

# Network Modelling and PSTN-NGN Migration

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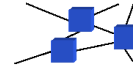
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## Review

- 1 Introduction
- 2 New Network Model
- 3 Procedure for Designing a Network
- 4 Interworking between Networks
- 5 PSTN-NGN Migration

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## 1 Introduction

### Changes in Telecommunication Networks

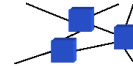
- NGN (Next Generation Networks), Voice/All over IP, UMTS Release 5, Fixed/mobile Convergence
- Network integration: e.g. PSTN, ISDN, GSM
- More complex networks

### Reduction of complexity

- By using a structured network model
- OSI Reference Model with 7 Layers, ISDN- and generic protocol reference model
  
- **But: Restricted to certain Layers or Strata**
- **But: Important network functions such as „Services“, „Mobility“, „Security“, „Quality of Service“ are spread over different Layers and Planes → not modelable**
  
- **New network model required!**

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## 2 New Network Model

### Characteristics

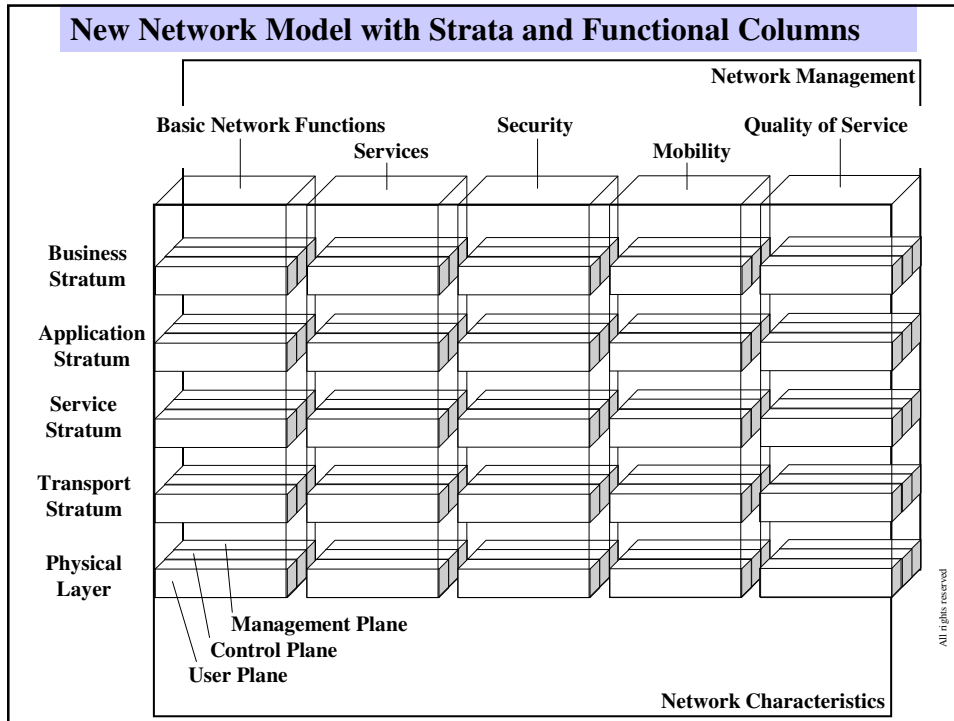
- **For modelling arbitrary Telecommunication Networks**
  
- 1) Graphical Model
- 2) Calculation Model for variant calculation
  
- **Strata: Layer(s)**
- **Planes**
- **Functional columns**
- **Network Management**
- **Concrete network characteristics such as number of subscribers, traffic dimensions**
  
- **Overcoming the restrictions of OSI Reference Model**
  
- **Solving the problem of modelling overall network functions such as Security and Mobility**

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### 3 Procedure for Designing a Network – Step 1: Definition of Requirements

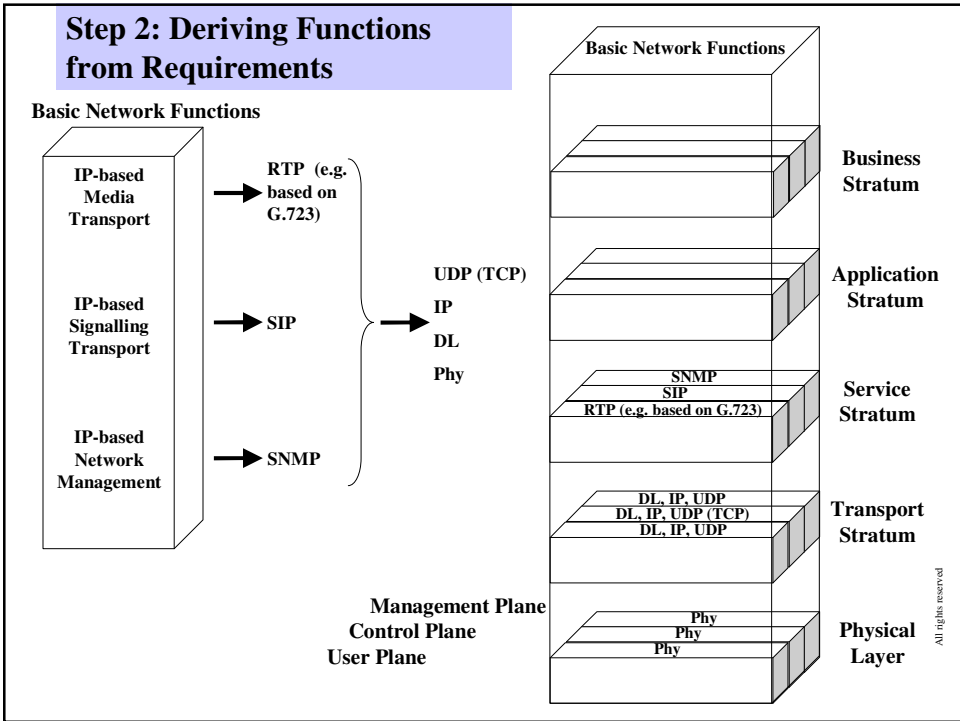
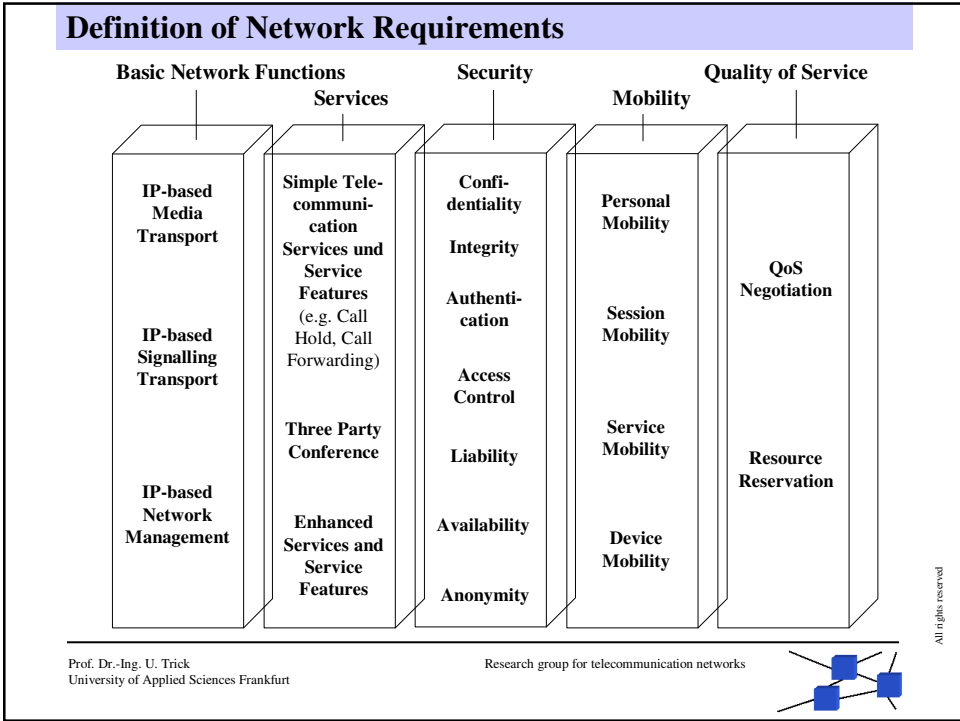
- Step-by-Step modelling

Step 1: Definition of requirements for

- Basic network functions
- Services
- Security
- Mobility
- Quality of Service
  
- Network Management
- Network Characteristics

→ „Natural“ approach





### Step 3: Allocating Network Functions to Network Nodes

Type of Network, e.g. SIP/IP-based:

- SIP User Agent
- SIP Registrar Server
- SIP Proxy Server
- SIP Application Server
- Conference Server
- IP Router
- Firewall
- Bandwidth Broker

- One individual column-based network model for each type of network element
- Each network element model = Subset of total network model
- Overlap of all network element models = total network model

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### Step 4: Complete Functions in one or more Nodes if necessary

- Additional functions are automatically adopted from nodes into total network model

### Step 5: Export Network Characteristics from Graphical Model into Calculation Model

- Automated readout of numeric network characteristics (e.g. number of subscribers, traffic dimensions, costs) from up to four graphical network models

### Step 6: Use Calculation Model

- Add further numeric characteristics to imported characteristics if necessary
- Network calculations, network optimisations, migration scenarios
- Arbitrary number of single scenarios for time sequence simulation

### Step 7: Export Results from Calculation Model into Graphical Model

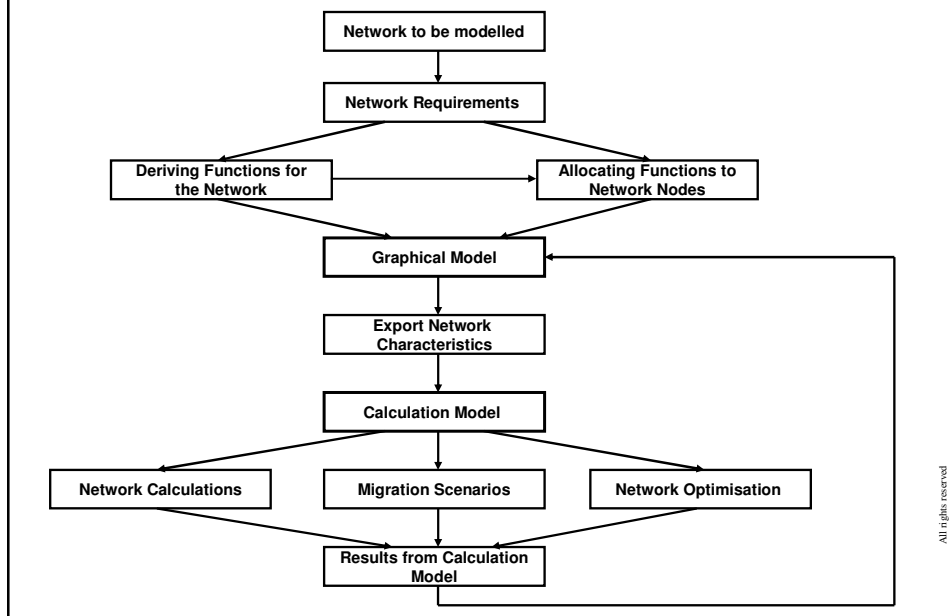
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## Procedure for Designing a Network - Overview

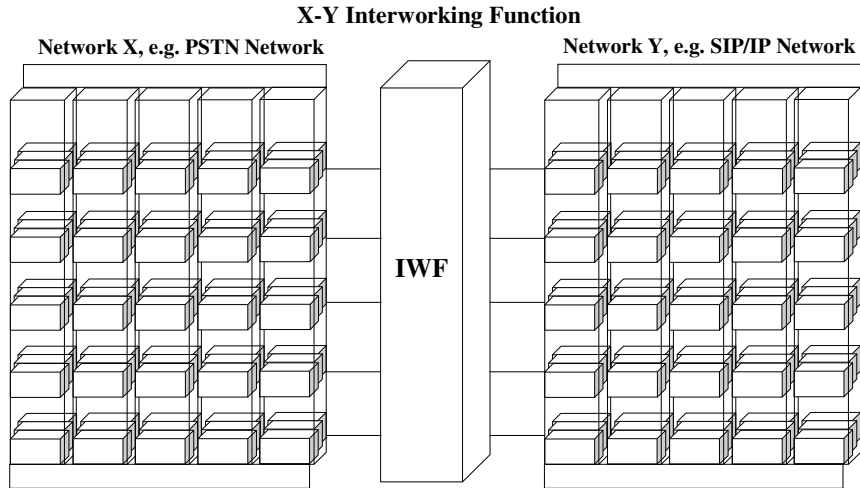


## 4 Network Interworking

- In future: pure IP networks such as SIP/IP fixed networks, UMTS Release 7
- While still converging: heterogeneous networks, both circuit and packet switched, different protocol stacks
- Interworking, gateways for connecting (2) networks
- Steps 1 and 2: Graphical Model for each of the 2 networks
- Step 8: Merging both Graphical Models → Relationship of network functions, Interworking Function (e.g. ISUP-SIP)
- Step 9: Allocating Interworking Functions to network nodes (e.g. Media Gateway Controller)
- Full Model Realisation with EXCEL and VBA (Visual Basic for Applications)



## Interworking of two different Networks



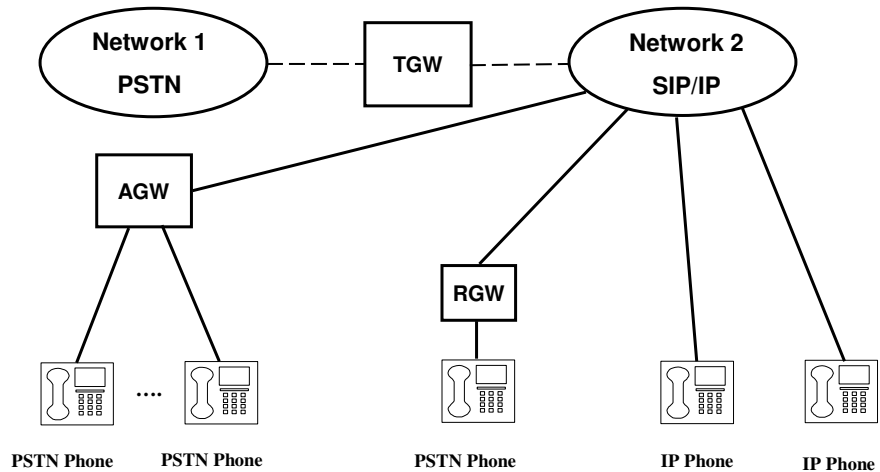
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## 5 PSTN-NGN Migration



SIP: Session Initiation Protocol  
PSTN: Public Switched Telephone Network

TGW: Trunking Gateway  
AGW: Access Gateway  
RGW: Residential Gateway

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## PSTN-/SIP/IP Migration

### User Traffic

- 0,119 Erl per PSTN subscriber
- 0,4 Erl per SIP/IP subscriber

### Trunking Gateway (TGW)

- Traffic: 7.200 Erl (240 E1 à 30 Erl)
- Cost: 720 CU (Cost Unit)

### Access Gateway (AGW)

- Traffic: 2.380 Erl (20.000 PSTN subscriber à 0,119 Erl)
- Cost: 12.500 CU

### Residential Gateway (RGW)

- Traffic: 0,119 Erl
- Cost: 1,2 CU

### IP-Phone

- Traffic: 0,4 Erl
- Cost: 1 CU

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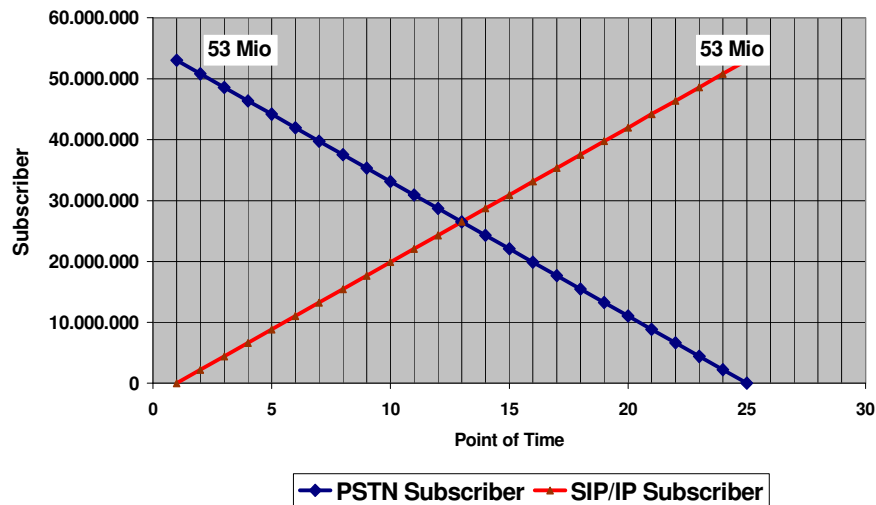
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## Subscriber Development in case of linear Migration

### Subscriber Development

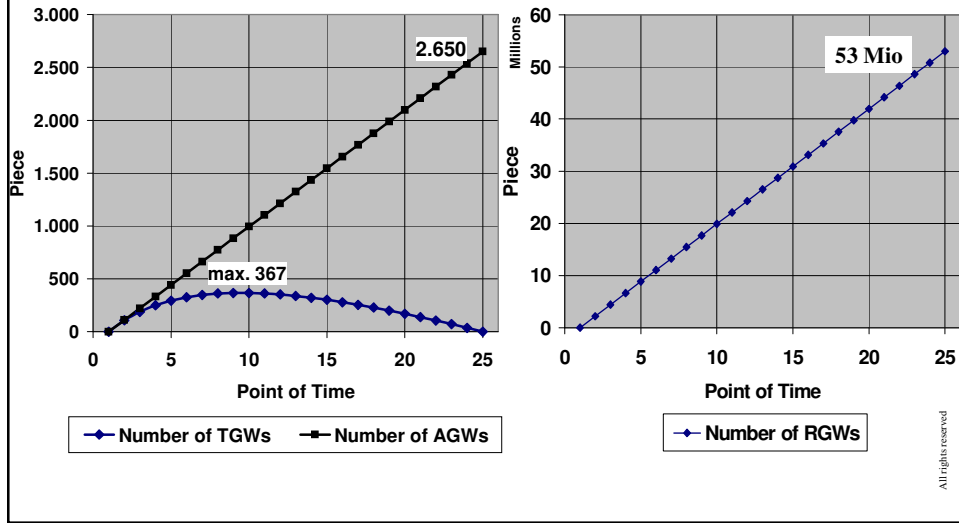


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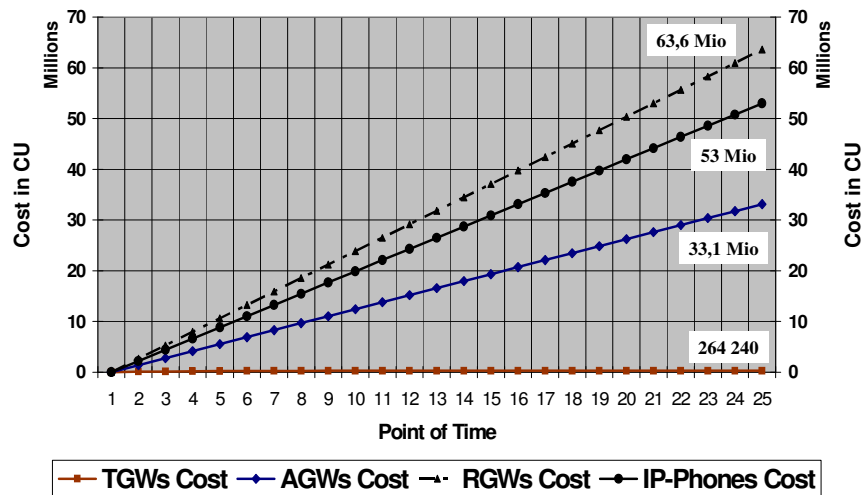
## Number of Gateways required

### Number of Gateways required

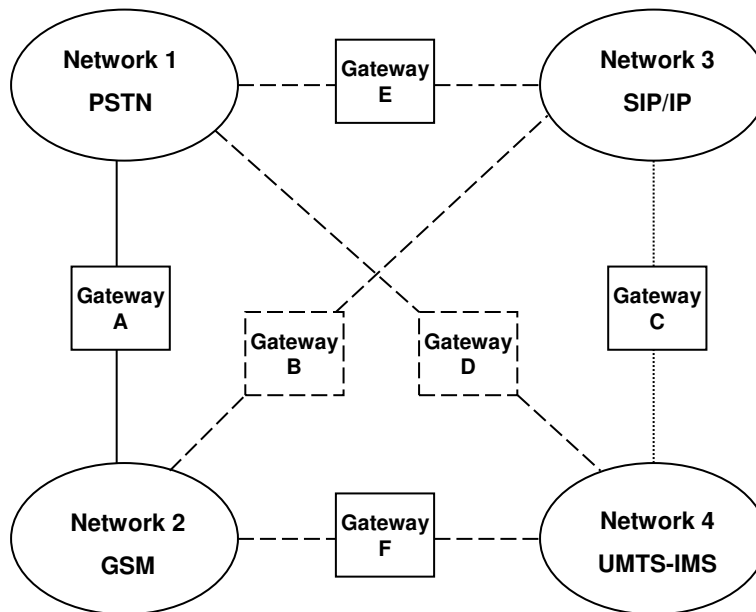


## Migration Costs

### Migration Cost



## Interconnection of four different Networks



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## PSTN-SIP/IP- and GSM-IMS-Migration → All-IP Network

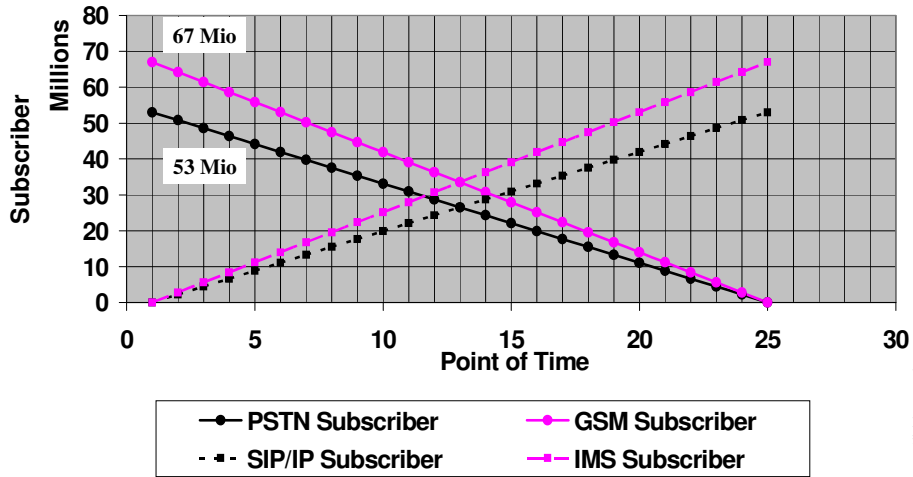
- **0,119 Erl** average traffic per bearer channel (fixed subscriber)
- max. 50000 bearer channels per local exchange
- **0,4 Erl** average traffic per SIP/IP subscriber
- max. 1 Million subscriber per CS (Call Server = SIP/IP-Softswitch)
- **0,025 Erl** average traffic per GSM subscriber
- max. 150000 mobile subscriber per MSC (Mobile Switching Center)
- **0,4 Erl** average traffic per IMS subscriber
- max. 1 million subscriber per S-CSCF (Serving-Call Session Control Function)
- max. 19354 Erl per IP/PSTN- or IMS/GSM-Media Gateway
- GSM/IP- and PSTN/IP-Gateways exchangeable

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### Subscriber Development in case of simultaneous linear Migration of 4 Networks

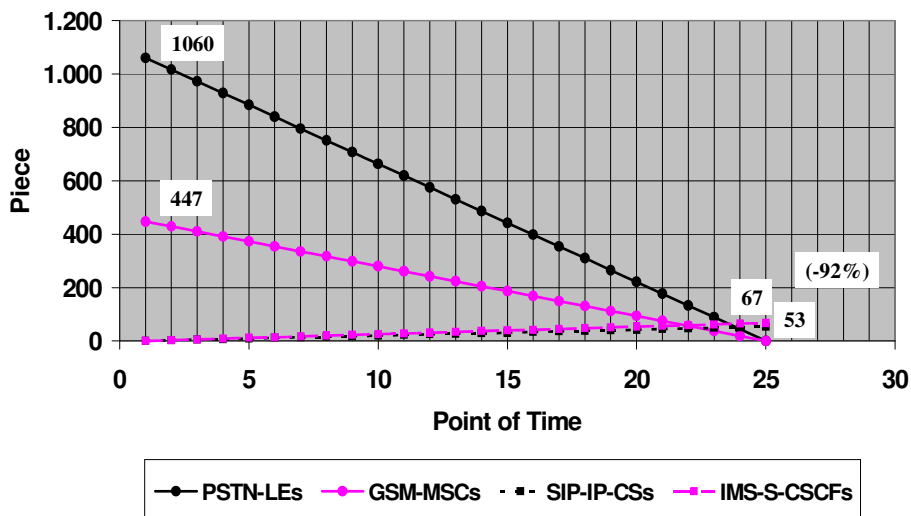
#### Subscriber Development



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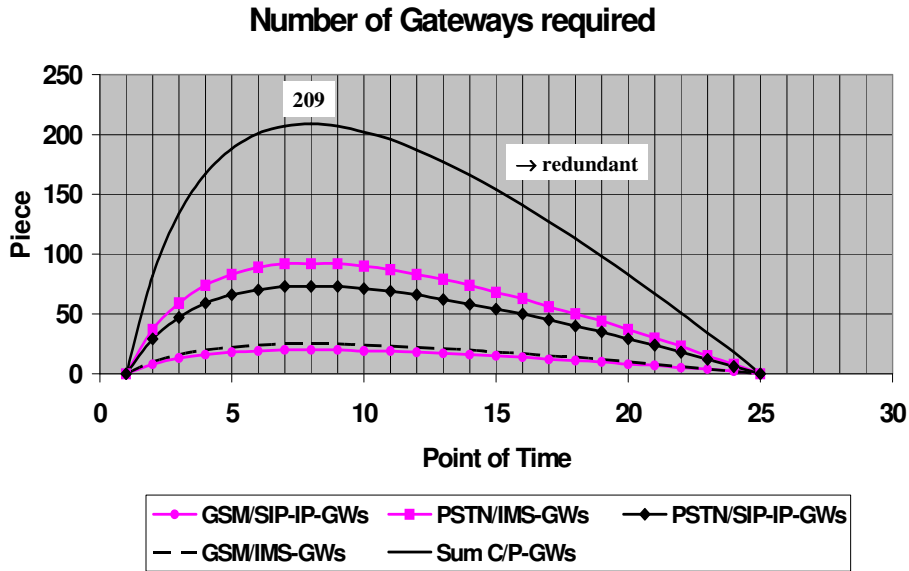
### Number of LEs, CSs, MSCs and CSCFs required in case of 4 Networks Migration

#### Number of Switching Node required

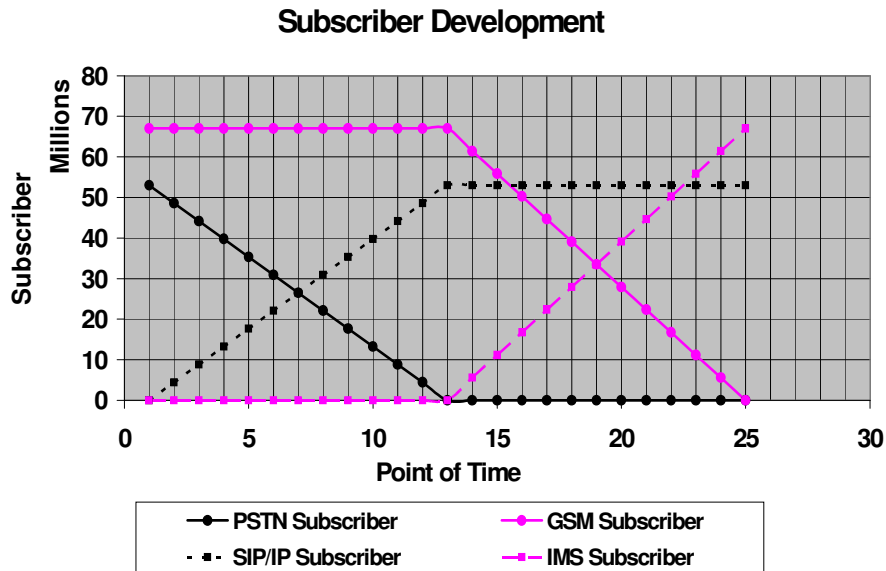


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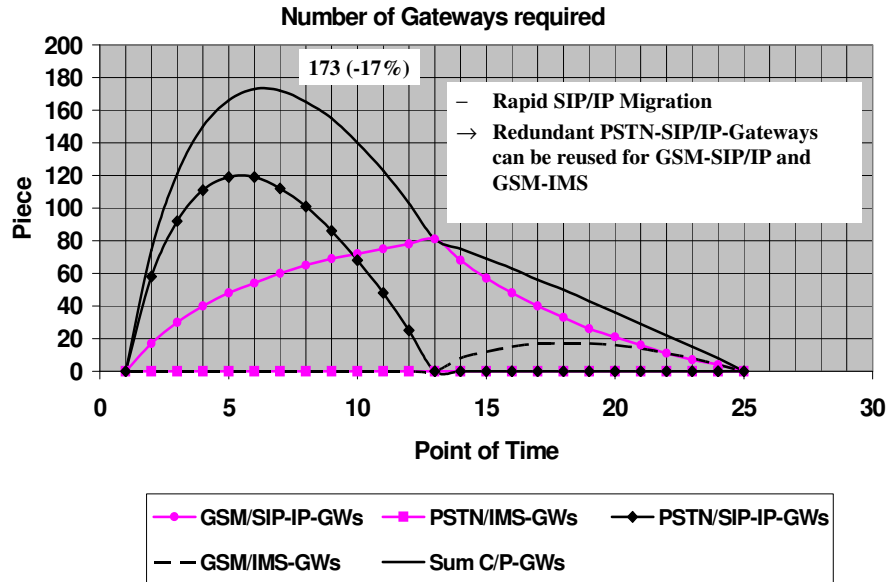
**Number of Media Gateways in case of simultaneous linear Migration of 4 Networks**



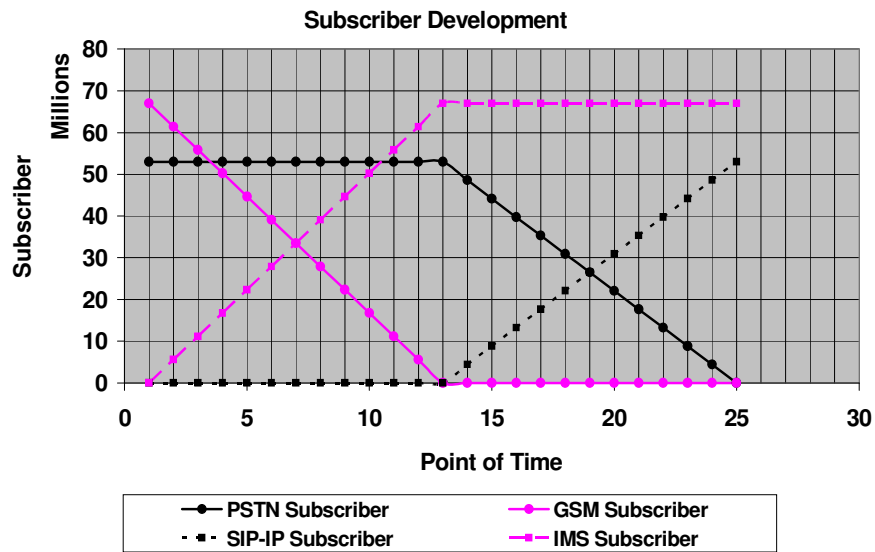
**Subscriber Development in case of sequential linear Migration of 4 Networks: 1. PSTN, 2. GSM**



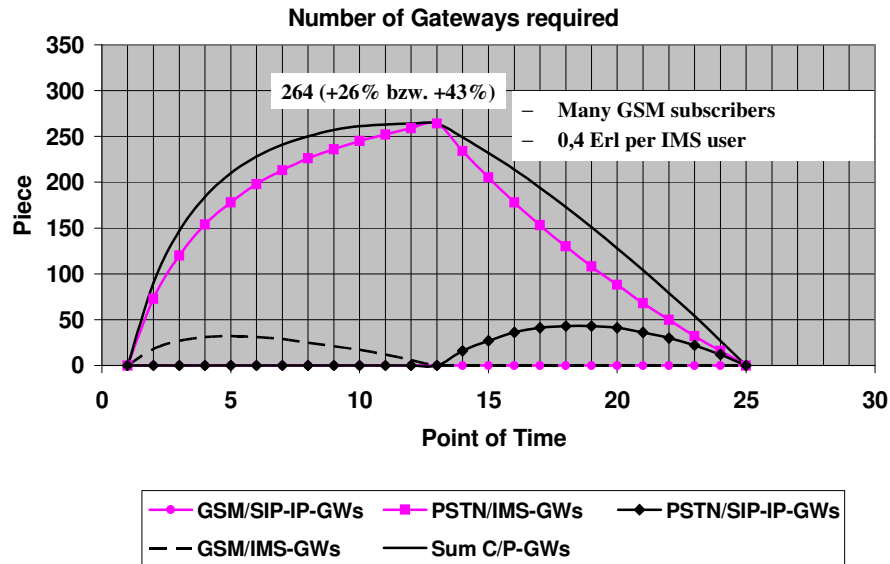
**Number of Media Gateways required in case of sequential linear Migration of 4 Networks: 1. PSTN, 2. GSM**



**Subscriber Development in case of sequential linear Migration of 4 Networks: 1. GSM, 2. PSTN**



## Number of Media Gateways required in case of sequential linear Migration of 4 Networks: 1. GSM, 2. PSTN



## Summary

- Use of the new network model recommendable
- Proceed according to the steps 1 to 9
- Migration of circuit to packet switched network  
→ very strong reduction of the number of switching systems
- Minimization of redundant media gateways by clever migration
- Possibility of minimization of PSTN-SIP/IP migration costs by clever model use
- Choose the most suitable Gateway type in each case
- Migration costs can be related to providers (TGW, AGW, RGW) or users (IP-Phone, RGW)

