

# Economic aspects of spectrum management for space satellite systems

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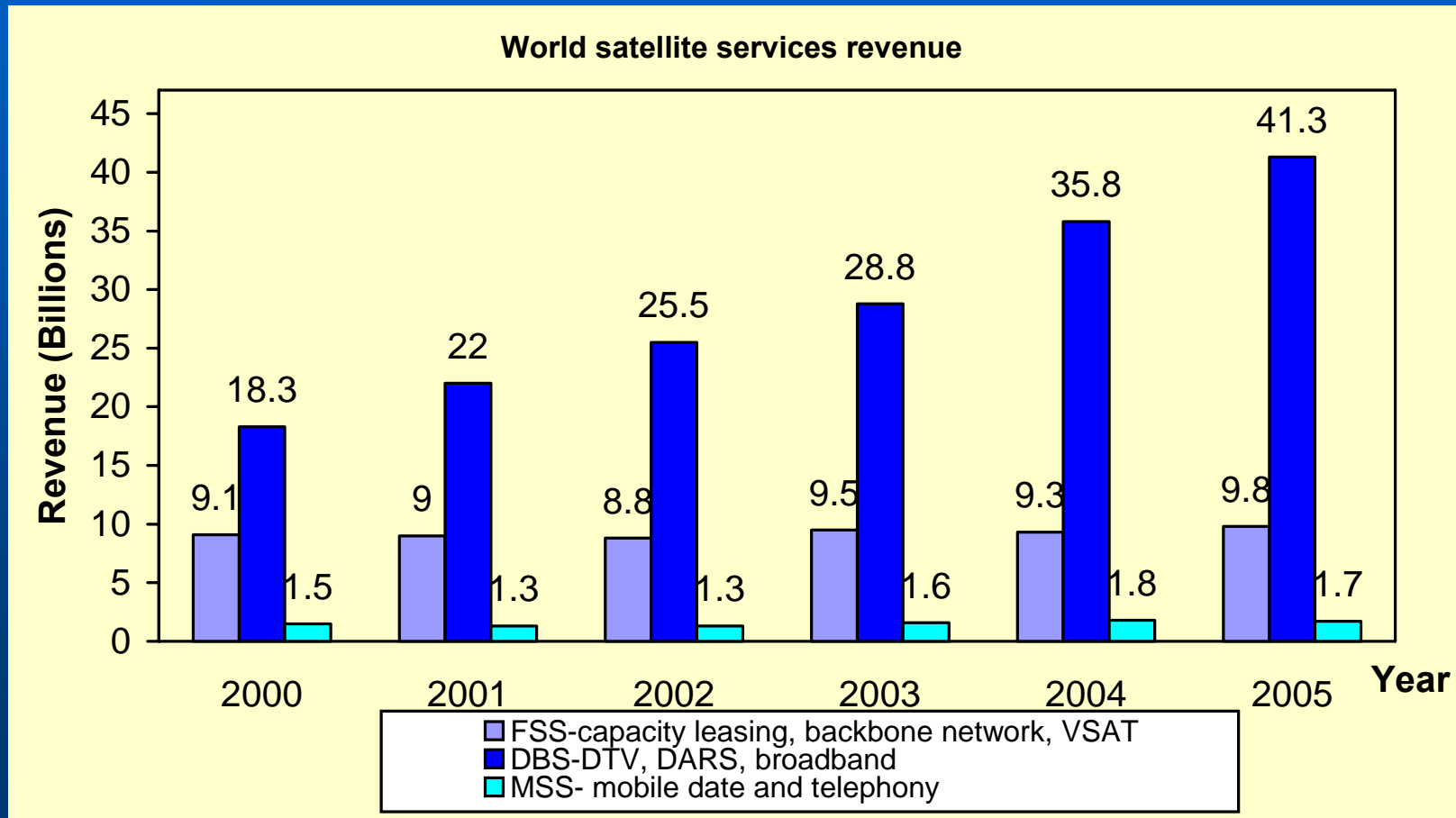
BR/SSD/SSC

Report expresses opinion of author

# Introduction

- **Current state and trends in satellite services development**
- **Orbit capacity**
- **International spectrum management of satellite services**
- **Theory of common open resource management**
- **Options for improving international regulation**

# Current state and trends in satellite services development



# Current state and trends in satellite services development (2005)

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- 1) **240 commercial satellite systems (Via Satellite)**
- 2) **Near 6 000 transponders (Futron)**
- 3) **VSAT- near 1 million (ITU-D)**
- 4) **BSS TV - 112 millions users (ITU)**
- 5) **MSS (2005) –1,4 million users (ITU-R SG8D)**
- 6) **BSS (sound)- near 12 millions (Research and Market eMarketer)**

# Current state and trends in satellite services development

- 1) 2006-2015- 208 GSO and 160 NGSO to be launched (FAA)
- 2) 2015- near 9 000 transponders (Futron)
- 3) Demand grows- is there enough capacity?
- 4) (Europe)
- 5) MSS- Complementary ground component, multimedia broadcasting
- 6) BSS (sound)- Europe (2010) – 12 000 000 (Digital Radio)

# Orbit capacity

$$N_{opt} = F(NPV)$$

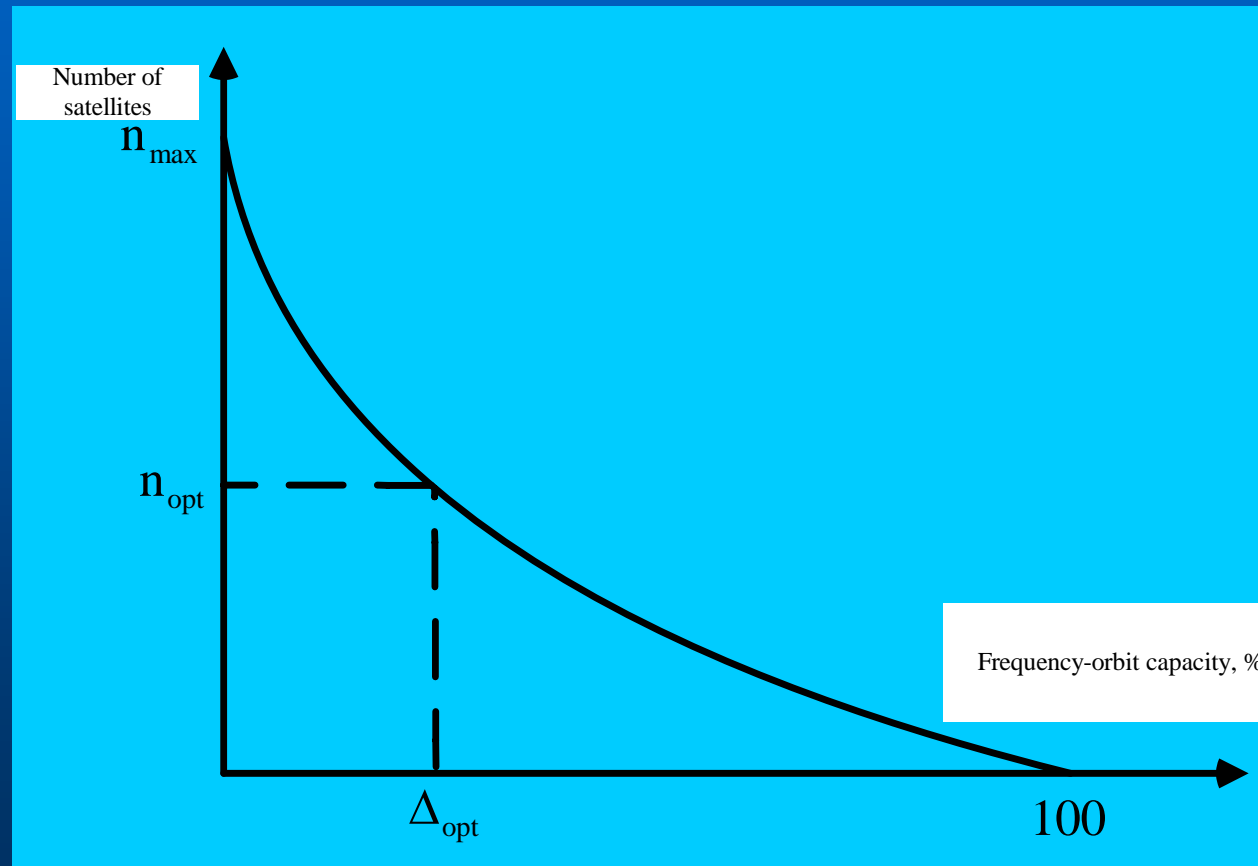
$$NPV = -C + \sum_{k=1}^n \frac{P_k}{(1+R)^k}$$

C- project cost

$P_k$ -profit(revenue-operational costs)

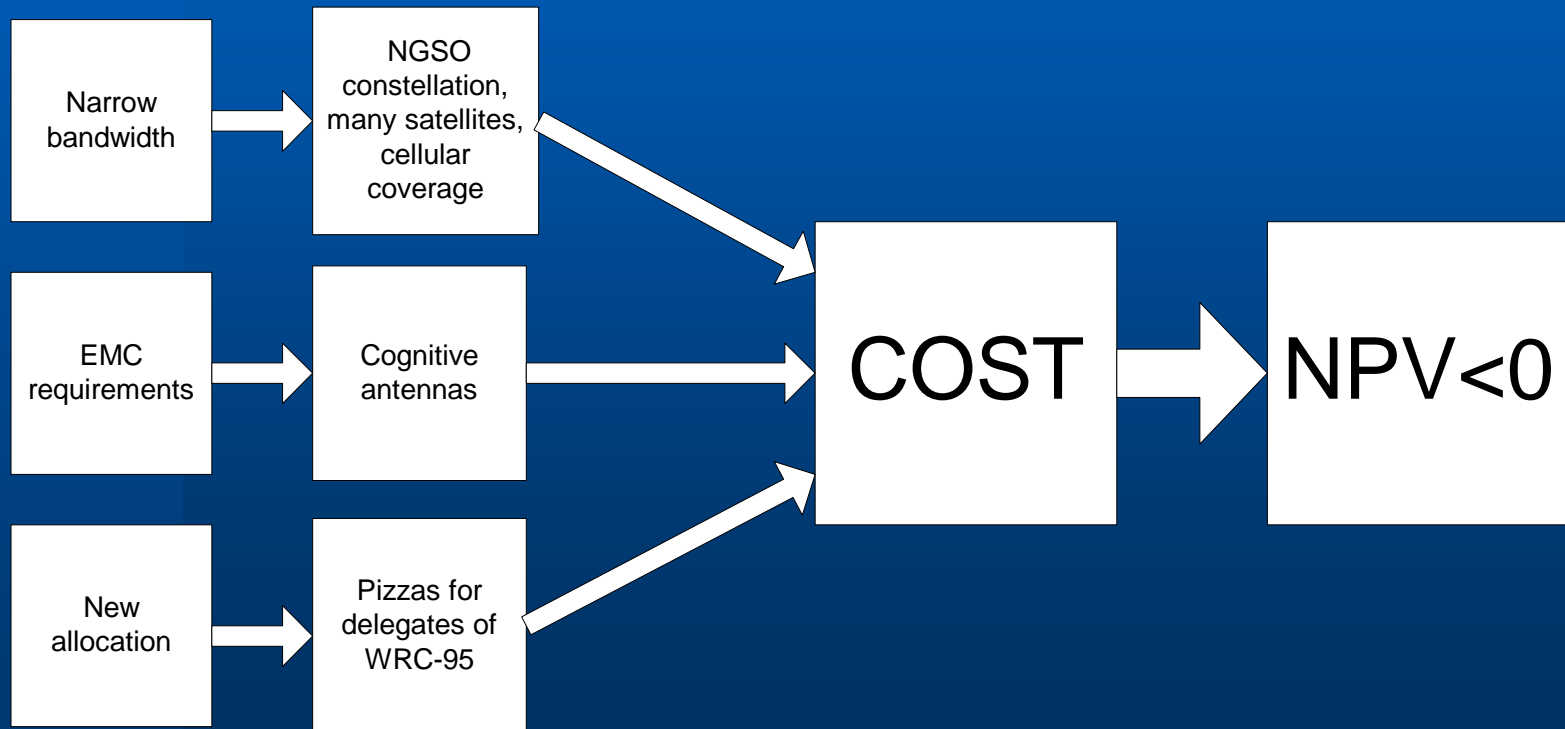
N- project time

R-discount rate



# Orbit capacity

- Example- Teledesik



# International spectrum management of satellite services

the Union shall in particular ...**effect allocation** of bands of the radio-frequency spectrum, the allotment of radio frequencies and the registration of radio-frequency assignments and, for space services, of any associated orbital position in the geostationary-satellite orbit or of any associated characteristics of satellites in other orbits, in order to avoid harmful interference between radio stations of different countries;

coordinate efforts to eliminate harmful interference between radio stations of different countries and **to improve the use made of the radio-frequency spectrum for radio-communication services and of the geostationary-satellite and other satellite orbits;**

Radiocommunication Sector shall be, bearing in mind the particular concerns of developing countries,..by ensuring the **rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including those using the geostationary-satellite or other satellite orbits,** subject to the provisions of Article 44 of this Constitution, and

# International spectrum management of satellite services

- Two mechanisms for sharing orbit / spectrum:



**Coordination  
Approach**

Efficiency  $\Leftrightarrow$  First come, first served for actual requirements



**Planning Approach**  
Equitable access  $\Leftrightarrow$  Plan for future use  
( BSS and FSS Plans)

# International spectrum management of satellite services

## Planning Approach

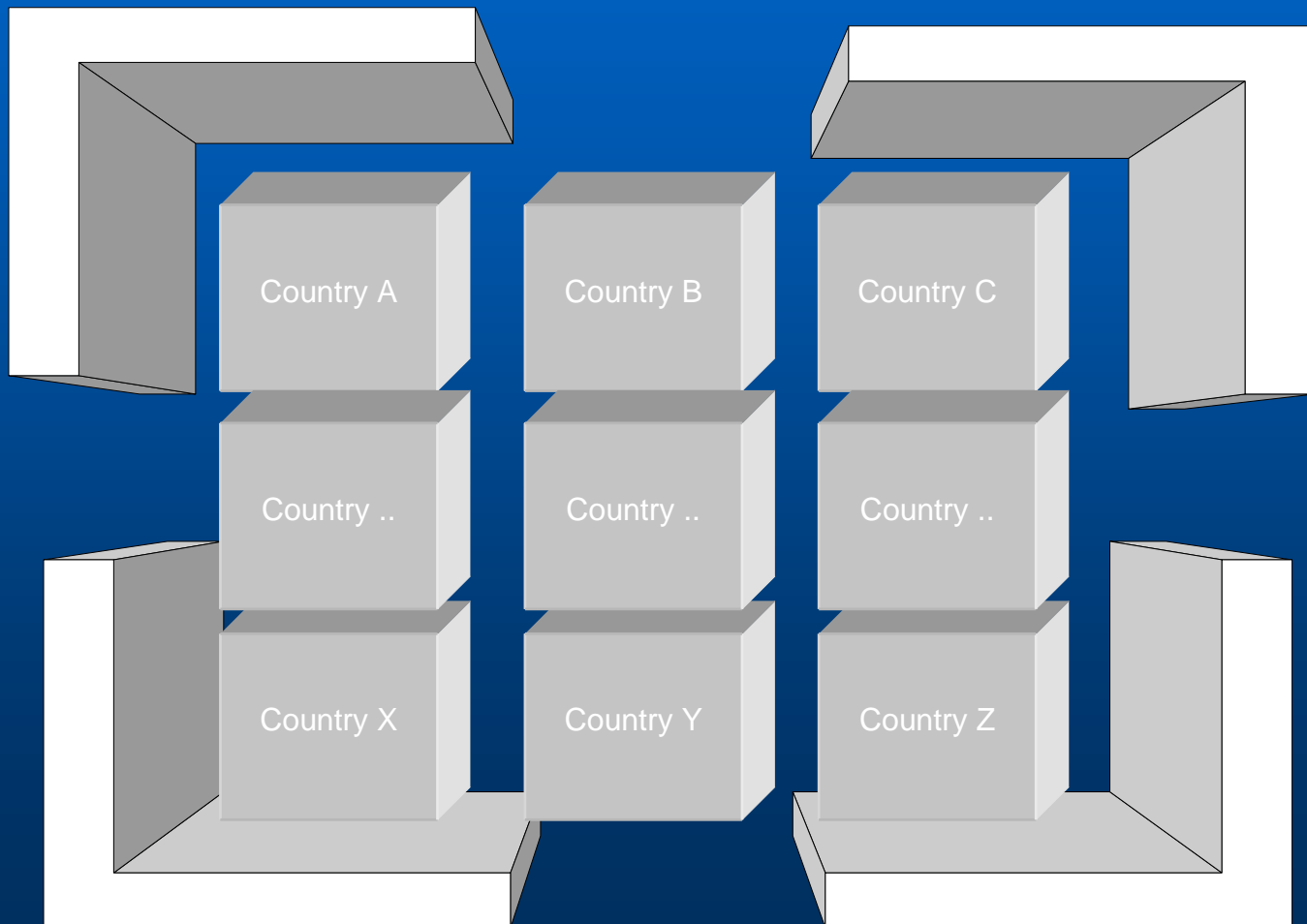
Size:

Frequency  
band

Orbit

Power

National  
Coverage



# International spectrum management of satellite services

## Current problems

**Plans** up-take practically **non-existent**

Free riders (additional use and regional systems)

Reason: lack of capital,

Lack of know-how,

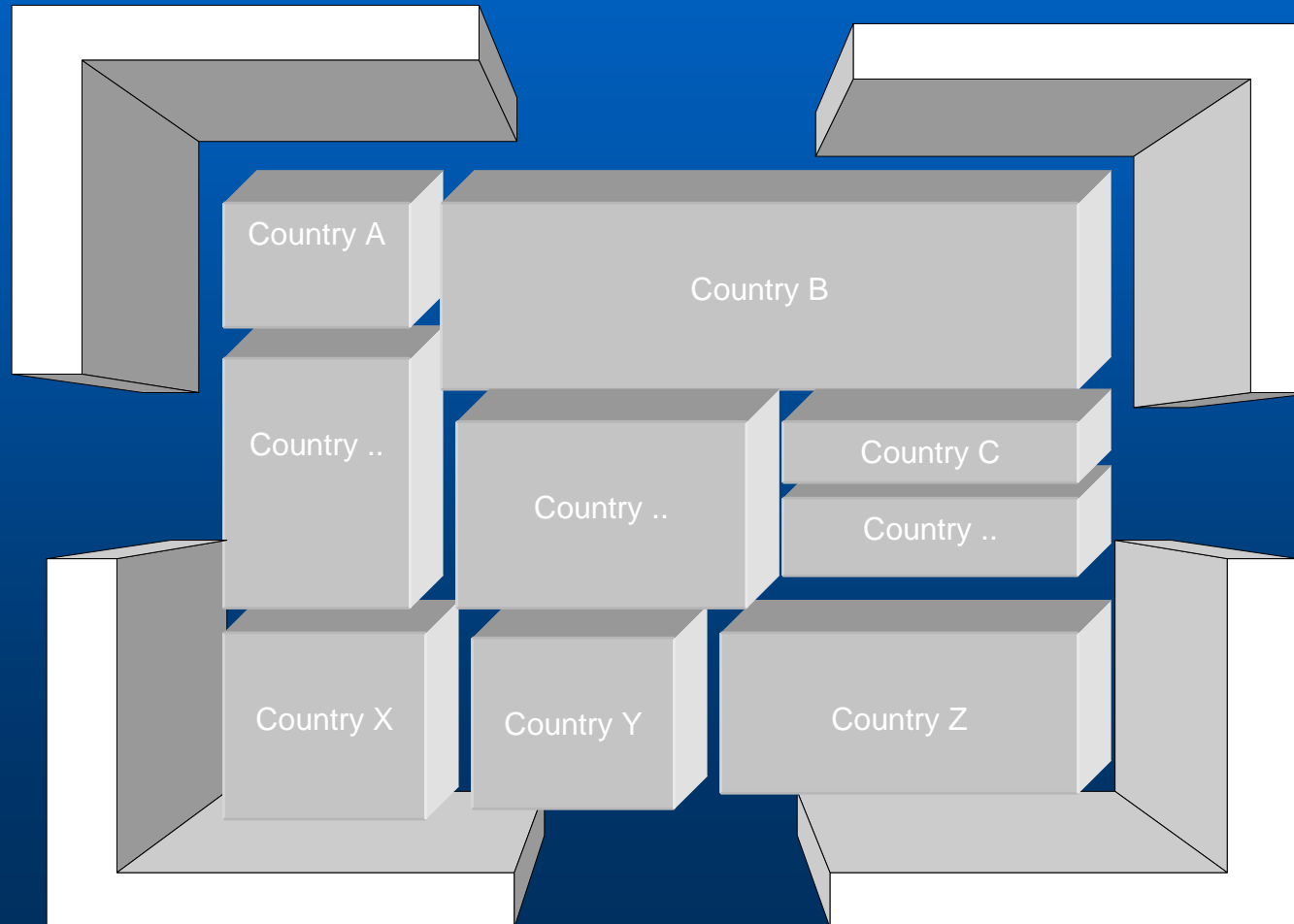
Low current demand,

National coverage restrictions.

# International spectrum management of satellite services

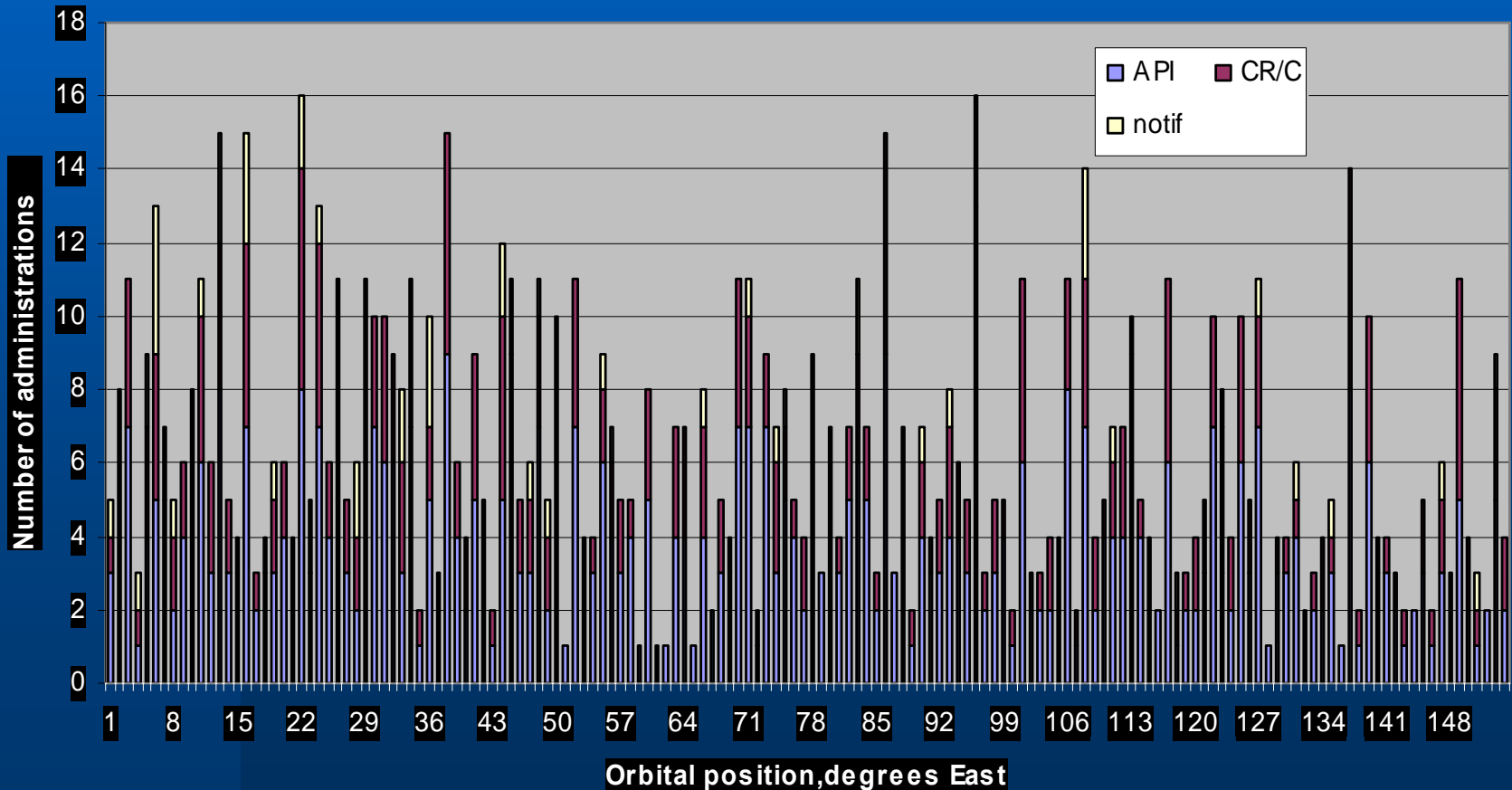
## Coordination Approach

- API
- Coordination (CR/C)
- Notification
- Near 3000 filings in processing.
- 400 MIFR entries



# International spectrum management of satellite services

Number of filings, 2000-2006, Ku-band



# International spectrum management of satellite services

## Current problems:

- EMC is calculated on the basis of SRS date base.
  - “paper” satellites
  - “paper” parameters
- ⇒ “paper” congestion
- Dysfunctional enforcing mechanism

# International spectrum management of satellite services

**Result:**

$$NPV = -C + \sum_{k=1}^n \frac{P_k}{(1+R)^k}$$



- Increasing  $C$  due to rising transaction costs
- Decreasing  $P_k$  due to coordination with newcomers
- Increasing  $R$ - investment risk

# International spectrum management of satellite services

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## Transaction cost

- expenditure of time and resources to obtain the spectrum access
- Latecomer penalty: currently US\$ 3-5 m, increasing 2-3% annual (see recent US DB orbital position auctions)
- Affects incumbents too!

# International spectrum management of satellite services

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## Creep in annual operational costs

- **Coordination with newcomers**
- **Staff, software, coordination meetings, travel costs**

# International spectrum management of satellite services

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## Risk of investment

- **Uncertainty of access to resource under required conditions, probability of interference, limitations imposed on power, service area etc.**

# Theory of common property resources

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- **Tragedy of commons**
- **Methods to improve efficiency:**
  - **independent public regulation body,**
  - **economic approaches,**
  - **effective enforcement mechanism.**

# Options to improve international regulation

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**Independent common public  
regulation body**



**ITU**

# Options to improve international regulation

## Economic approach

```
graph TD; A[Economic approach] --> B[Spectrum rights trading]; A --> C[Spectrum price];
```

Spectrum  
rights trading

Spectrum  
price

# Options to improve international regulation

- Spectrum rights trading

First theorem of social welfare economics:

in a competitive market, all possible mutually profitable transactions end up taking place sooner or later, resulting in the economically efficient distribution of resources.

# Options to improve international regulation

## EC Radio Spectrum Policy Group

## Existing FSS Plan

<b>Spectrum right</b>
<b>Name of the public authority that assigns the right</b>
<b>Name of holder</b>
<b>Spectrum bandwidth</b>
<b>Max in band power or Max out of band power or Spectrum mask</b>
<b>Service area and maximum in-band power beyond geographical limits</b>
<b>Duration and rights of renewal</b>

<b>National allotment</b>
<b>Name of Administration</b>
<b>800 MHz (up- and down- links), orbital position</b>
<b>A,B,C,D, aggregate C/I<math>\geq</math>26 dB, C/N<math>\geq</math>16 dB, single entry C/I<math>\geq</math>30 dB</b>
<b>National coverage, Test points</b>

# Options to improve international regulation

## Bands subject to a Plan

- **Spectrum right is very well defined**
- **Regulatory framework to promote allotment leasing**
- **Service neutrality**

# Options to improve international regulation

## Non- plan bands

- **Leasing impossible, as spectrum rights remain undefined**
- **Annual spectrum fee for systems in SRS database (opportunity price-NERA-Smith)**

# Options to improve international regulation

## Enforcement mechanism

- Independent radio monitoring
- Victim receives interference  
fine

# Conclusions

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- 1) SatCom prospects remain good**
- 2) Existing system for international spectrum management system needs to be looked at**
- 3) Introduction of economic methods- promising option to increase efficiency of spectrum use for satellite systems**



# Questions?

