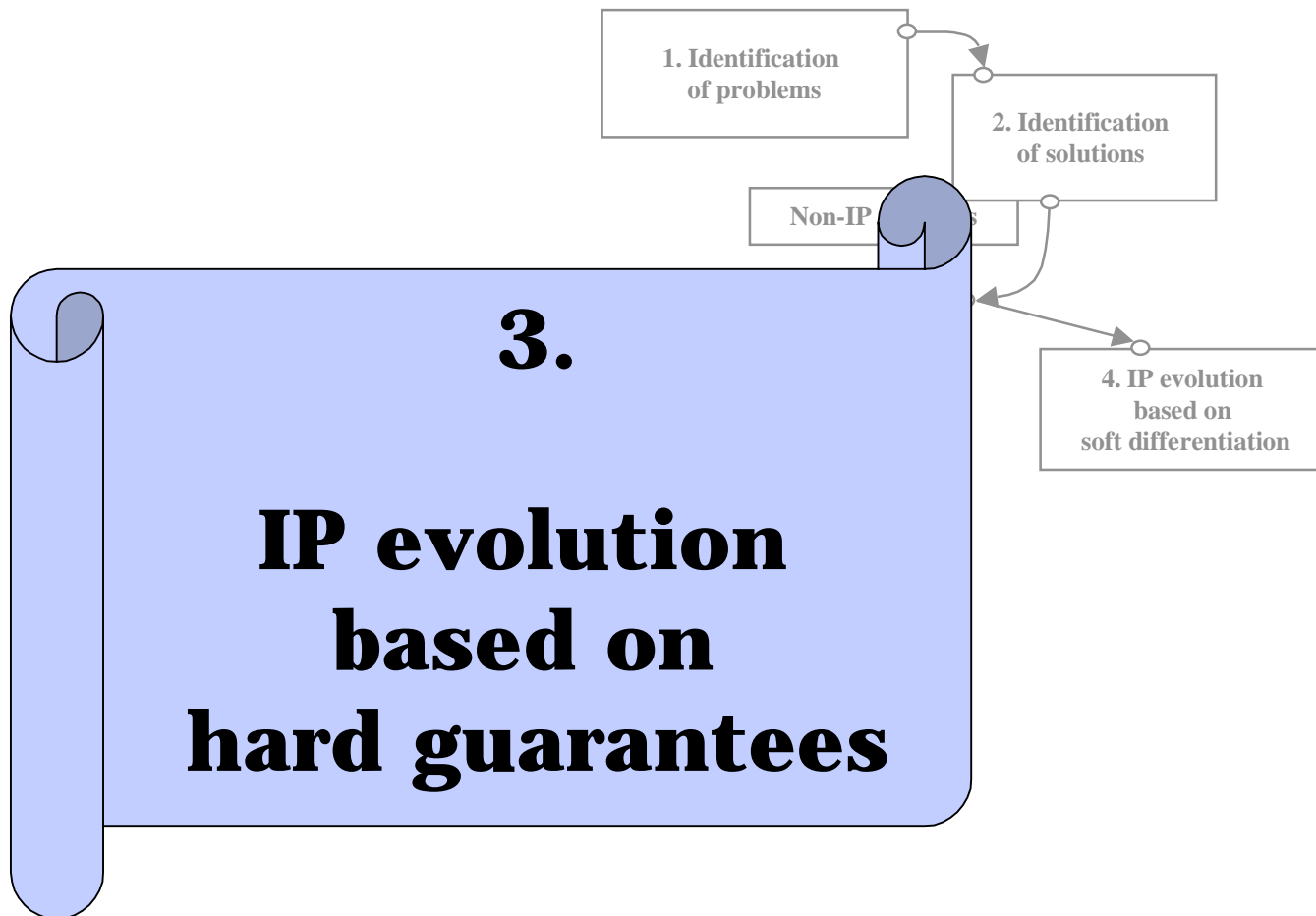
# Outcome 1: Pressure to integrate

- **Let us design a new network (A)**
  - to avoid the shortcomings of old ones
    - that was the idea of ATM
  - The risk
    - instead of integrating two networks a third one is created, and then all three try to live with each other
    - even more interoperability problems and overheads
- **Another alternative**
  - take an existing network as a starting point and improve and expand it



# Conclusion 1:

**Instead of designing a new network,  
an evolutionary approach  
based on packet network (IP)  
is the only reasonable choice**





# Start 2:

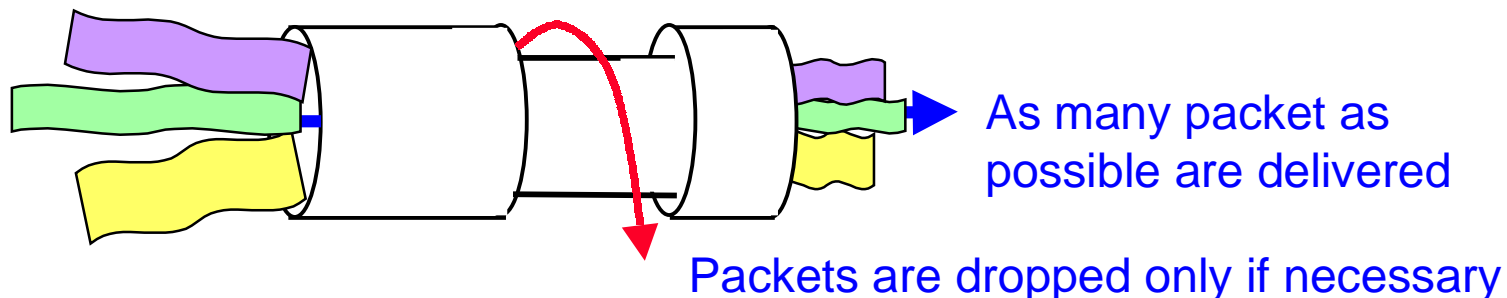
## Based on the current Internet model

- **Best Effort Service**

- far from perfect, but seems to work well enough for most purposes
- ⇒ continues to make the fundamental Internet service

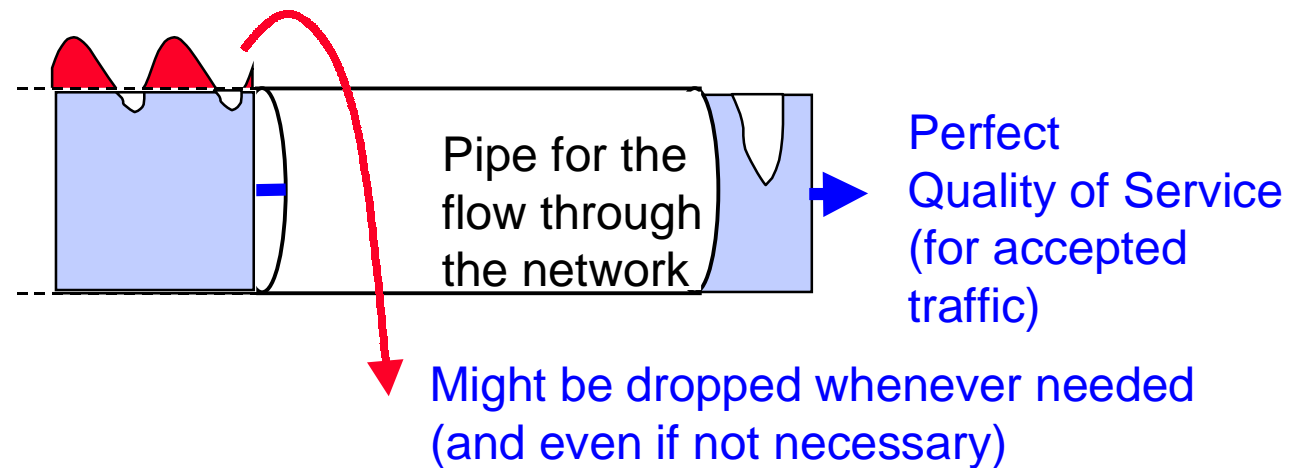
- **Features**

- no quality differentiation ⇔ flat rate charging
- no reservations for flows ⇔ simple traffic control in core network
- relies on TCP/IP ⇔ **no hard control over traffic process**



# Outcome 2: Pressure to add Guaranteed Services

Approach: “In addition to best effort service, add guaranteed pipes”



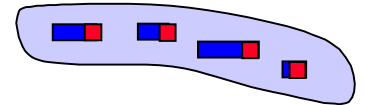
# Integrated Services & RSVP - a short analysis

- **Guaranteed, Controlled Load & RSVP**
  - with exactly defined bit rate and strict QoS objectives (like ATM)
    - capacity reservation is required throughout the network
    - charging is based on the bit rate and QoS objectives
- **NOT a small evolutionary step**
  - **instead, it means a huge change of service philosophy**
- **Acceptable only if we can find really good reasons**
  - (1) for resource reservations
  - (2) for complex charging

# Reservations - What is the point?

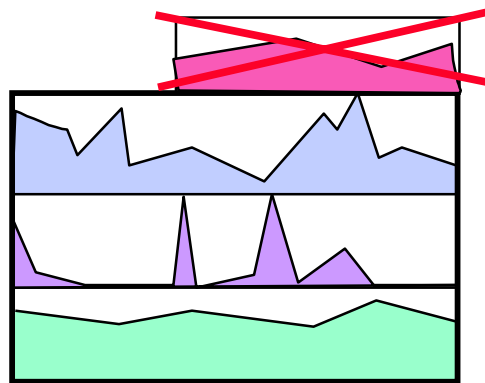
- **IP is a packet networking technology**

- ⇒ capacity reservation is not a natural part of IP
- ⇒ credible reasons are needed to justify reservations



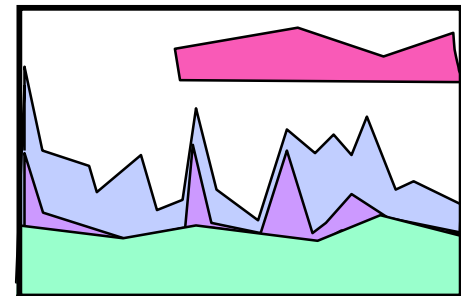
- **Typical statements**

- customers are willing to pay extra *only* if something is reserved
  - **Wrong!** Reservation is a mechanism rather than a service
- improved QoS is not possible without capacity reservations
  - **Wrong!** Sometimes capacity reservations are harmful



← reservation

sharing ⇒



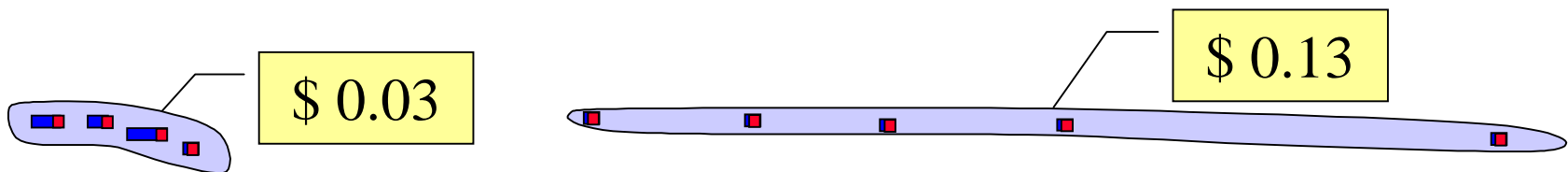
# Applications needing reservations

- **Priority for flows in progress**
  - traditional telephone network is the most obvious example
  - reasonable objective with some applications (audio, video), while not relevant or even undesirable with some others
    - **not the default operation in IP**
  - instead, higher priority can be used permanently for important flows
- **Virtual Private Networks (VPNs)**
  - reservations make it easier to design and control Service Level Agreements
  - from business viewpoint reservations seem useful
    - **but bring about low utilization (<10 %)**

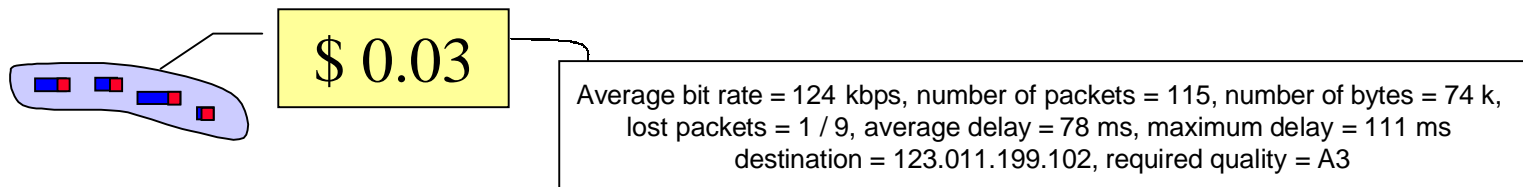
# Complex pricing - Why not?

- **A lot of small flows**

- Web-browsing  $\Rightarrow$  short duration per destination
- IP telephony  $\Rightarrow$  small bit rate



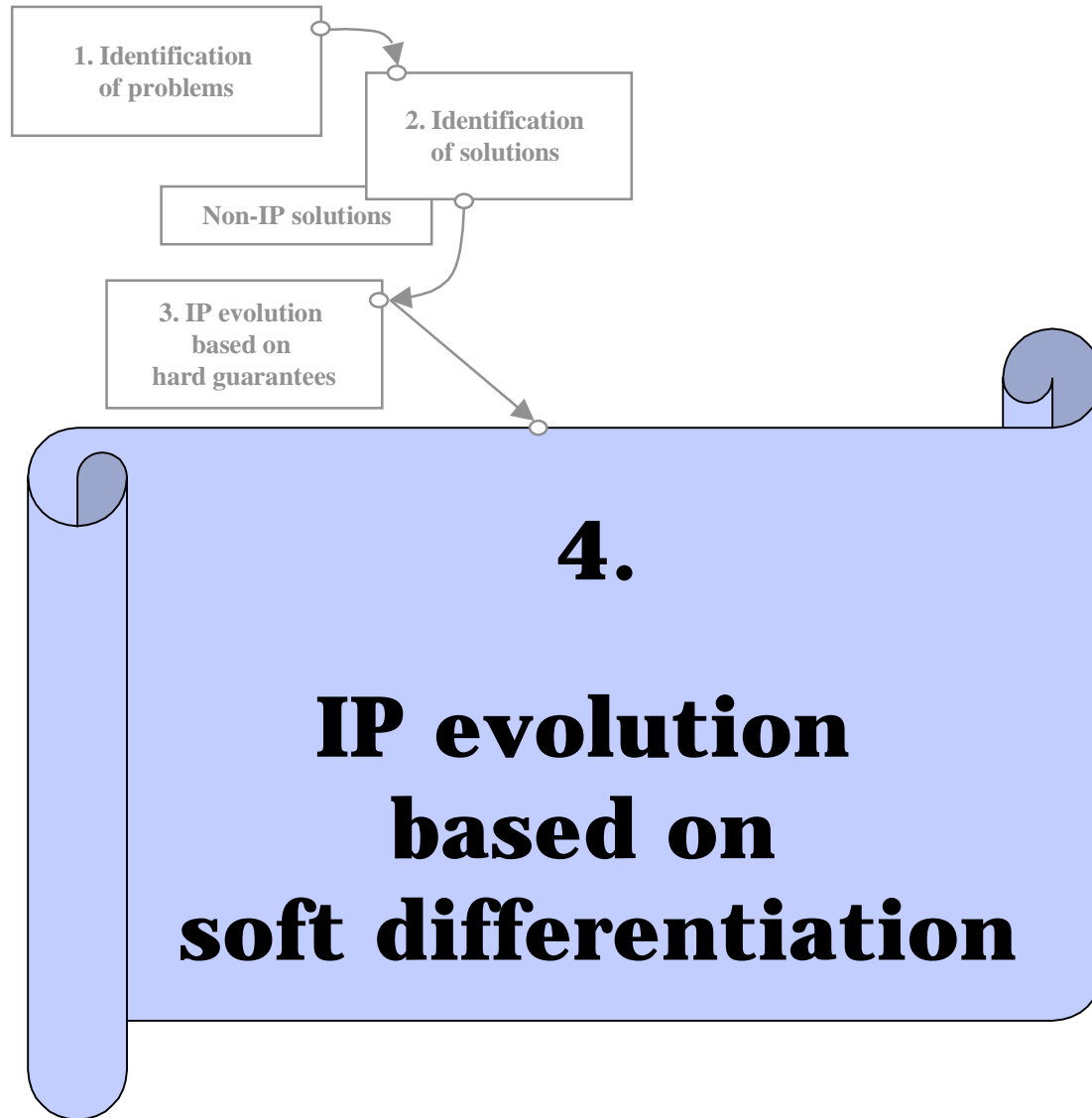
- actual transmission of bits is not usually the dominant cost factor
- complex because parameters related to QoS are needed as well



- billing & accounting system yields large expense

## **Conclusion 2:**

**Guaranteed Services  
may have minor role in future IP  
but surely not a major one**





# Start 3: Service differentiation

- **Differentiated Services**
  - [Panacea](#) - perhaps but then some problems should be solved
- **Overall weakness of end-to-end services**
  - best effort is not enough for all applications
  - differentiation is needed for business reasons
- **Exploitation of network resources**
  - TCP/IP model is not always robust and fair
- **Implementation and management**
  - problems should be solved but without any excessive implementation and management costs

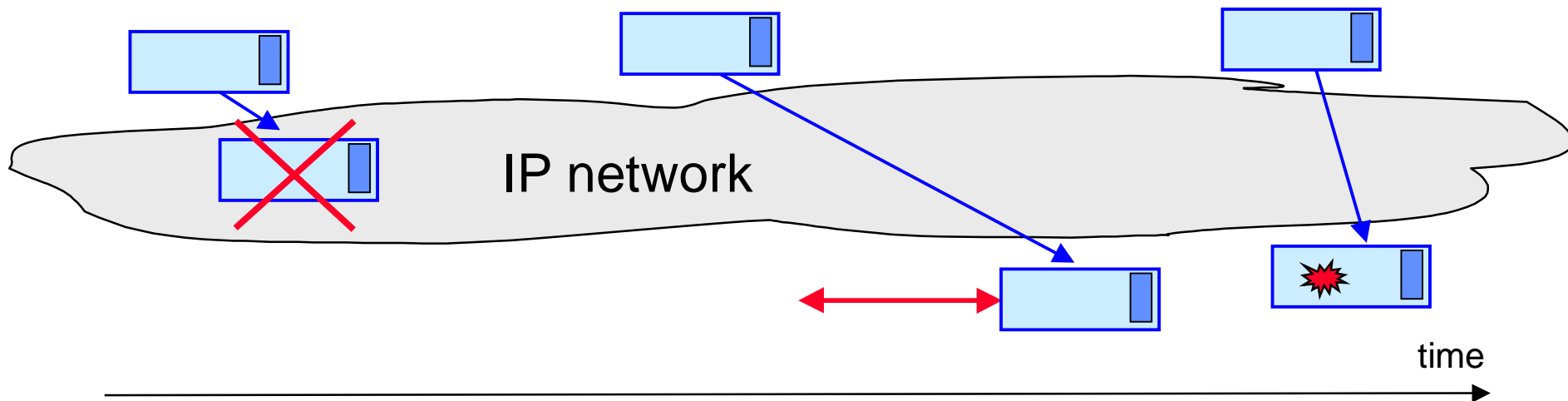
# Quality for IP - An implementation

- **IP is a packet network**

- let us avoid converting it to a circuit switched network

- **A packet can be damaged, delayed or lost**

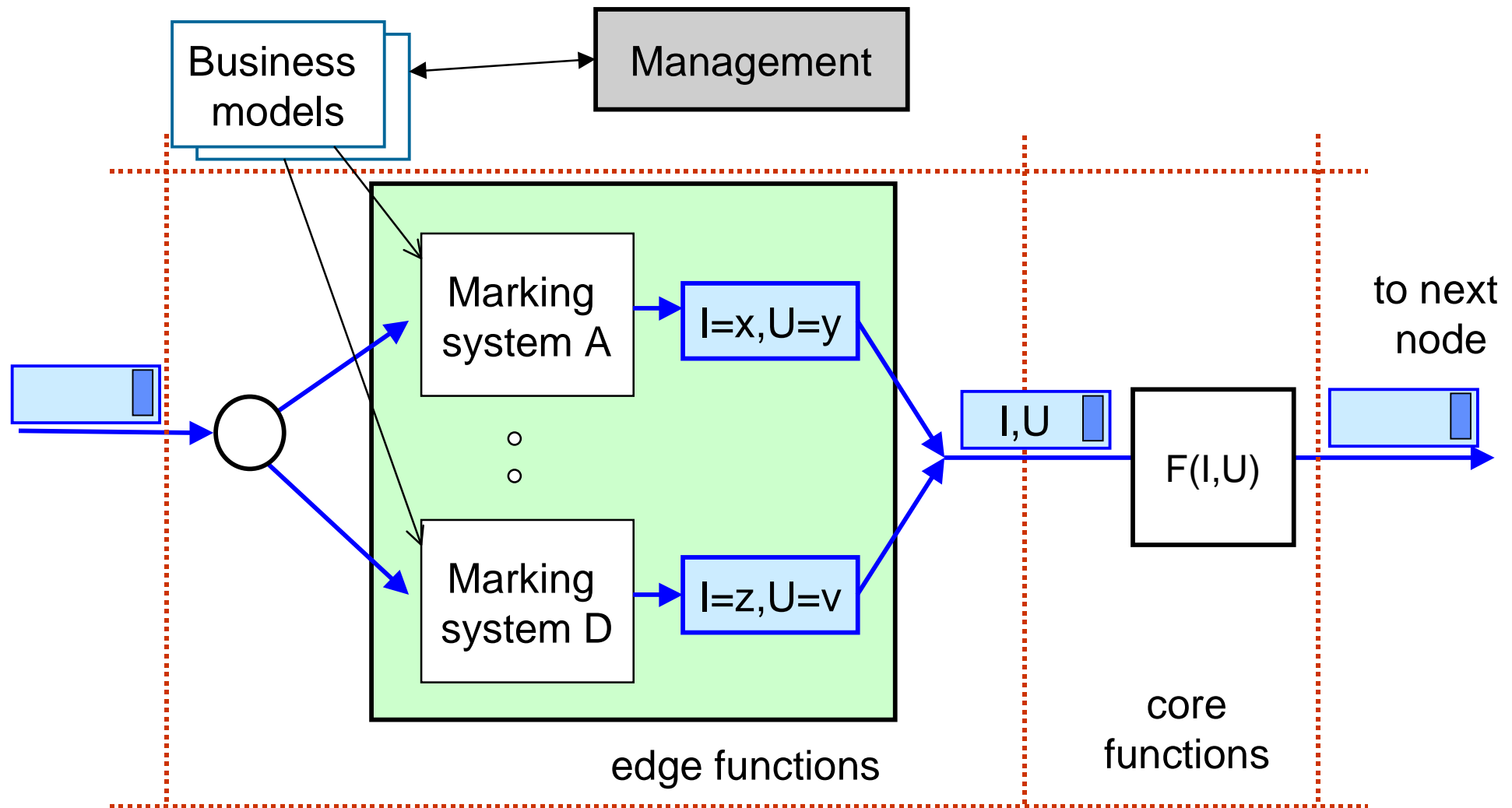
- to manage packet losses  $\Rightarrow$  importance scale for packets (I)
- to manage delays  $\Rightarrow$  urgency scale for packets (U)
- bit errors are relevant sometimes but not usually in core network



# Edge functions

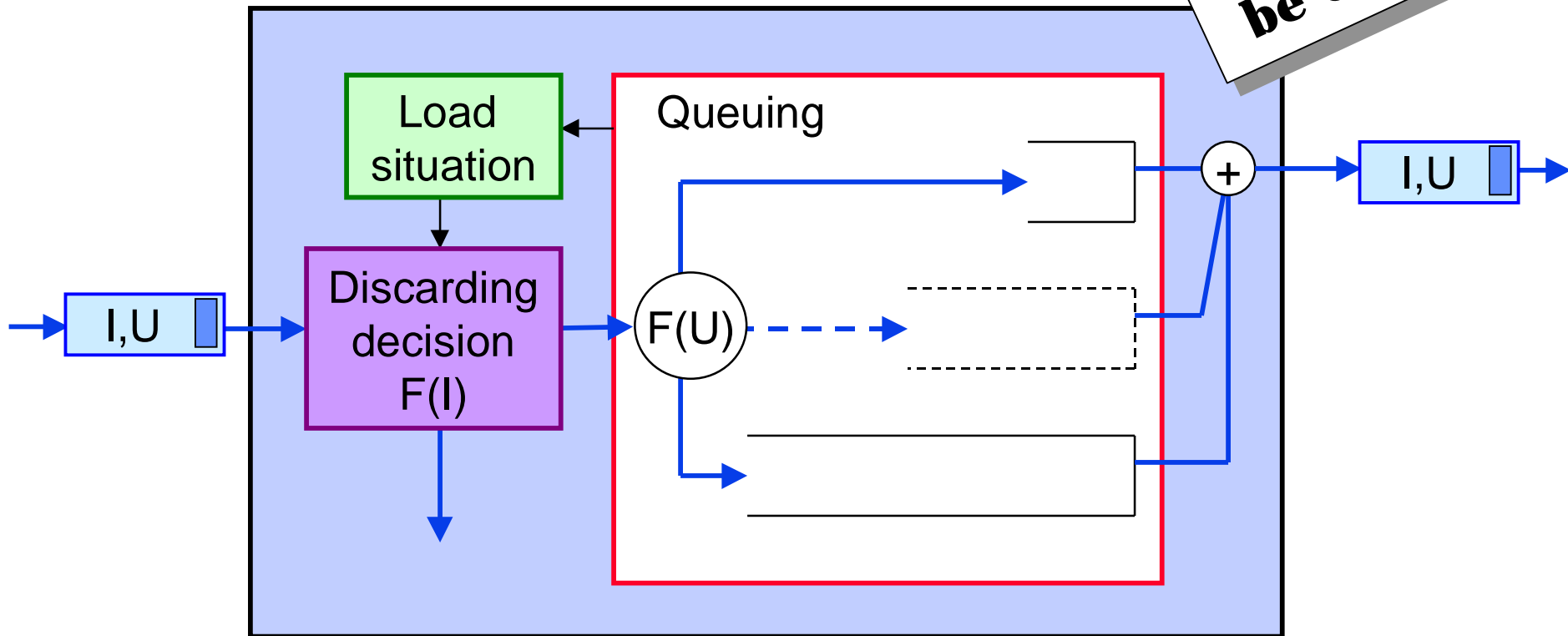
- **Task**
  - is to define the basic attributes for each packet
  - not for flows because IP/DiffServ core is a packet transport tool
- **Basic attributes**
  - importance of the packet (I)
  - urgency of the packet (U)
- **All needs are *mapped* to these attributes**
  - higher price ⇒ more important
  - more demanding application ⇒ more important
- **(but this is not exactly the standard DiffServ model)**

# The essence: Edge model



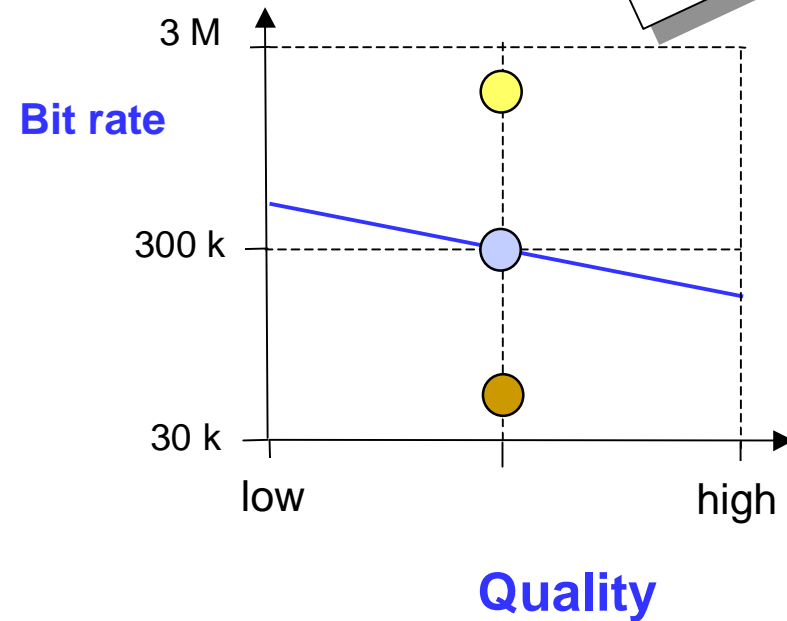
# Simplest part: Core functions

**Difficulties to be overcome**



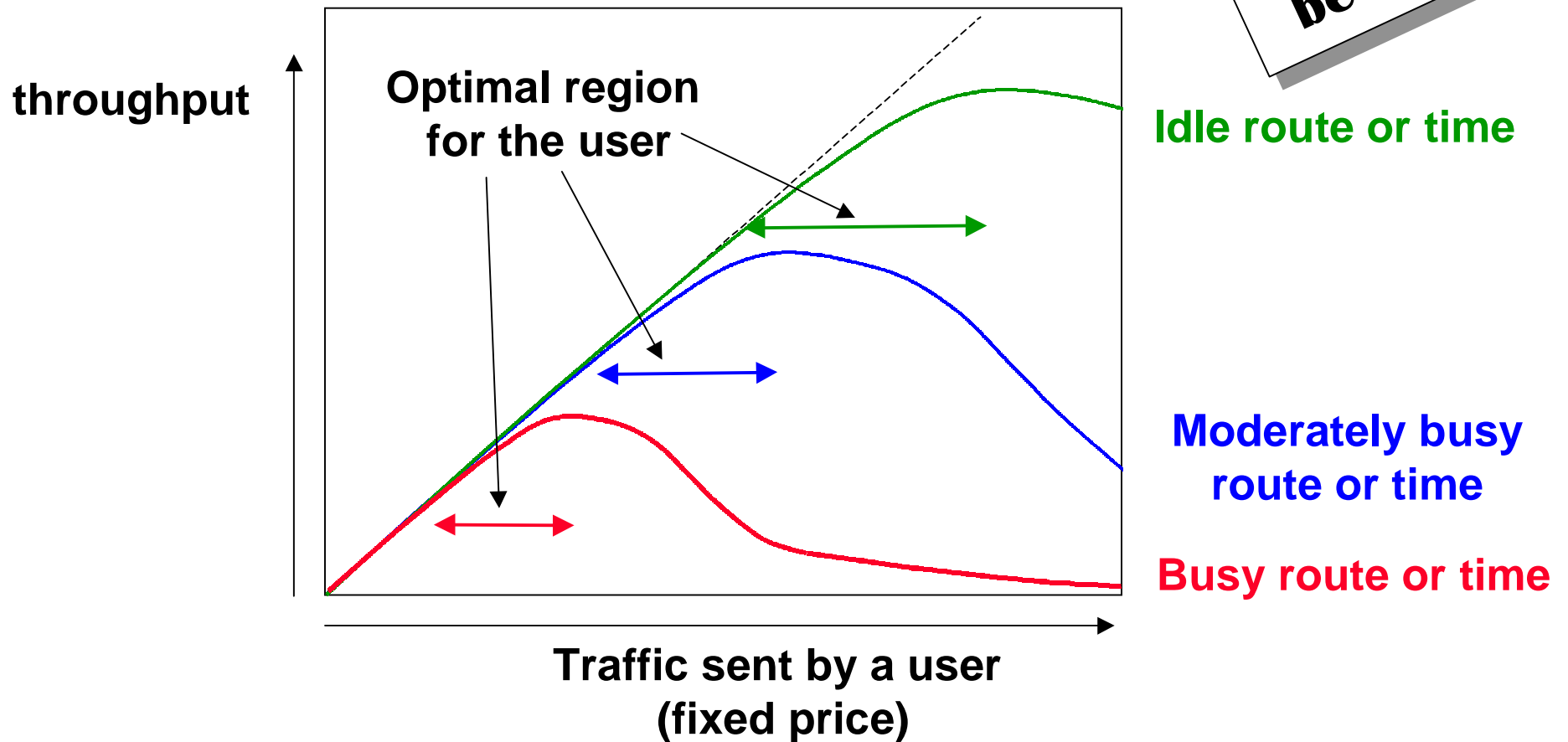
# Service differentiation

- **Several levels of fixed price, e.g.**
  - \$100 per month ●
  - \$30 per month ●
  - \$10 per month ●
- **Relationships between**
  - bit rate
  - quality (delay)
  - availability



# Quality vs. Demand - incentive to adjust bit rate

**Evils to  
be tamed**



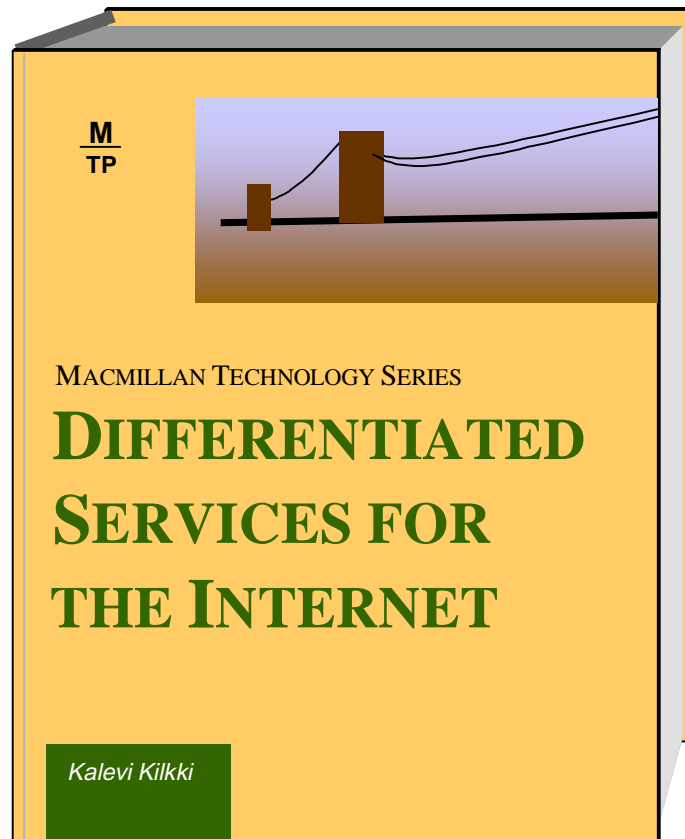
# DiffServ - Panacea?

- ★ **Diseases to be cured: weak services**
  - **Yes, DiffServ provides basic tools for service differentiation**
- ★ **Evils to be tamed: exploitation of resources**
  - **Yes, if the packet marking is properly designed**
- ★ **Difficulties to be overcome: complexity**
  - **Yes, as to the core, while edge functions and management are unsure**



# References

- <http://www.ietf.org/html.charters/diffserv-charter.html>
- More (356 p.) about DiffServ



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**The End**