Converged Services and a New Generation of Networking

... your Comments please! ...

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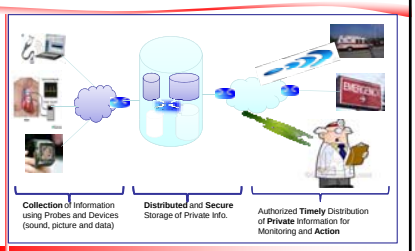
Overall Presentation Outline

- Convergence of Communications
  - VoIP, IPTV, Streaming media
  - **TeleMediCare and TelePresence/TruePresence**
- **Architecture for New Generation of Networking**
- Research Topics, and Emerging Revenue Models
- Q&A and Open Discussions
- Extras: based on time availability & interests
  - Wireline and Wireless Broadband Access
  - Multimedia Traffic Transmission Techniques

TeleMediCare

Converged Services and NGN based TeleMediCare



Collection of Information using Probes and Devices (sound, picture and data)

Distributed and **Secure** Storage of Private Info.

Authorized **Timely** Distribution of **Private** Information for Monitoring and **Action**

TeleMediCare Probes and Devices (TPDs)

http://www.medgadget.com/archives/img/62345ww2.jpg

Cyclos Implantable Pacemaker
Image source: Biotronik

http://mobilewellbeing.info/

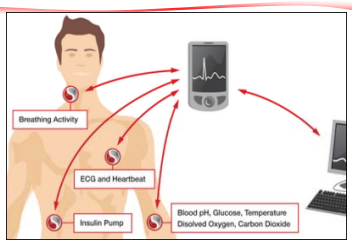
GlucoPhone. Image source: HealthPia USA

Customized Mobile Handset for Elderly and Remote Monitoring Terminals

- SoftBank-840Z - a specially customized (by ZTE, May-2010) 3G flip form handset for senior citizens in Japan
  - Tri-band GSM/GPRS/EDGE 900/1800/1900 and HSDPA/UMTS 2100 connectivity, with a **dual camera** function
  - Equipped with a special **SOS button**, which can dial and send short text messages to a pre-set list of numbers and features a **GPS** to help locate the user in the event of an emergency
  - Easy-to-use **navigation** buttons can also store friend and family numbers with one-touch, and the **home button** can be programmed to contact the main emergency contact
  - A special button that blinks repeatedly for easy **visual recognition** in case of a missed call or an unread text message
- ZTE's Z001 and Z002, remote monitoring devices using UMTS 2100MHz networks
  - Can be used for **security monitoring** for indoor users, with 0.3Mp camera with infrared night vision and motion detection
  - The application software for the terminals can also be connected using any mobile phone for maximum flexibility and security
  - Users can **view video** of their chosen **location** via their **mobile phone**, keeping an eye on the pet and the baby, the shop or their small office from wherever they are

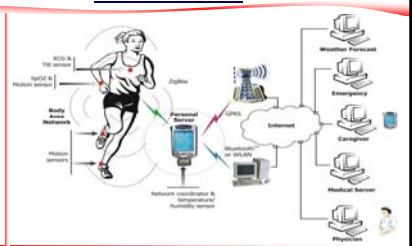
Source: http://wwwen.zte.com.cn/en/press_center/news/201005/t20100521_185157.html

Aggregation of Information from TPDs

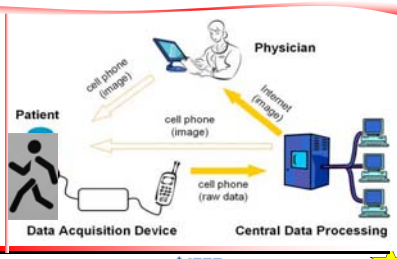


Distribution of Aggregated (from TPDs) Information

Internet Based Distribution of the Info Collected via TPDs



Internet and Mobile/Cell Phone based TeleMediCare System



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Internet and Mobile/Cell Phone based TeleMediCare System

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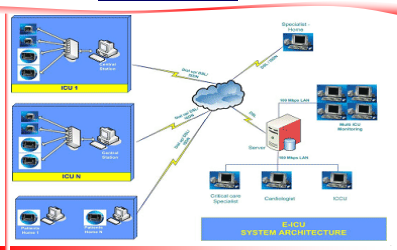
Internet and Mobile/Cell Phone based TeleMediCare System



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TPD Use Challenges

- **Privacy and security**
  - Safeguarding information (in probes and devices)
  - Ensuring authentication before transmission

Image Source: WS2, 1-June-2010

- Technological issues
  - Graceful handling of information overload and overhead
  - **Developing and supporting Standards**
    - Seamless introduction of new technologies
  - Hosting small-scale pilot testing and large-scale interoperability events (to prove the benefits of new technologies)
- Probes and Device issues
  - **Non-Uniform/Incomplete cell phone service coverage**
  - Network fragmentation
  - User acceptance (older generation yet to fully embrace the technology)

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Privacy-Preserving Mode for Data Mining and Transmission

- **Categorize** (binary or multi-class) data, make them **Anonymous**, then **Randomize** *before* mining and/or transmitting

Let T represent survival time. The so-called *hazard function* is a representation of the distribution of survival times, which assesses the instantaneous risk of demise at time t, conditional on survival to that time:

$$h(t) = \lim_{\Delta t \to 0} \frac{Pr[t \le T < t + \Delta t | T \ge t]}{\Delta t}.$$

The Cox regression model assumes a linear model for the log-hazard, or as a multiplicative model for the hazard:

$$\log h(t) = a(t) + w'x, \quad (4.6)$$

4.4 Privacy Preserving Cox Regression. The main idea of the privacy preserving SVM is to perform a random mapping of the original predictive variables into a new space, and then perform standard SVM on the new space. Since in the Cox regression the interaction between the parameter of the models and the data is linear, we can also apply the same idea presented in section 4.2 for the privacy preserving Cox regression. Given the random matrix B and assuming that we are using a linear kernel, equation 4.6 is slightly changed to:

$$\log h(t) = a(t) + w'xB', \quad (4.7)$$

Source: http://www.csee.umbc.edu/~kunliu1/p3dm08/program.html

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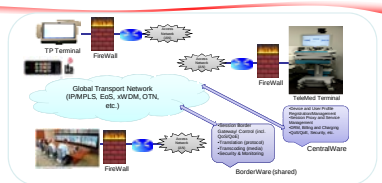
TelePresence/TruePresence (TP)



- TeleMed and TP services are used in Enterprises today, and in near future these will find their ways to hand-/palm-held devices and consumers' premises
- Guaranteeing **Bandwidth** and managing **latency** must be achieved for maintaining the desired QoS/QoE
  - A combination of policy, protocol, and Architecture may help achieve these goals
- NetFlix, Cisco, Google, Skype, etc. may create new revenue opportunities

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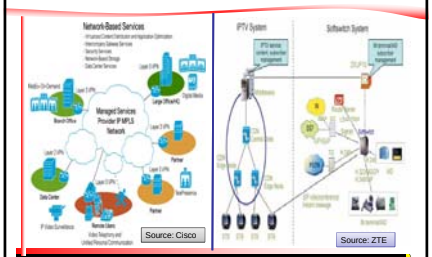
TeleMed/TP Implementation: Two Paradigms



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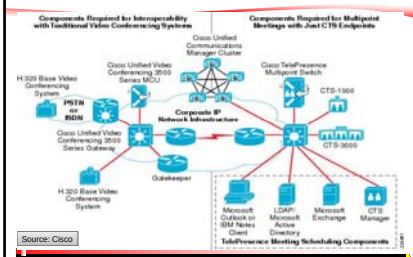
Interoperability of Legacy and Emerging TP Systems



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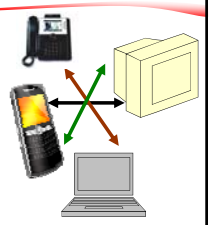
Emerging Communication Paradigms
based on Converged Services Requirements

What's Happening Today ?

- Digitize the Contents & Communications
- Personalize and Customize the Services
- Multimedia Focused Interactions
- Interworking of Different NGN Interconnection Technologies
- Budgeting Impairments for Different Segments of the Interconnect
- Seamless Support of Domestic, Regional and Global Variants of Services
- Service-Specific Policy Design & Enforcement
- Service-Specific Security, Tests & Certification

Convergence of Devices

- Phone Call and Emails over TV
- TV/VOD and Emails Services over Cell-Phone/PDA
- Any-media services in a Laptop/PC

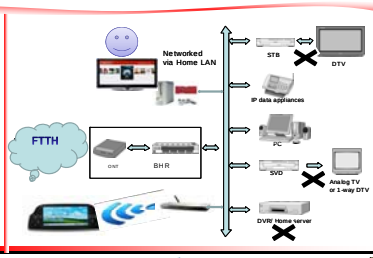


Emerging Communications Services

- High-Definition, Stereo, Surround Sound Voice
- Streaming NG/3D Media Service
- Blended/Converged Services
- Multi-Screen Mobile Culture
- Evolved Social Networking Services
- Open Sourcing & Global Development
- Consumers are the KINGs / QUEENs
- Resiliency through Distribution
- COTS & Virtualization
- Broadband Digital Pipes

Multi-Core Multi-GHz Processor
16 GB or more RAM
Multi-TB Disk
Wearable/Embedded PC
Asymmetric Bandwidth (CGC)

Complexity of Home Networks



What Will be Happening in Future ?!

- Apps for Any Services in Any Device from Any Provider (Globally)
- More Machine-to-Machine and Mobile-to-Mobile Communications (in *embedded* fashion)
- Remote and Automated Health Care Initiatives
- Green Initiatives (Environmental Awareness)

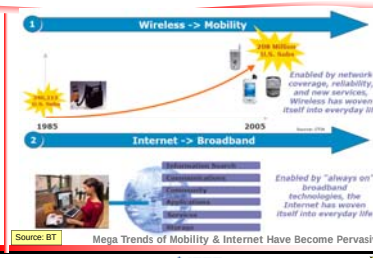
Users' View (as perceived by BT)

- More than 1.5 bn internet users
- 20+ bn web pages on 150+ m. domains
- $3.5+ bn $ online music revenues worldwide
- 250+ m registered ebay users, 50+ k product categories
- 200+ m streams from YouTube a day
- 200+ m myspace users
- Over 7 m users in Second Life
- 100+ bn emails per day, incl. 45 bn spam
- Over 100 m blogs worldwide
- 3.0+ bn mobile phone users
- 3+ bn SMS per day
- 1+ bn mobile phones with camera
- 3+ bn € mobile gaming revenue in
- 8+ m mobile TV users in Japan and South Korea

Trend to **Digitize** — *ALL IP / ALL Digital*
Trend to **Socialize** — *Global Communications & Local Actions*
Trend to **Individualize** — *My Tech NOT Hi Tech choice & the "long-tail"*

Source: BT

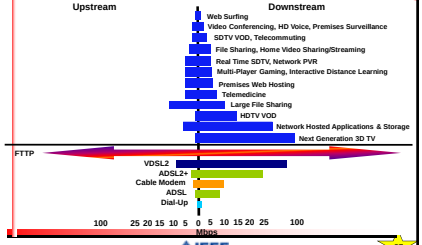
Dynamics and Trends (as seen by BT)



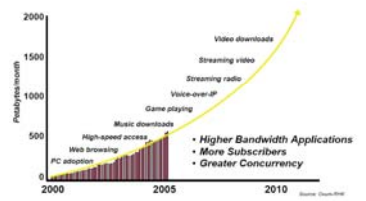
Source: BT

Mega Trends of Mobility & Internet Have Become Pervasive

Applications and Media Bandwidth



Traffic Growth Prediction



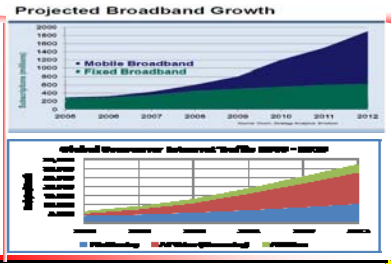
Traffic Mix Prediction

Video Growth Prediction

Source: http://www.videsentnetworks.com/market.html

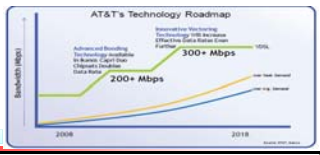
Source: http://www.cisco.com/en/US/solutions/collateral/ns341/ns525/ns537/ns705/ns827/white_paper_c11-481360_ns827_Networking_Solutions_White_Paper.html

Access Bandwidth and Internet Traffic growth



AT&T's 24 Mbps U-verse (DSL) Service

- It is called "**U-verse High Speed Internet Max Turbo**" service
  - 24 Mbps downstream (to user) and up to 3 Mbps upstream
  - Available where U-verse IPTV service is available (120 markets across 22 states in the US, launched in Austin, San Antonio and St. Louis in Dec. 2009)
  - US$ 65 per month as part of a bundle with AT&T U-verse TV (US$ 95 per month for eligible business customers)
- Orders of magnitude slower than what Fiber can provide



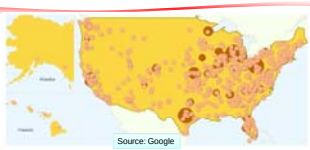
Source: AT&T

Verizon's TEN Gbps FTTP Field Test (16-Dec-2009)

- XG-PON supporting all-fiber FiOS network
  - 10 Gbps downstream and 2.4 Gbps upstream (four times faster than current top transmission speeds)
    - The overlay test confirmed no interference between the XG-PON signal and the regular FiOS signal using GPON at 2.5 Gbps downstream and 1.24 Gbps upstream
  - Unicast HD video streaming, ultra-high-definition video, 3D video, user-generated content distribution, video conferencing, etc.
  - The XG-PON test used a new OLT installed in a CO generating a 10 Gbps XG-PON signal transmitted over a wavelength
    - First test transmitted the XG-PON signal by itself on a separate PON fiber between the CO and a new ONT at a customer's home
    - In the second test, the XG-PON stream was merged as a separate wavelength onto an already-operating live fiber running FiOS with GPON at 2.5 Gbps to provide a total downstream flow of 12.5 Gbps
    - At the customer's house, the XG-PON and GPON signals were received by ONT devices, showing that the network can simultaneously deliver the GPON and XG-PON signals on the same fiber at the two speeds, without any degradation in service
- Verizon launched BPON based FiOS service in 2004
  - Supported Downstream and upstream speeds (Mbps) are 50/20, 35/35, 25/25, 30/15, 15/5, and 5/2

Source: Verizon

Google's FTTP (>1 Gbps) Project

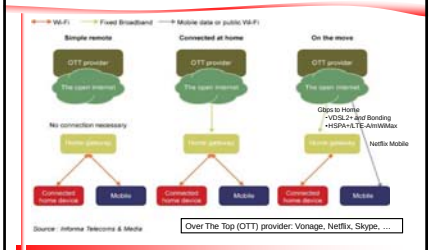


Source: Google

- Received applications from over 1,100 communities
- Over 194,000 individuals wrote letters in support of their communities applications
- **Small dots represent a Government responses**
- **Large dot represents locations where more than 1,000 residents submitted a nomination**

http://www.nextgenservers.com/services.php?sub=voice

Where would the Fixed Line Operators Stand?



Customers' and Networks' Needs

- Consumers need
  - Cloud computing based services (choice and service selection)
  - Seamless mobility and streaming media
  - Social media and networking
- Enterprises of the future needs
  - Voice service is just another data-based application
  - Mobile TV, Streaming media, YouTube, Tele-/True-presence, 3D/NG/HD TV, etc.
- Networks need to support
  - Higher speed and robust access/transport including intelligent routing
  - More granular control of **service quality and policy**
  - Smart caching and content distribution

Devices for Converged Services

•Device is "becoming" the service in the emerging information-distribution, communications, and entertainment environment
- •This essentially calls for the support of **converged services using any device** at hand by embedding the clients and capabilities as the basis of demand sand requirements

•The Network must inherently support **cognitive access** and desired QoS/QoE for all of the required services – voice, data, video, graphics, gaming, and so on
- •**Smart** and **intelligent** devices will use the **network as transport commodity;** just like the cars use the city roads and highways (?? !!)

•Dynamic groups of user will be formed just like the **cars can form a cluster** based on the proximity for video games, collaboration, etc.

Commoditization of Communications

- Service
  - Voice→VoIP, Data→Email/IM, VideoConf→TelePresence/TruePresence
  - Video/TV→InternetTV, VideoPhone→TelePresence/TruePresence
- Device and Handset manufacturers
  - Develop low-end handsets and soft-clients (for use in laptop or PC)
  - Build smart palm-/hand-held devices with value-added services and Apps (gaming, concierge, customized/personalized, etc.)
- Service Providers/operators
  - Provide customers more online applications and content (music, video, gaming, banking, etc.)
- Network
  - Support free connectivity (e.g., WiFi) and use of networks
  - Allow low-cost renting/leasing of network equipment
- Equipment manufacturers
  - Offer testing, system integration, internetworking and operations

Operators: Become vanilla/smart pipe providers *Or*
Reduce operational costs/overheads and add OTT Service

Commoditization of Entertainment

- Service
  - Voice→VoIP, Data→Email/IM, VideoConf→Tele-Presence/True-Presence
  - Video/TV→InternetTV, VideoPhone→TelePresence/TruePresence
- Device and Handset manufacturers
  - Develop low-end handsets and soft-clients (for use in laptop or PC)
  - Build smart palm-/hand-held devices with value-added services and Apps (gaming, concierge, customized/personalized, etc.)
- Service Providers/operators
  - Provide customers more online applications and content (music, video, gaming, banking, etc.)
- Network
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- Equipment manufacturers
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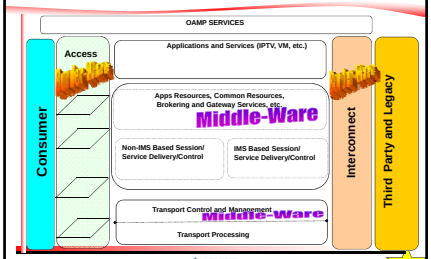
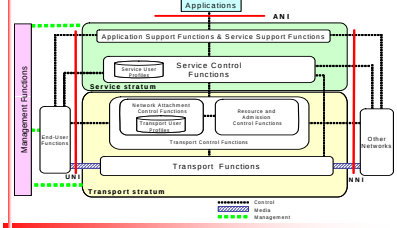
Operators: Become vanilla/smart pipe providers *Or*
Reduce operational costs/overheads and add OTT Service

Emerging NGN Architecture

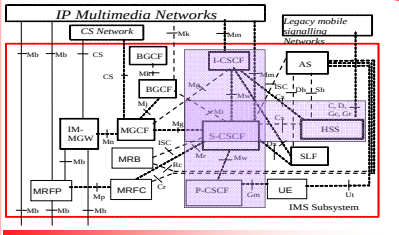
MSF Rel.4 Architecture Template



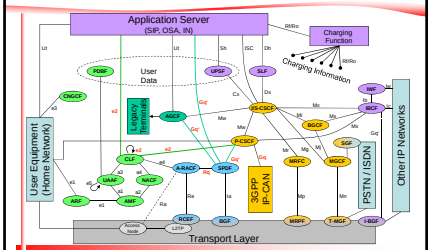
ITU-T NGN Architecture (Y.2012)



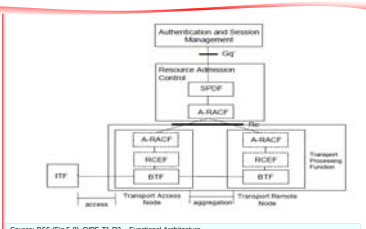
3GPP IMS Release 8 Architecture



ETSI/TISPAN NGN Rel.1 Architecture

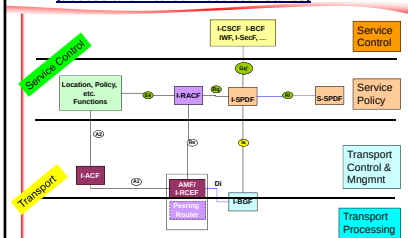


OpenIPTV Forum's Resource and Admission Control (RAC) Architecture

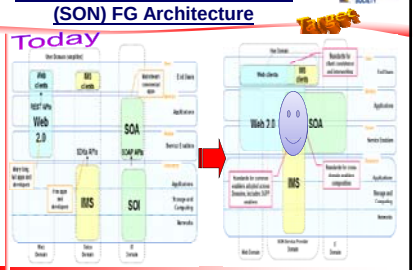


Source: P.56 (Fig.5-8), OIPF-T1-R2 – Functional Architecture
http://www.openiptvforum.org/docs/OIPF-Functional_Architecture_v2_0-2009-09-08.pdf

Granular Policy and Service Control (access and interconnect boundaries)



ATIS Service Oriented Network (SON) FG Architecture



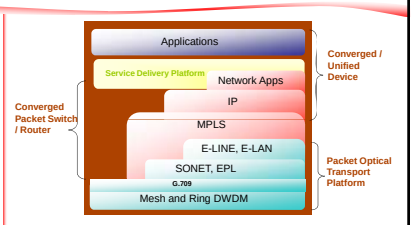
ATIS SON FG Current Work Items

- **Service Delivery Creation and Enablers (SDSC)**
  - Common Product Data Catalog Repository (AT&T)
  - Common Service Enabler Description (HP)
  - Consistency of 3rd Party Interfaces (AT&T)
  - Standardization of WS-* Specifications (HP)
- **Policy and Data Model (PDM)**
  - Common Policy Reference Model , Syntax, and Semantics (US Cellular)
  - Common Data Model Requirements (Network Cadence)
  - Common Name Space Requirements (Qwest)
- **OSS/BSS and Virtualization (OBV)**
  - Packaging of OSS/BSS Components as Service Enablers (Cisco)
  - IT Infrastructure Virtualization (Cisco)

Common Elements of all NGN Architectures

- Common Theme
  - *Support Grand-Separation for Pay-Per-Use Service*
    - ***Separation*** among access, transport, application, services, networked-resources (CPU, storage, etc.), networked-contents (generated and managed by anyone), security services, content subscription and exchange, transaction capability, etc. ***using*** well-defined ***open interfaces***
    - Drive users and developers alike to ***continuously build and market innovative services*** to improve the lifestyle of human beings for both work and play
- Ultimate Objectives
  - SEAMLESS offering of Any Service to Any Device using Any Network, Anywhere in the World, … … …

Grand Separation and Cross-Layer Interactions



Source: http://netseminar.stanford.edu/

US Federal Gov. Security NEEDs

- Not all cyber threats are equal. They vary in terms of intentions, technical sophistication, access methods, financing and tools and techniques. FIVE different levels of cyber threats can be considered:
  - **Cyber Vandalism**: Widespread non-targeted attacks over the Internet designed to cause disruption of services
  - **Cyber Crime** : Adversaries motivated by greed or ideology
  - **Cyber Surveillance** : Broad based general surveillance conducted via internet-based attacks designed to gain large amounts of information held by the target
  - **Cyber Espionage**: Specifically targeted espionage using a number of highly sophisticated approaches
  - **Cyber Warfare** : Multi-prong attacks to degrade or destroy an opponent's use of its information infrastructure

Source: IEEE ComSoc Region 1 Presentation

US Service Providers' Security NEEDs

- TWELVE (12) layers of information services defense used in a US tier-1 service provider's Wireline networks. That company is merging the Business and Telecom carrier-class networks together to form the Wireline network. The 12 layers of security include the following ..
  - Physical
  - People
  - Compliance
  - Training
  - Business continuity planning
  - Operations
  - Governance
  - Policies
  - Procurement
  - Network communications
  - Software
  - Management

Top 3 (!)

Source: IEEE ComSoc Region 1 Presentation

A Few Useful Books

[1] Chapter 2 & Appendix-C of "*Implementing Voice over IP*," by Bhumip Khasnabish, Published by Wiley-IEEE, 2003, ISBN 0471216666, 9780471216667, 208 pages.

[2] Chapter 3, 4, and 6 of "*Multimedia Communications Networks: Technologies and Services*," Edited by Mallikarjun Tatipamula, and Bhumip Khasnabish, Artech House, 1998, ISBN 0890069360, 9780890069363, 631 pages.

[3] Chapter 4 of "Next Generation Telecommunications Networks, Services, and Management," Edited by T. Plevyak and V. Sahin, Wiley-IEEE, April 2010, ISBN: 978-0-470-57528-4, 297 pages.

Thanks for Your Kind Attention and Participation!

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Multimedia Comm. Networks, ISBN: 0890069360
Implementing Voice over IP, ISBN: 0471216666

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