# Network Modelling and PSTN-NGN Migration

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**Dipl.-Ing. Soulaimane El Bouarfati**
**Dipl.-Ing. Frank Weber**
**Prof. Dr.-Ing. Ulrich Trick**

**University of Applied Sciences Frankfurt/Main**
**Research Group for Telecommunication Networks**
**Kleiststraße 3**
**D-60318 Frankfurt**
**Germany**
**Tel.: (+49) 6196/641127**
**E-Mail: trick@e-technik.org**
**Web: www.e-technik.org**

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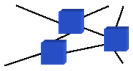

## Review



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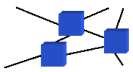


## 1 Introduction

**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**

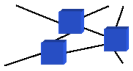
→ **OSI Reference Model with 7 Layers, ISDN- and generic protocol reference model**

- **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!**







## 2 New Network Model

**Characteristics**

- **For modelling arbitrary Telecommunication Networks**

- **1) Graphical Model**
- **2) Calculation Model for variant calculation**

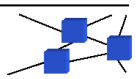
- **Strata: Layer(s)**
- **Planes**
- **Functional columns**
- **Network Management**
- **Concrete network characteristics such as number of subscribers, traffic dimensions**

→ **Overcoming the restrictions of OSI Reference Model**

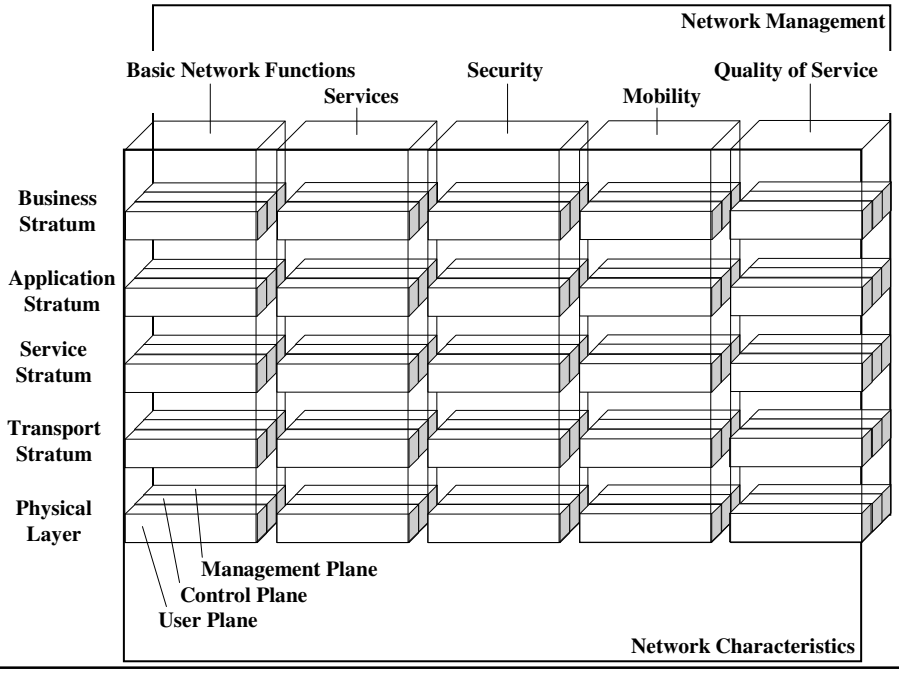
→ **Solving the problem of modelling overall network functions such as Security and Mobility**







## New Network Model with Strata and Functional Columns






## 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**

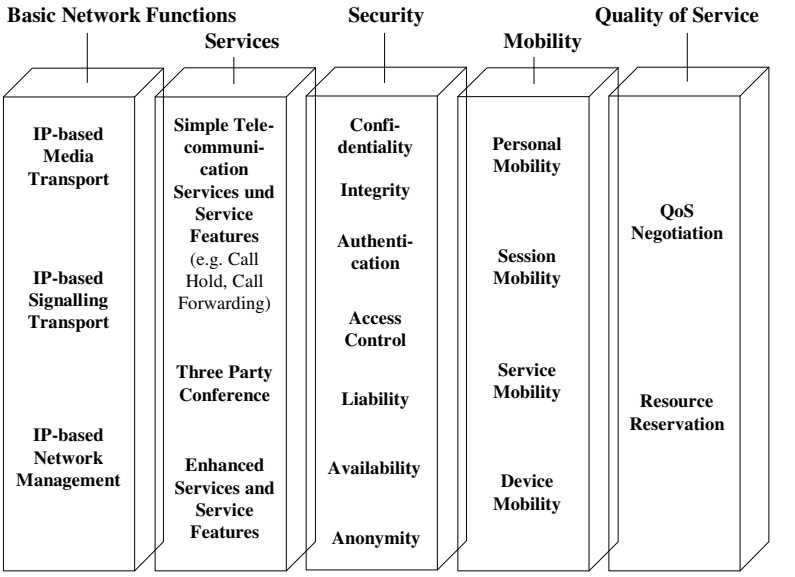
- **Network Management**
- **Network Characteristics**

→ **„Natural“ approach**





## Definition of Network Requirements



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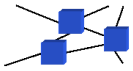
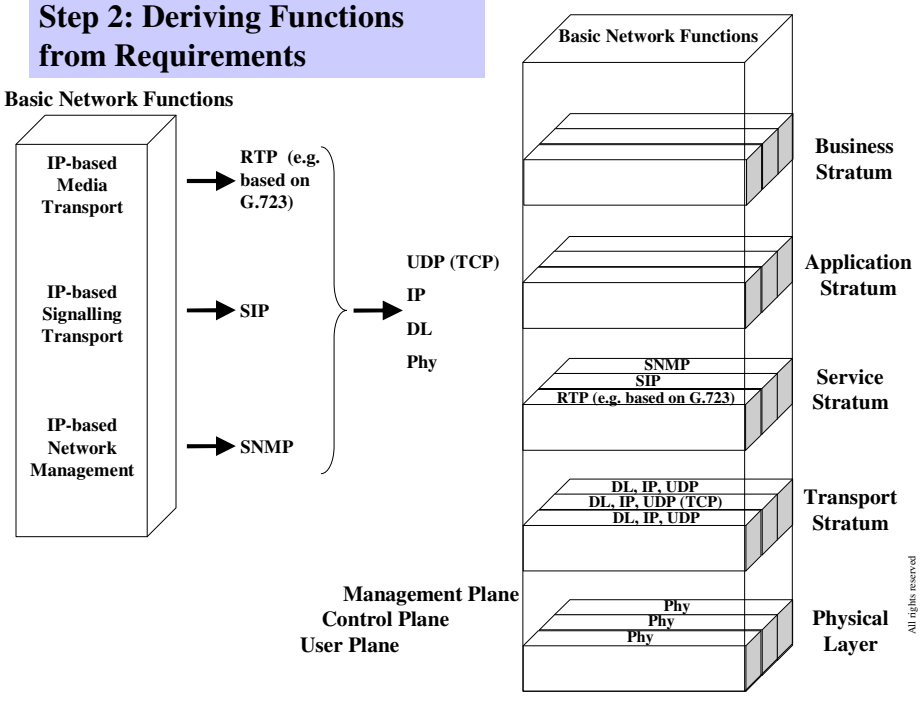


## Step 2: Deriving Functions from Requirements



## 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**

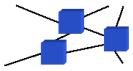
– **One individual column-based network model for each type of network element**

– **Each network element model = Subset of total network model**

– **Overlap of all network element models = total network model**







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

– **Aditional 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**

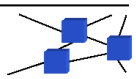
## Step 6: Use Calculation Model

– **Add further numeric characteristics to imported characteristics if necessary**
→ **Network calculations, cetwork optimisations, migration scenarios**
– **Arbitrary number of single scenarios for time sequence simulation**

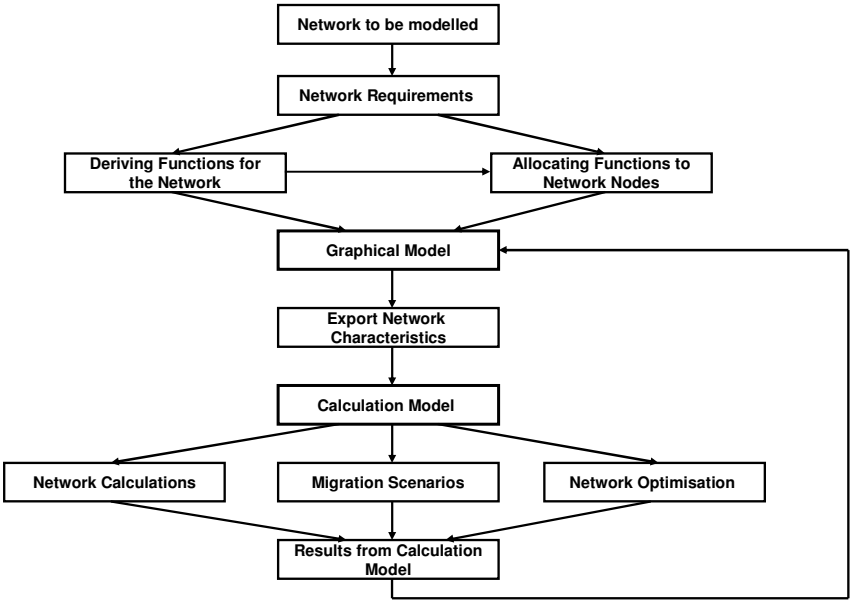
## Step 7: Export Results from Calculation Model into Graphical Model







## 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**

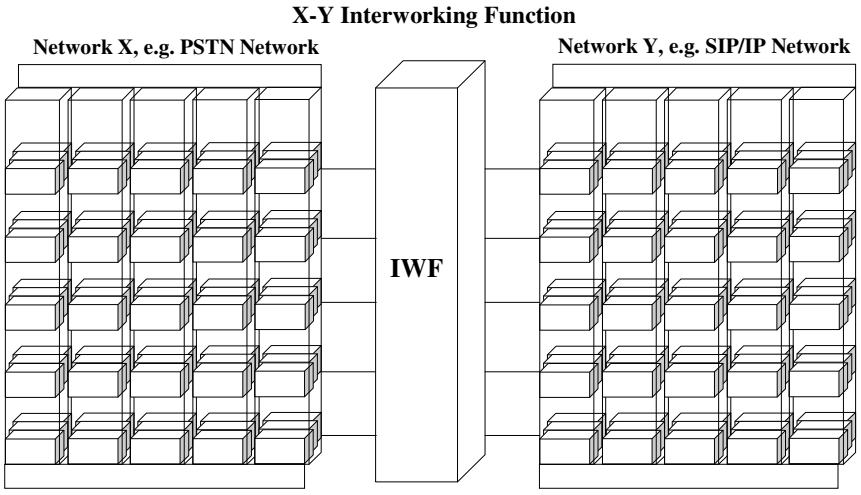
- **Steps 1 and 2: Graphical Model for each of the 2 networks**
- **Step 8: Merging both Graphical Models → Relationship of network functions, Interworking Function** (e.g. ISUP-SIP)
- **Step 9: Allocating Interworking Functions to network nodes** (e.g. Media Gateway Controller)

- **Full Model Realisation with EXCEL and VBA** (Visual Basic for Applications)





## Interworking of two different Networks



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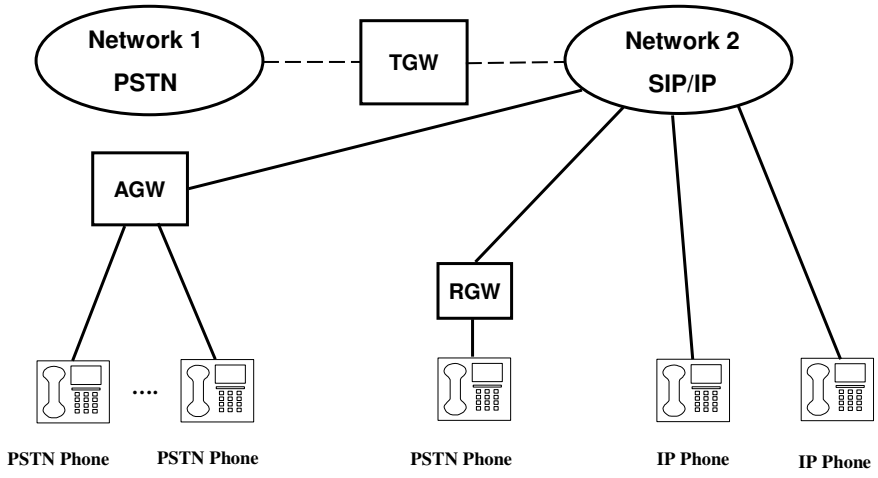
## 5 PSTN-NGN Migration




SIP: Session Initiation Protocol
PSTN: Public Switched Telephone Network

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

## 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)

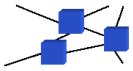
- **Traffic: 0,119 Erl**
- **Cost: 1,2 CU**

**IP-Phone**

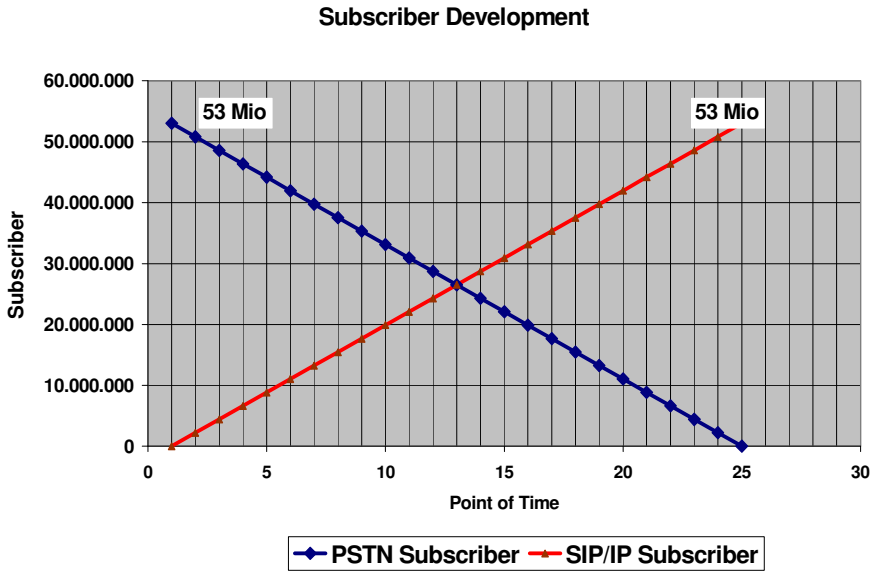
- **Traffic: 0,4 Erl**
- **Cost: 1 CU**



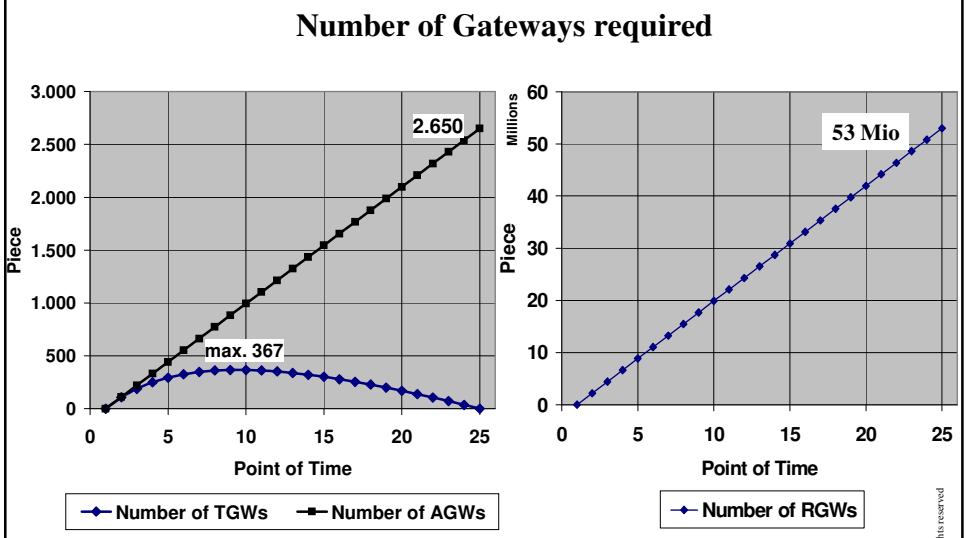




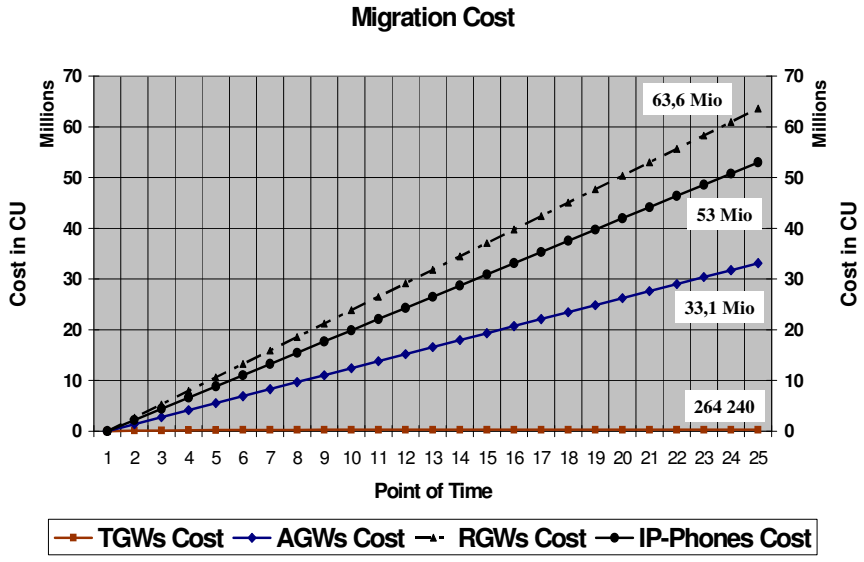
## Subscriber Development in case of linear Migration



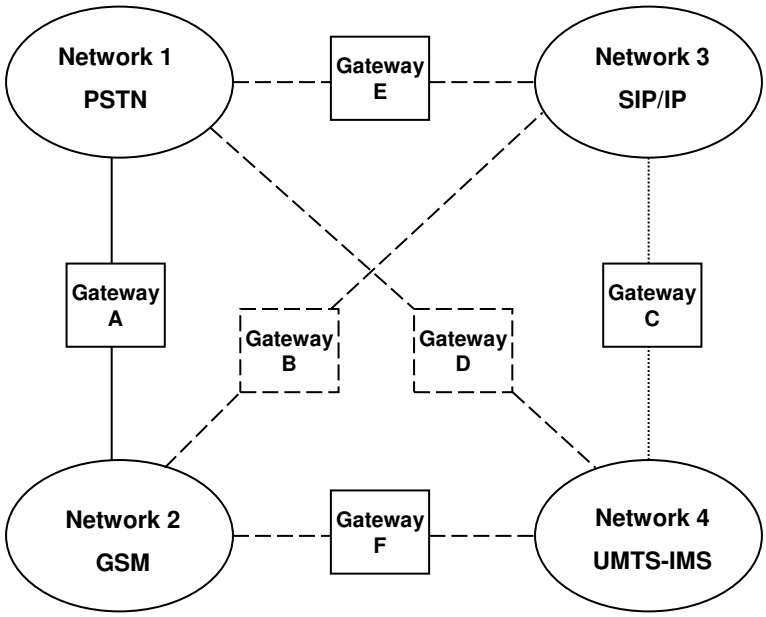
## Number of Gateways required




## Migration Costs



## Interconnection of four different Networks






## 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)**

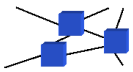
- **0,025 Erl average traffic per GSM subscriber**
- **max. 150000 mobile subscriber per MSC (Mobile Switching Center)**

- **0,4 Erl average traffic per IMS subscriber**
- **max. 1 million subscriber per S-CSCF (Serving-Call Session Control Function)**

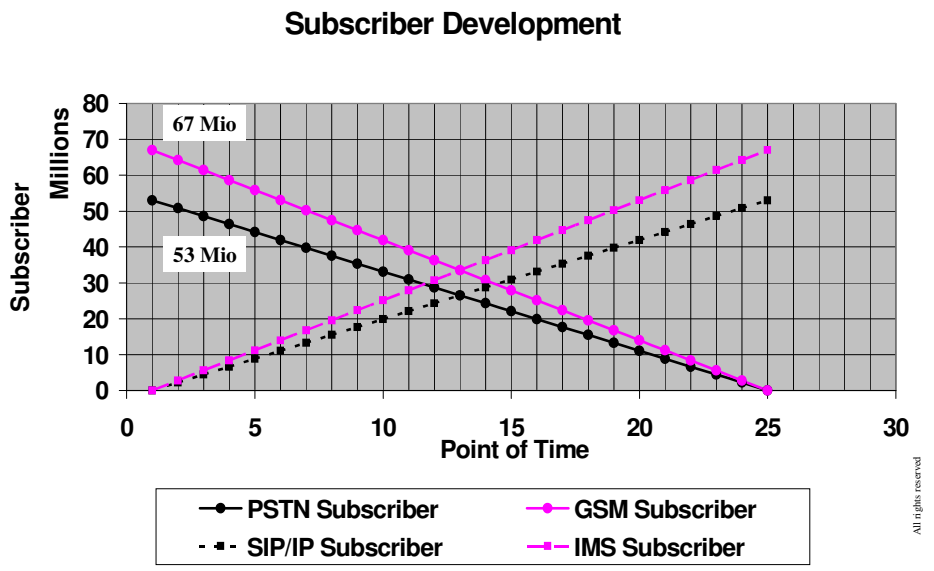
- **max. 19354 Erl per IP/PSTN- or IMS/GSM-Media Gateway**
- **GSM/IP- and PSTN/IP-Gateways exchangeable**



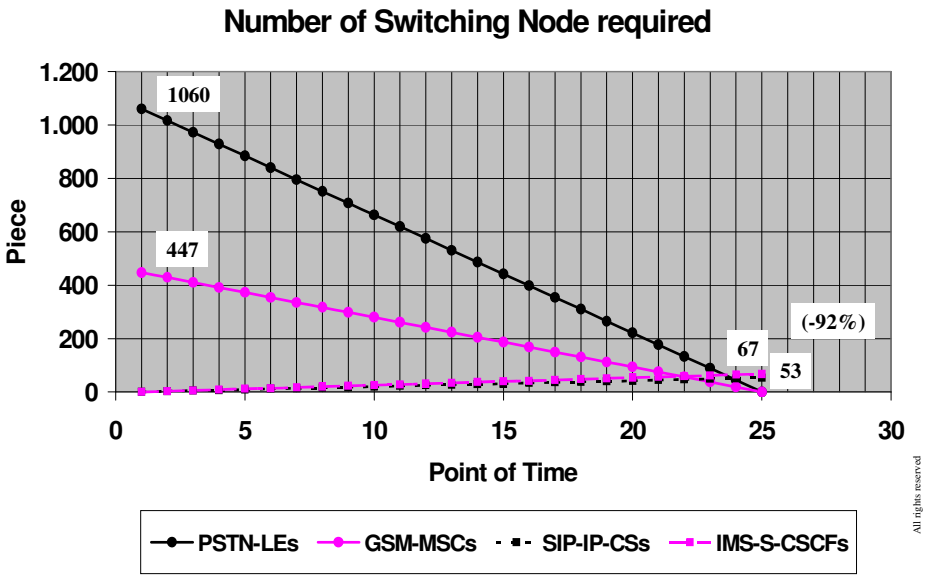




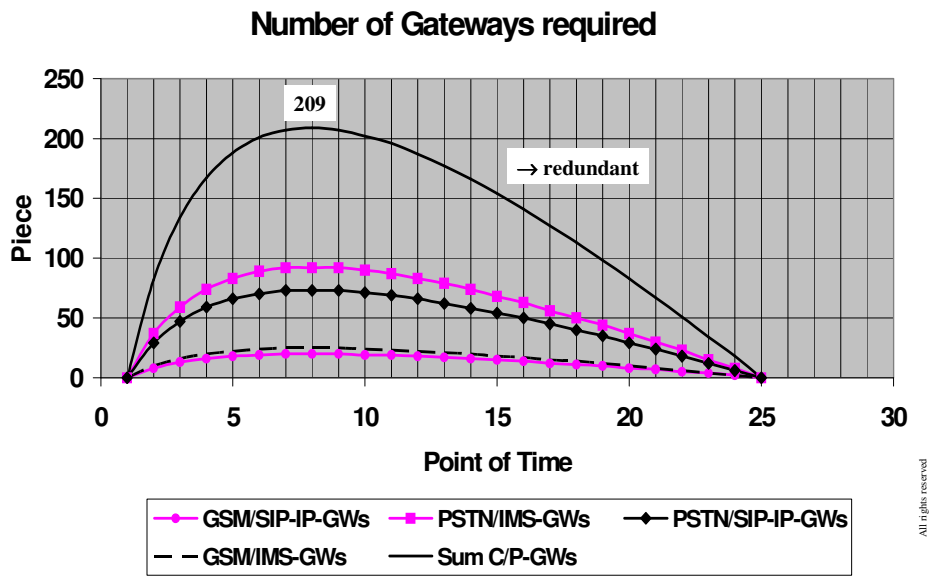
## Subscriber Development in case of simultaneous linear Migration of 4 Networks



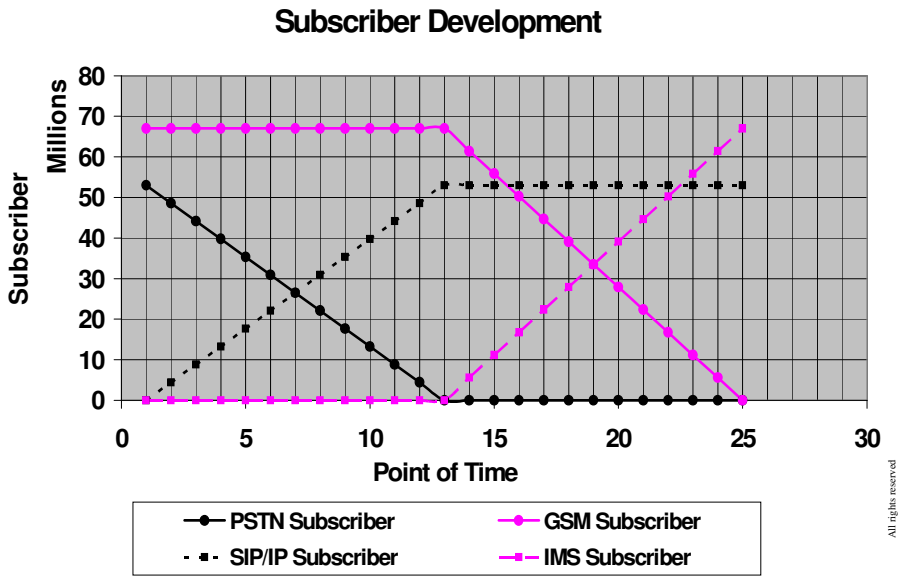

## Number of LEs, CSs, MSCs and CSCFs required in case of 4 Networks Migration



## 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



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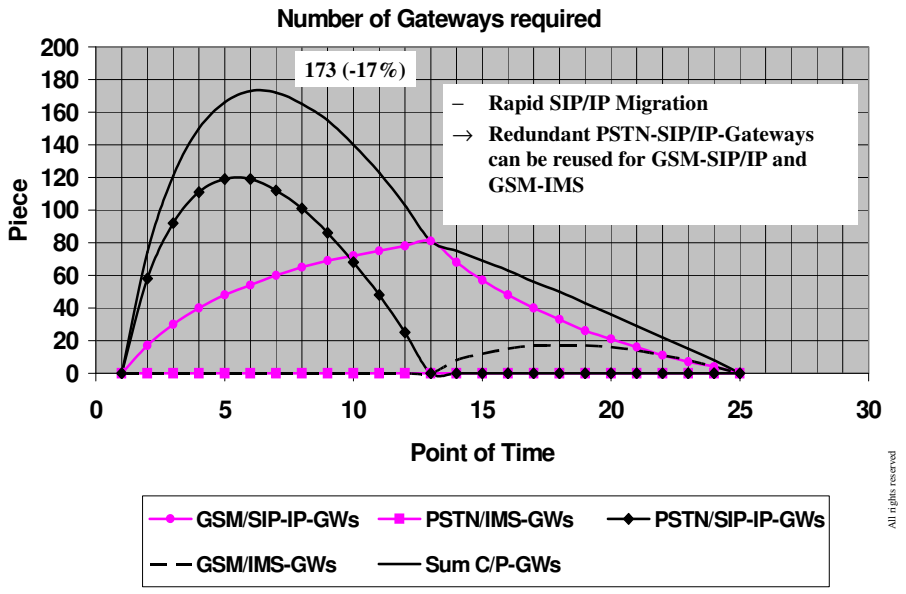
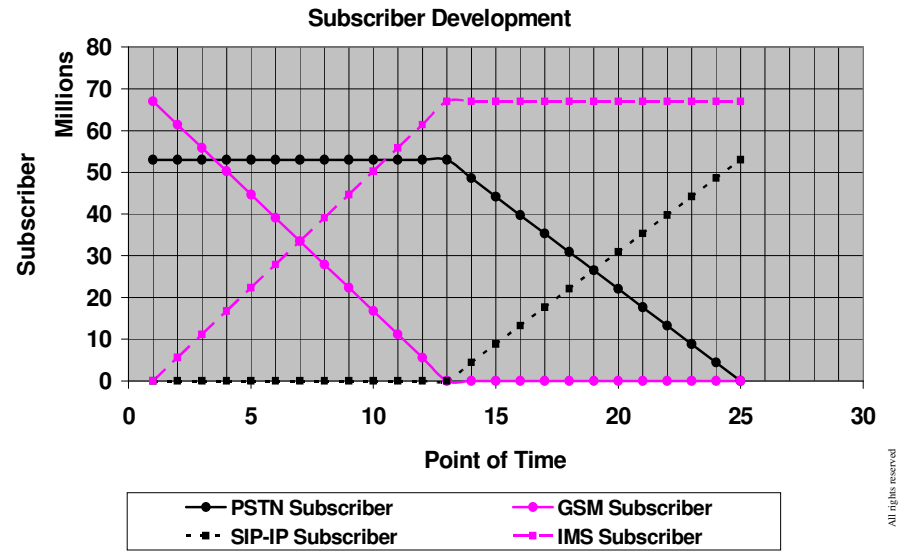
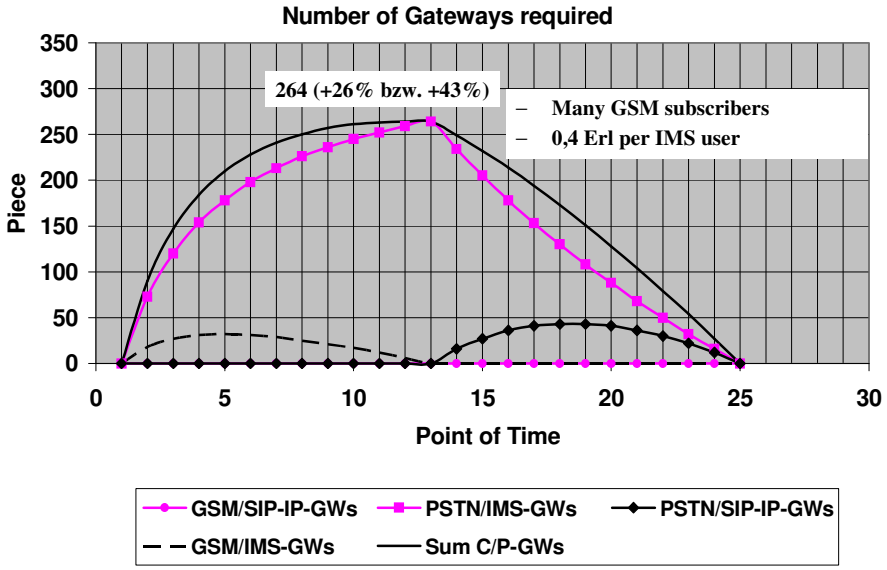



## Subscriber Development in case of sequential linear Migration of 4 Networks: 1. GSM, 2. PSTN



## 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)



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