The IP Network Management Paradigm

Juha Liukko and Yuchen Zhou

Helsinki University of Technology,

Laboratory of Telecommunications Software and Multimedia

Version: 25.05.2000

The IP Network Management Paradigm

Juha Liukko and Yuchen Zhou
Helsinki University of Technology,
Laboratory of Telecommunications Software and Multimedia

Abstract

In this paper we discussed the IP network management paradigm. Within a TEKES project called IPMAN had been developed a network management reference model for massive IP network. This developed reference model was used as the framework for this work. That reference model divided network management into four layers, which are network element management, traffic management, service management and content management layers. In this paper we identified and resolved some management related problems on that new layered model.

Introduction

IP routed packet traffic in the traditional telecommunications network and data networks is expected to grow rapidly in the following few years. The target of the IPMAN project[1] is to research and develop a network management paradigm for massive IP network. The goals for the project are to investigate the effect of growth of IP services to network architecture, model IP traffic for network management purposes and prototyping network and service management.

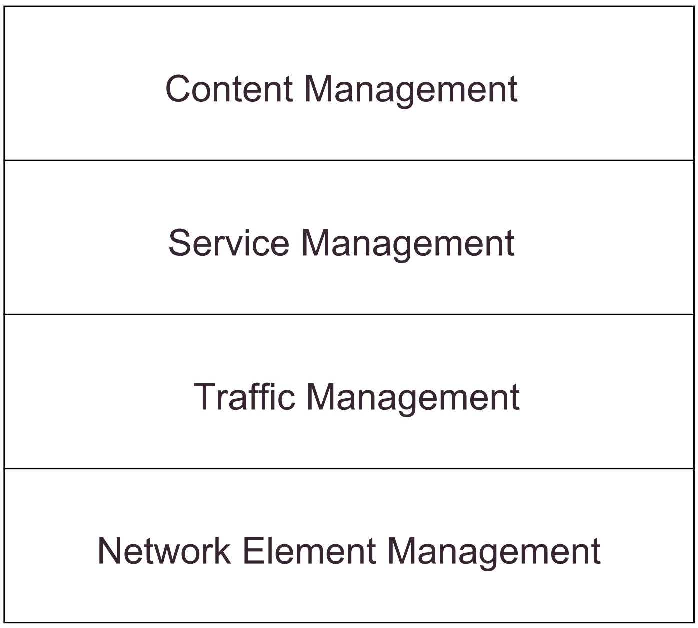

Figure 1: Refined reference model

[1] IPMAN project is a two years project, funded by TEKES and industry partners. The project will end year 2000. The project is directed by Professor Olli Martikainen from Helsinki University of Technology, Telecommunications Software and Multimedia Laboratory.

The key industry drivers & trends for networks evolution are:

- Reshaping business models: Variety of **ISP**s (Internet Service Providers), some of those build their own network; content providers are coming to picture;
- Explosion of the services: Services are the differentiators for driving profit; new services are being introduced all the time, not once a year;
- Explosion of the data traffic, a vast amount of IP packets: In 5 years, 1000-5000 more traffic, and IP packets are dominating; traditional network operators are offering IP based multiservice platforms where capacity bottlenecks are resolved;
- Emerging network technologies: Broadband access is being deployed, first in fixed, then in wireless; IP cloud is spreading, intelligence of a services is at the edges of the network.

Many network management models have been developed in today's rapidly growing large and complex network. IPMAN project has made the new network management model by further developing the reference model and has modified its structure as shown in the Figure 1, where network management model is divided into four layers.

The layers are network element management, traffic management, service management and content management. This model and it's basic definition, basic properties and characteristics is going to be introduced.

In the future networks it is difficult to 'guess' the content of transferred data. For that reason we have been concentrated on the internet technology, which in this context means IP traffic management, IP service management and web based content management. We have been tried to identify and resolve main problems within that model.

In this paper we have used the IPMAN project's IP network model and the classical TMN model, see Figure 2, as the basis and further developed the model as shown in the Figure 3.

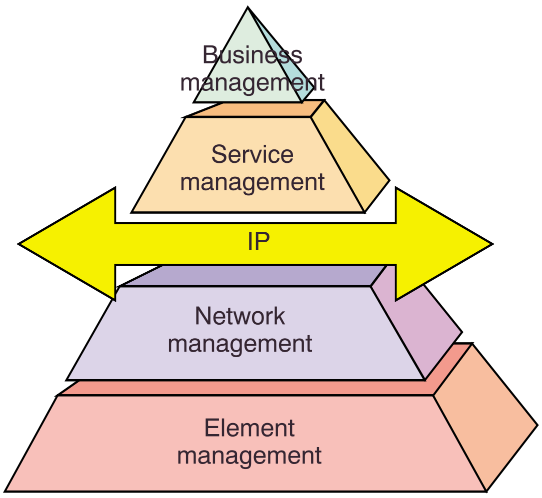

Figure 2: IP network model, classical TMN view

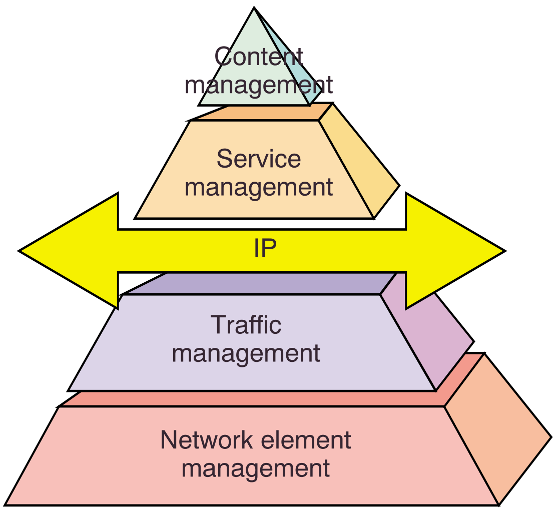

Figure 3: Developed IP network model, IPMAN view

For services (anything over IP) the focus will be on value added applications and the service management concentrate on solving business problems. Anything under IP, the focus will be on network technologies and the management is used for solving technical problems. This means multiservice platform interface and a widely accepted single transport for all services.

In this new model, the Business management layer is concentrated on Content management, and the Network management layer is replaced with the Traffic management layer. The Element management layer is to be whatever network element is available. The IP management is no separate issue.

Network element management

A **network element** is a telecommunication system, which belongs to the telecommunications environment and can be managed, monitored or controlled in a telecommunications network. The network element has one or more standard interfaces and it is identified by a unique address. The network element layer encapsulates equipment specifics from services, provides a uniform **API** (Application Programming

Interface) to all network elements, provides means for controlling and monitoring the elements via a set of high level functions, contains objects for all physical network elements and application servers, the network element specific objects implement the communication protocols to control the devices, for example `telnet`.

A **network** is a group of two or more computer systems linked together. There are many types of computer networks, including for example **LAN**s (Local Area Networks), where the computers are geographically close together (that is, in the same building); **MAN**s (Metropolitan Area Networks), where data transmission network covering an urban or metropolitan area, providing the support of narrowband and broadband services integrated in the same network; and **WAN**s (Wide Area Networks), where the computers are farther apart and are connected by telephone lines or radio waves.

The element management and network management layers can be characterised by following: [42]

EML (Element Management Layer)

- ❖ control and coordination of a subset of NEs on an individual basis
- ❖ control and coordination of a subset of NEs on a collective basis (carrier system, ring, etc.)

NML (Network Management Layer)

- ❖ wider geographical area than EML
- ❖ complete visibility of the whole network, nodes and links
- ❖ control and coordination of the network view of all NEs within its scope or domain
- ❖ provision, cessation, or modification of network capabilities for the support of service to customers
- ❖ maintenance of network capabilities
- ❖ maintenance of statistics and history pertaining to circuits, etc.

Network management refers to the broad subject of managing computer networks. **ITU-T** (International Telegraph and Telephone Consultative Committee - Telecommunication Standardization Sector) Recommendation M.3000 [19] gives an overview of **TMN** (Telecommunications Management Network) recommendations. Recommendations for TMN management functions and TMN management function sets are specified in [21]. The **OSI** management framework defines five basic network management functions, that is, **FCAPS** division: **F**ault/Problem Management, **C**onfiguration Management, **A**ccounting Management, **P**erformance Management and **S**ecurity Management.

The problem of two devices transferring meaningful information between them can be divided into two distinct areas – that of establishing a connection between them, and then determining that they can understand each other's language. Also, the information value chain before, during, and after the transfer has to be managed.

The rules for achieving this definitions of the way the individual problems are resolved (by both hardware and software means) and these rules are called **protocols**. There are, therefore, protocols for both **communication** and for **connection**. Communication protocols are associated with communication between devices, regardless of the method of physical connectivity; connection protocols are associated with the ability of devices to physically connect, regardless of their ability to communicate.

OSI (Open Systems Interconnection) 7-Layer model [5], see Figure 4, is the basis for various protocols used in different networks. From OSI 7-Layer model perspective can be seen that connection protocols are usually standard protocols used by everybody and communication protocols are more often associated with a manufacturer or company. Management framework for OSI for **CCITT** (Comite Consultatif International Telegraphique et Telephonique) applications can be found on [6] and Systems management overview can be found on [7]. The principles for a Telecommunications Management Network are described in the Recommendation M.3010 [20].

All techniques for accessing services on the Internet relies on a suite of protocols known as **TCP/IP**. It describes the way that virtual connections are made over data networks, including hardware addresses, IP addresses, hostnames, etc.

TCP/IP (Transmission Control Protocol/Internet Protocol) is a 4-Layer protocol stack, see Figure 4, and it is not part of the OSI standards; (the protocols are de-facto standards) – it therefore does not conform to the OSI model. But it can still make comparisons for reference purposes. In the case of TCP/IP, four layers are involved: Network(-access) Layer, Internet Layer, Host-to-Host Layer and Process/application Layer.

The Internet consists of many different types of computer networks that are connected together to form an "Internetwork". Each computer on the Internet is allocated a unique address. This is called an **IP** (**Internet Protocol**) address, which allows one computer to communicate with another computer across the world by the use of routers located in different networks. The Internet Protocol is a network layer protocol concerned with addressing and packaging. IP is implemented in all the end systems and routers. It acts as a relay to move a block of data from one host, through one or more routers, to another host. There can be **TCP** (connection-oriented) or **UDP**, User Datagram Protocol, (connectionless) over IP layer. Internet Official Protocol Standards (June 1999) are defined in **RFC** (Request for Comments) 2500.

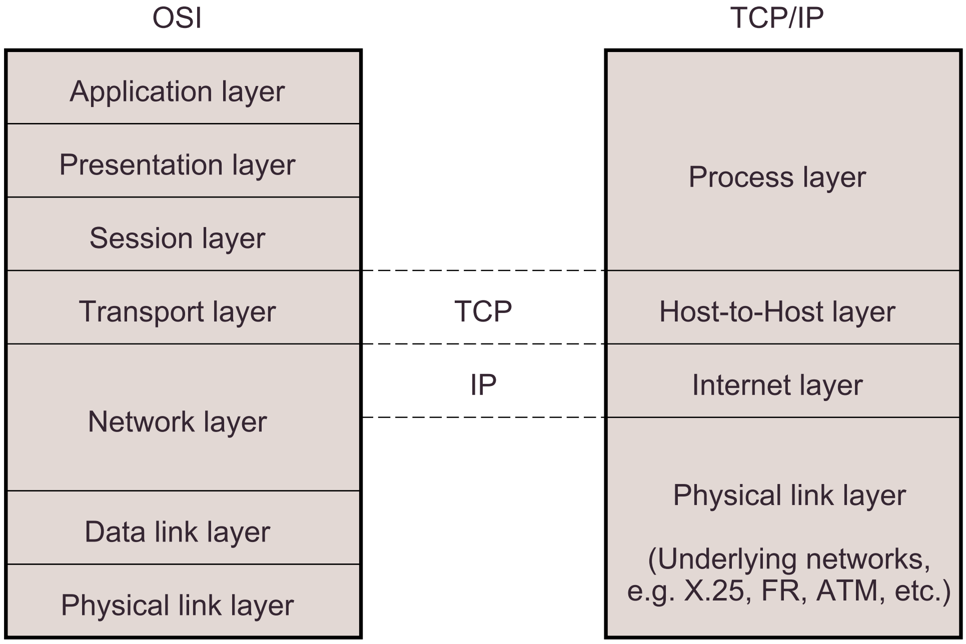

Figure 4: A comparison of the OSI layers and TCP/IP layers

The two best known **network management protocols** are the **CMIP** (Common Management Information Protocol) [8] and the **SNMP** (Simple Network Management Protocol) [10], see Table 1. In SNMP, the roles of manager and a agent are separate; there is no meeting of the two. With CMIP there is a manager and agent at both ends of a link. The agent can become the manager and vice versa.

CMIS/CMIP	**SNMP**
♦ ***CMIS*** (Common Management Information Service): Defines the services provided by each network component for network management. These services are general (not specific) in nature. ♦ ***CMIP*** (Common Management Information Protocol): The protocol that actually implements the CMIP services. ♦ ***OSI SMI*** (OSI Systems Management Information): ITU-T Recommendation X.720 [23] presents a general management information model of OSI systems management information. ♦ ***OSI MIB*** (OSI Management Information Base): MIB is a collection of managed objects.	♦ ***SNMP*** (Simple Network Management Protocol) v1/v2/v3: The SNMP specification is contained in RFC 1157. SNMP version 2 is defined in RFCs 1901...1910. Some of these RFCs are experimental. SNMP version 3 is defined in RFCs 2271-2275. The documents define a framework in which SNMP based entities operates. ♦ ***SMI*** (Systems Management Information): Structure and Identification of Management Information for TCP/IP-based Internets is defined in RFC 1155 (SNMPv1). ♦ ***MIB*** (Management Information Base): Management Information Base for Network Management of TCP/IP-based internets: MIB-II is defined in RFC 1213. This RFC is updated by RFCs 2011...2013.

Table 1 : Summary of Common Management Information Service/Common Management Information Protocol and Simple Network Management Protocol

One direction taken by **IAB** (Internet Architecture Board) was to use CMIP over TCP/IP and this was called **CMOT** (CMIP Over TCP/IP) [9]. **CMOL** (CMIP Over LLC) is proprietary network management draft developed jointly by 3Com and IBM that specifies using CMIP over **LLC** (Logical Link Control) to provide network management of devices on mixed-media LANs. Also known as **HLMS** (Heterogeneous LAN Management Specification).

Traffic management

Traffic can be seen as the **load** on a communications **device** or **system**, where the load refers to the amount of data (traffic) being carried by the network. **Traffic management** means the process of arranging how traffic flows through the network so that congestion caused by uneven network utilisation can be avoided. [40] It includes, among others, bandwidth management, load balancing, prioritising, IP management, and collecting. Inadequate attention to accurate and effective traffic management techniques (including measurement collection, engineering, admission control and congestion control) can lead to severe service degreation or outage, even at low levels of demand. When considered OSI 7-Layer model, traffic management comprises on the layer 2 (data link layer) and layer 3 (network layer).

For the traffic management system, it is reasonable that the following steps would be the preferred sequence for defining the content of a traffic management system [17]: Characterise customer needs, understand fundamental relationships among demand, capacity and performance, and specify algorithms and processes for network planning, capacity management and admission/congestion control.

There exist a lot of standards for Internet traffic management. The **IETF** (Internet Engineering Task Force) has three working groups developing the new service model or network architecture. According to the IETF, there are two models for providing QoS:

1. **IntServ** (Integrated Services)
2. **DiffServ** (Differentiated Services)

The IntServ model is based on reservations-based traffic engineering assumptions. It reserves resources explicitly using a dynamic signalling protocol and employs admission control, packet classification, and intelligent scheduling to achieve the desired QoS. Its service categories contains **Guaranteed Delay** provides absolute guarantees on the delay and loss experienced by a flow (intended for non-adaptive real-time applications). **Controlled Load** provides service equivalent to that of an unloaded network (intended for adaptive applications that perform well under lightly loaded network conditions). **RSVP** (Resource ReSerVation Protocol) is used, because resources must be reserved for flows in order to provide the requested QoS. This can be done via a dynamic reservation protocol, via manual configuration, or via a network management protocol. IntServ is not tied to a specific mechanism and is deliberately defined to be independent of the actual mechanism used. It does, however, specify in a generic way what traffic and path characteristics are to be communicated. **Admission Control** is used for the reason that IntServ relies on admission control to limit the amount of traffic that is admitted into the network, so that adequate resources are available to provide QoS to existing flows. Resource reservation requests are processed by nodes to determine if the new reservation can be accepted without adversely impacting existing flows.

The DiffServ model is based on reservation-less traffic engineering assumptions. It classifies packets into a small number of service types and uses priority mechanisms to provide adequate QoS to the traffic. No explicit resource reservation or admission control is employed although network nodes do have to use intelligent queueing mechanisms to differentiate traffic. The goal of the DiffServ offers a range of network services (levels of performance) to improve revenues (premium pricing) and competitive differentiation. DiffServ is more scalable, requires less from routers, and easier to deploy than IntServ architecture. The basic difference between IntServ and DiffServ architectures is that while IntServ provides an absolute level of QoS, DiffServ architectures is a relative-priority scheme (Admission Control is not used in DiffServ architecture, thus only priorities between di˙erent classes are guaranteed.).

Comparison of IntServ and DiffServ can be summarised by following: IntServ: Hard guarantees, complexity at core network, router to router signaling needed, problems with scalability, connection-oriented QoS. DiffServ: Relative guarantees, complexity at edge of network, no signaling required, good scalability, packet-oriented QoS.

MPLS (Multi-Protocol Label Switching) is a forwarding scheme that is based on a label-swapping forwarding (label switching) paradigm instead of standard destination-based hop-by-hop forwarding paradigm. It is important to note that this label state is not per packet or per flow, but usually represents some aggregate (e.g., between some source-destination pair). Therefore, the state produced by MPLS is manageable and scalable.

COPS (Common Open Policy Service) Protocol is an Internet standard (RFC 2748). The standard describes a simple query and response protocol that can be used to exchange policy information between a policy server (**PDP**, Policy Decision Point) and its clients (**PEP**s, Policy Enforcement Points). One example of a policy client is an RSVP router that must exercise policy-based admission control over RSVP usage. As an efficient technology solution example is **VNS** (Virtual Network Switching).

Service management

A **service** is something offered from customer to customer. The service is offered by an **ISP** (Internet Service Provider) and/or by an operator. It can be seen as a service circle: data collection, rating, billing, contract and order management, provisioning, and metering. This means end to end **service management**. This brings service requirements, interworking requirements and functional requirements.

Service requirements consists of service care and **SLA** (Service Level Agreements), billing and multiple services, new service features, volumes, and one touch provision. Interworking requirements are related of multiple vendors, legacy systems, network layers and technologies, multiple network providers, and multiple service providers. Functional requirements are concentrated on network planning and design, inventory, traffic fault, configuration, accounting, performance, and security management. Differentiated Services network implements **SLS** (Service Level Specification) and **TCS** (Traffic Conditioning Specification). SLS is made between user and service provider. It determines the level of the service. During network congestion the user is treated according to the TCS.

IP service management can be seen as two processes:

1. Customer/subscription management process
2. Service deployment process

Customer/subscription management process consist of on-line registration, Service Level Agreements, service creation, rating, billing, invoicing, and data collection. Service deployment process is related to interaction with the underlying network elements, monitoring and diagnostics, and resource assignment which means server resources, connectivity, **QoS** (Quality of Service). QoS is evaluated by the user. Only end-to-end quality is significant. QoS is only as strong as the weakest link.

These requirements and processes brings challenges for IP service management:

1. Traditional management systems (network and service) deal with homogeneous networks and services
- ❖ by definition IP is across network technologies and thus the management cannot be tailored towards any networking technology
- ❖ end to end management across network domains not practical, works for closed networks, for example enterprise, and **VPN**s (Virtual Private Networks)
2. The number and type of services is much wider
- ❖ hard to define the metrics that a general service management relies on for performance monitoring and accounting
- ❖ scalability concerns much stronger, same scaling issues apply to the service management as to the services (client - server model)
3. Dynamic distributed routing
- ❖ traffic management and network administration
- ❖ no hierarchical network management, but network element management
- ❖ trouble ticketing and alarm correlation

Service management functionality is stated to be closely related to network management and element management functionality. For example, the availability of a service is often related to the status of network element involved in providing the service and the status of the network connections. The QoS often depends on the performance of the network elements and the traffic on the network. [12]

Network management functional areas (FCAPS) for IP service management can be described as the following:

Fault Management
- ❖ correlate network level abnormalities with services
- ❖ trigger automatic recovery

Configuration Management
- customer and service oriented
- SLAs, policies, connectivity

Accounting Management
- financial transaction between service users and service providers
- micro payments

Performance Management
- L2 or application level metrics - how is it with IP !?

Security Management
- certificate and key management
- trusted third party
- public key infrastructure

Service management can seen also as a Management of IP Network Operator's customer relationships and services directly sold or offered by IP Network Operator. In the framework of **TINA-C** (Telecommunications Information Networking Architecture Consortium), see http://www.tinac.com/, the service management level aspect is concerned with how the network level aspects are utilised to provide a network service, and as such is concerned with the requirements of a network service (for example availability, cost, accounts, etc.) and how these requirements are met through the use of the network, and all related customer information. [14] The TINA-C outcomes have been somehow enhanced by EURESCOM P.103 project. [11]

Convergence and new services. Traditionally, communications media were separate. Services were quite distinct - broadcasting, voice telephony and on-line computer services. They operated on different networks and used different "platforms": TV sets, telephones and computers. Each was regulated by different laws and different regulators, usually at national level. Nowadays digital technology allows a substantially higher capacity of traditional and new services to be transported over the same networks and to use integrated consumer devices for purposes such as telephony, television or personal computing. This tendency is called convergence, see Figure 5.

Telecommunications, **IT** (Information Technology), and media industries are using the flexibility of digital technologies to offer services outside their traditional business sectors, increasingly on an international or global scale. Recent examples of new, convergent services include [4]:
- Internet services delivered to TV sets via systems like Web TV,
- E-mail and World Wide Web access via digital TV decoders and mobile telephones,
- Webcasting of radio and TV programming on the Internet, and
- Using the Internet for voice telephony.

Convergence is not just about technology. Convergence is a debate about the impact of technology when going towards a mature Information Society.

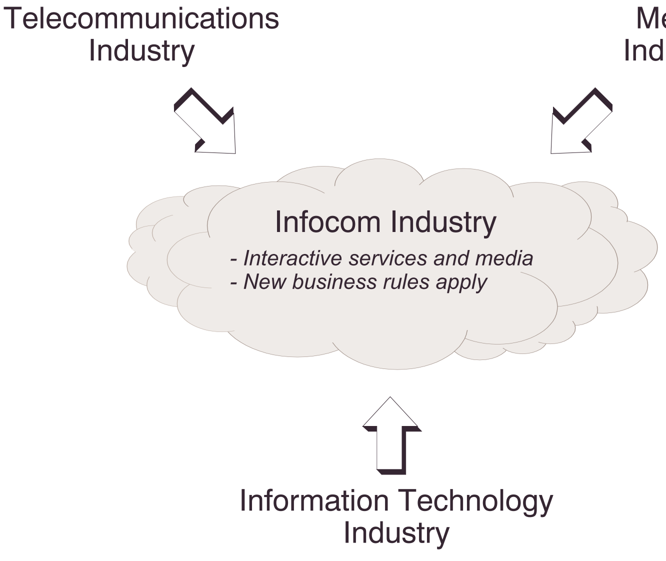

Figure 5: Convergence

Future services. IP networks will need many new requirements if they are to become the common platform for future services. One fundamental difference between IP and previous service models used by operators is the existence of intelligent, end-to-end-capable hosts in IP. In IP terminology, the host is an end system. IP applications reside on the host, and are knowledgeable about the ability of the host to provide end-to-end communications. Consequently, any two hosts that can communicate with each other can define a new service between them without the IP network having to accommodate the change. [3]

There are many demands for future service platforms, such as
- provide extensive network services for converging networks,
- enable fast time to market for new services,
- provide ease of deployment, configuration, and management,
- use the open, modular, distributed and standard architecture,
- ensure application-independent high quality of service and fault tolerance,
- enable the use of advanced charging mechanisms,
- make use of commercially available hardware and software components,
- ensure high usability and appropriate diagnostics.

Hybrid services are going to play a very important role in the future year. Hybrid services span different network technologies, for example the public switch telephone network and the Internet. From network perspective, new standards are needed because of real-time services, reliability, policy management and zero administration (fully automated).

Content management

Content is meaning that is recorded on a medium. [28] The content can take various forms such as media content and information, but it can also contain enablers for further activities, for example various software packages. Markus Kajanto states in his doctoral dissertation [13] the notion of virtualization of content. The initial content is called by Kajanto primary content, which is divided into two parts: virtual part and physical part. The virtual part of content is distributable through the information network, but the physical part is distributed outside the information network.

Markus Kajanto gives briefly review of representative sample of published value chain frameworks for the interactive information networks industry. In that document the new value chain framework has been proposed based partly on those models. The important characteristic of the interactive information networks is that they virtualise part of the value chain. The more the value chain elements can be virtualised, the more the business can take advantage of the value chain characteristics of the interactive information networks industry.

This virtualisation of the value chain also means virtulisation of the content. In this proposed framework the actual content and the physical delivery of content are virtualised. Primary content is divided into two parts:

1. Virtual part, which is distributable through the network, and value-added from networks on this part.
2. Physical part, which has distribution outside network.

There are also two more dimensions to consider in the categorisation of the interactive information networks industry value chain:
1. Complexion of content (publishing content or communication content).
2. Bandwidth requirement for the content (especially if the requirement is real-time).

Complexion of content in that first dimension is defined to be either:

1. Publishing content, which means that content is used for revenue generation through direct transactions, e.g. news service, TV programs, or
2. Communication content, which means that content is created only for the specific occasion. This can be a real-time (for example telephone conversation, discussion forum) or delayed (for example electronic mail) service.

In other dimension is considered the bandwidth requirement for content. In the framework there are two segments defined:

1. Broadband content, which means real-time broadband content.
2. Non-broadband content, which includes broadband access with all other possible content.

In the latter case there is no requirement to deliver broadband content real-time. An important characteristics of the broadband content is that it consists of continuous stream of information.

The content dimensions developed in this model can be structure the roles of organisations in the interactive information networks industry value chain.

Content management is systems and methods that contain ownership and transfer methods, rights and origin notarised time-stamped transactions, correct use statement, color management, media types and workflow components. It also encompasses all business practices and technical processes that are performed for the purpose of capturing, maintaining, sharing and preserving recorded meaning. [1] Content management can seen also as a management of content and applications delivered by (**CSP**) Content Service Provider.

There are requirements for content management. Basic requirements of customers of a system include cataloging - with uniformity regardless of who provides the content; search and retrieval - which must be easy to use without training; browsing interface; and network protocol.

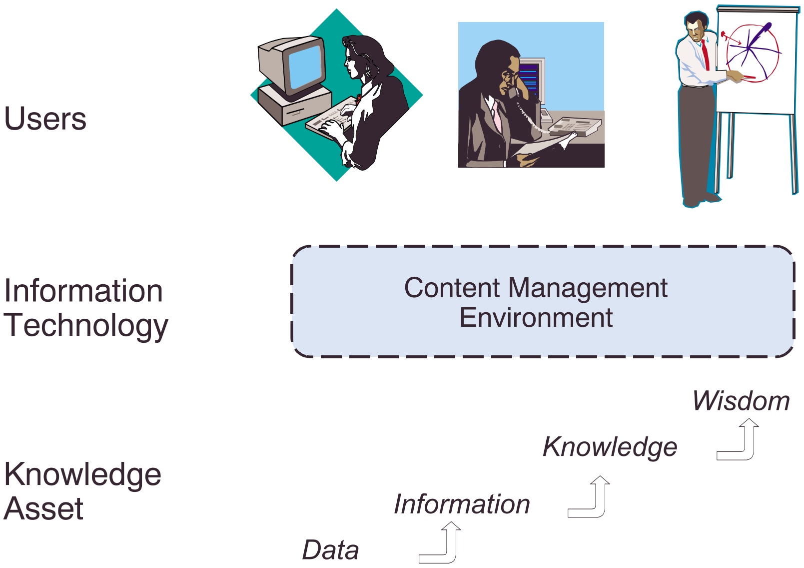

Figure 6: The content management environment [2]

Content management environment. The content management environment can be seen consisting of the technical infrastructure that an enterprise uses to capture, maintain, share and preserve recorded meaning. As an intermediary between "users" and the enterprise knowledge asset, the content management environment has an internal "architecture" that can be structured, chaotic or blended, see Figure 6. The industry organisation **DMTF** (Distributed Management Task Force, Inc.) is leading the development, adoption and unification of management standards and initiatives for desktop, enterprise and Internet environments. Working with key technology vendors and affiliated standards groups, the DMTF is enabling a more integrated, cost effective, and less crisis-driven approach to management through interoperable management solutions. They are working with, for example, **DMI** (Desktop Management Interface) standards, **CIM** (Common Information Model) standards, **WBEM** (Web Based Enterprise Management) standards, and other support standards for customer support and helpdesk applications by providing common data models for incident and solution exchange.

Web content management. Web technology is used in the IP networks. Web content management is the foundation for any web application, regardless of whether it is for e-business, customer relationship management or knowledge management.

There are standards for content. **SGML** (Standard Generalized Makeup Language) was an attempt at defining a framework or meta-description for new languages. Its complexity hindered its broad adoption. **HTML** (HyperText Markup Language) was created out of SGML, its greater strength being simplicity. This simplicity fueled the growth of the Internet, but limited functionality to straightward presentation. **XML** (Extensible Markup Language) - extensible because it is not a fixed format like HTML - combines the power and ease of two earlier languages, SGML and HTML. At the same time, its structure and format are not significantly more complex than HTML. In achieving these two design aims, XML delivers its power to the business and application domain specialists - where is belongs. XML adoption drives the requirement for an enterprise-wide platform for Web development and deployment. XML is a framework that helps develop new, domain-specific languages tailored to the needs of a particular industry or interest community. [39] This highly scalable language clears the path for rapid development of complex yet elegant Web sites the will run faster than ever before.

Early content management systems that have either tried to force fit complex unstructured data into a rigid database scheme, or have simple ignored the problem. This has left organisations with costly and impractical conversation of existing content. The lack of a file system interface has forced unpopular and expensive retraining to proprietary editing tools of low functionality.

Now development architecture for content management can synchronise the development and management of not only file system assets, but also database content, providing a single integrated environment to manage and deploy both database and file system content. By managing the development of Web applications, operational database content can more easily and rapidly integrated into the site.

Sites must create a personalisation infrastructure, firms need to step up their efforts in three major areas: [41]

1. **Tagging content**. To deliver information and services that are highly relevant to an individual, firms must label their content with enough details to identify value while eliminating background noise.
2. **Creating a unified profile**. Firms must tap existing customer data from retail and direct marketing channels, collect behavioral information from Web sites, and exchange value in return for a visitor's personal information and preferences.
3. **Implementing matchmaking engines**. Merchandising rules and dynamic algorithms bring users together with the appropriate content and services.

There exist the content-commerce collision and commerce network:

- **Content sites move into commerce**. To better service consumers, supplement advertising revenues, and stay ahead of competitors, on-line publishers are building more commerce links into their sites. Convenience for consumers, not blind selling, drives the integration of commerce into media sites through embedded purchase links and comparison-shopping channel.
- **Serving the consumer means more than content**. While economics play a role, consumer demand is also forcing media sites to boost their commerce offerings. Commerce is becoming central to media programing and business models.
- **Media-Commerce mergers are inevitable**. Economic pressure and consumer's need for full service will force media-commerce consolidation within vertical categories. Arm's length alliances will yield to full-scale mergers between major publishers and resellers to create commerce networks. Content with limited commerce potential -- like news or investigative reporting -- will splinter among these verticals and serves as a loss leader traffic driver to commerce network sites.
- **Commerce networks provide a full experience**. A commerce network provides information, commercial opportunities, and community around a particular interest category. The organic experience that customers seek stretches the limits of a content-only or commerce-only site. A new type of site -- commerce networks -- will cater to customer needs a across all phases of the buying cycle.

Commerce networks first appeared in the entertainment area. But the trend will spread to other types of media s well. While many sites strive to offer content, community, and commerce to their audiences today, commerce networks will differ in two essential ways: [13]

1. **Scale**. Commerce networks, likemajor portals, will generate large volumes of eyeballs and transactions to dominate a vertical category.
2. **Ownship**. Rather than rely on arm's length partnerships with commerce or community vendors, a commerce network will have equity ownship in all money flows -- advertising and transactions -- conducted through its site.

Further development of content management. There are four principle areas for further development with the prototype service:

1. Expend on the automatic acquisition and interpretation of user profile information
2. Continue to improve the automatic creation of content alternatives through advanced media processing
3. Radically improve the performance of the service by introducing caching mechanisms for the XML, **XSL** (Extensible Stylesheet Language) and HTML files created by the system
4. Further investigation of how multiple universal content engines will coexist within the network and how the responsibility for managing different content sets will be divided between them

Most alternatives offer a combination of features for managing the input of multiple contributors or for dynamically storing, transforming, and delivering content.

Summary

In this paper the network management model defined by IPMAN project is used as a framework. The definitions, basic properties, and characteristics for each four layers have been introduced. We have identified and resolved some problems of each presented layers. In managing the networks efficient, customised and reliable network management is a necessity. IP affects all products. IP specifics need to be taken care of properly.

At the bottom layer, network element management layer, the one problem is when two devices are transferring meaningful information between them. The protocols are used as a solution for this problem.

The second layer is traffic management layer. Traffic management means techniques for avoiding congestion and shaping and policing traffic. To solve this kind of techniques, a traffic management system is needed. This management system should characterise customer needs, understand fundamental relationships among demand, capacity and performance, and specify algorithms and processes for network planning, capacity management and admission/congestion control. There exist a lot of standards for Internet traffic management. As an efficient technology solution example is Virtual Network Switching.

The third layer is service management. Service management is a key operational component for Internet Service Providers and operators to achieve faster time to market and reliable service delivery. The nature of best effort IP moves the emphasis of the service management from monitoring network level behavior to application level. Standardisation and research work on IP service management is just beginning although the need is for this functionality is obvious. And how to price service management. Many IP networking features relate and affect the role of service management: DiffServ and QoS, routing, autoconfiguration, service discovery, and mobility management. There are many demands for future service platforms. We have discovered that from network perspective, new standards are needed because of real-time services, reliability, policy management and zero administration (fully automated). In managing services the service management framework has to be defined. Small niche (killer) applications are used for creating new business. System management partnership may be needed?

The content management is the top of this reference model. We have discovered that the definition of content management is the basis for this layer. The content can take various forms such as media content and information, but it can also contain enablers for further activities, for example various software packages. The content value chain has to been virtualised. The initial content is called primary content, which is divided into two parts: Virtual part and physical part. The virtual part of content is distributable through the information network, but the physical part is distributed outside the information network. It seems that the content will play an important role in the future IP networks. This emphasises the importance of content management and this area should be studied later more in detail.

Acknowledgements

The great thanks to Professor Olli Martikainen for his suggested use of a reference model in IPMAN project. The authors want to thank Jouni Karvo for his guidance when developing further this model and writing this paper. The authors thank also Stiina Ylänen for her support when finalising this paper.

REFERENCES

[1] "Content Management, Omnibus Lexicon Definition" http://www.fourthwavegroup.com/Publicx/959w.htm

[2] "Structured and/or Chaotic Content Management, Controlling Versus Coping, Managing Content Intelligently: Practical Practices". http://www.fourthwavegroup.com/Publicx/920.htm

[3] T. Mc Dermott, T. van Landegem "New services mean new requirements for IP networks".

[4] "Green Paper on the Convergence of the Telecommunications, Media and Information Technology Sectors, and the Implications for Regulation. Towards an Information Society Approach" Brussels, 3 December 1997.

http://www.ispo.cec.be/convergencegp/greenp.html
[5] ITU-T Recommendation X.200 (07/94) – Information technology - Open Systems Interconnection – Basic reference model: The basic model.
[6] ITU-T Recommendation X.700 (09/92) – Management framework for Open Systems Interconnection (OSI) for CCITT applications.
[7] ITU-T Recommendation X.701 (08/97) – Information technology - Open Systems Interconnection – Systems management overview.
[8] [X.711] Recommendation X.711 (10/97) – Information technology – Open Systems Interconnection - Common Management Information Protocol: Specification.
[9] IETF RFC 1095 (April 1989) - The Common Management Information Services and Protocol over TCP/IP (CMOT).
[10] IETF RFC 1157 (May 1990) - A Simple Network Management Protocol (SNMP).
[11] Service management: from definition to information modeling - Gbaguidi, C.; Znaty, S.; Hubaux, J.-P. TCOM Lab., Swiss Federal Inst. of Technol., Lausanne, Switzerland. Global Telecommunications Conference, 1996. GLOBECOM '96. Communications: The Key to Global Prosperity on Pages: 457 - 462 vol.1.
[12] A management framework for Internet services - Qinzheng Kong; Chen, G.; Hussain, R.Y. – Network Operations and Management Symposium, 1998. NOMS 98., IEEE Volume: 1 , 1998 , Page(s): 21 –30 vol.1.
[13] Kajanto, Markus. Strategic Framework for the Interactive Information Networks. Acta Polytechnica Scandinavica.
[14] Information model to support TINA service and management applications - Wakano, M.; Kawanishi, M.; Richter, L. NTT, Japan. Global Telecommunications Conference, 1994. GLOBECOM '94. Communications: The Global Bridge., IEEE on Pages: 543 - 547 vol.1.
[17] Network traffic management for new technologies: myths and facts - Pack, C.D. Bellcore, Red Bank, NJ, USA. Global Telecommunications Conference, 1995. GLOBECOM '95., IEEE on Pages: 112 - 115 vol.1.
[19] ITU-T Recommendation M.3000 (10/94) - Overview of TMN Recommendations.
[20] ITU-T Recommendation M.3010 (05/96) - Principles for a Telecommunications management network.
[21] ITU-T Recommendation M.3400 (04/97) - TMN management functions.
[23] ITU-T Recommendation X.720 (01/92) - Information technology – Open Systems Interconnection - Structure of management information: Management information model.
[28] "Content, Omnibus Lexicon Definition". http://www.fourthwavegroup.com/Publicx/958w.htm
[39] Juan Pavon and Jose Tomas,'CORBA for Network and Service Management in the TINA Framework', IEEE Communications Magazine, January 1998 Vol.36 No.3.
[40] Hiroshi Saito, 'Teletraffic Technologies in ATM Networks', Artech House Boston.London, 1993.
[41] Network Working Group,'Network Element Service Specification Template', S. Shenker, J Wroclawski Xerox PARC/MIT LCS September, 1997.
[42] GENERIC REQUIREMENTS, GR-2869-CORE, ISSUE 2, OCTOBER 1996, Comments Requested. Bell Communications Research (Bellcore).

BIOGRAPHIES

Juha Liukko *(jliukko@tcm.hut.fi) has received an M. Sc. degree from Tampere University of Technology in 1994. He is post-graduate student in Tampere University of Technology. In 1995 he had a training period in Helsinki Puhelin Oy (nowadays Elisa Communications). Since 1996 he has worked in Nokia Networks in the area of telecommunication network management (concepts, specification, product management), where he is currently working as a product manager. He is also working as a part-time researcher in Helsinki University of Technology, Laboratory of Telecommunications Software and Multimedia in a TEKES project.*

Yuchen Zhou *(zhou@tcm.hut.fi) is a Ph.D. student studying in Laboratory of Telecommunications Software and Multimedia, University of Helsinki of Technology.*