Feature Interactions in Overlay Networks

Research Direction and Approach

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Outline

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- Challenges
- Approach
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  - Per Service Iterative Refinement
  - Goal Directed Interaction Model
- Summary

Why Overlay Service Networks?

- Overlay Service Network
  - A converged network that allows delivery of different multimedia services over a common infrastructure using shared resources
  - Introduction of a new overlay service may impact existing overlay services due to resource sharing
  - Shared resources may be at the business (customer data), service (e.g. applications and service data) and/or network (e.g. router configuration) level.
- Converged IP Networks allow
  - CAPEX Reduction: Deliver various applications and multimedia services over a shared infrastructure
  - OPEX Reduction: Improve operational efficiency through a common overlay network, unified management system and operation
  - New revenue generation: Facilitate bundling or integration of various services such as IM, voice and MMS

Challenges (1)

- New overlay service delivery paradigm e.g. VoIP, VoD, content, gaming, IPTV
  - Exacerbates the feature interactions problem due to continuous layering of new service networks over a common set of resources, and
  - Affects networks that are managed through either traditional network management systems or policy based management systems.

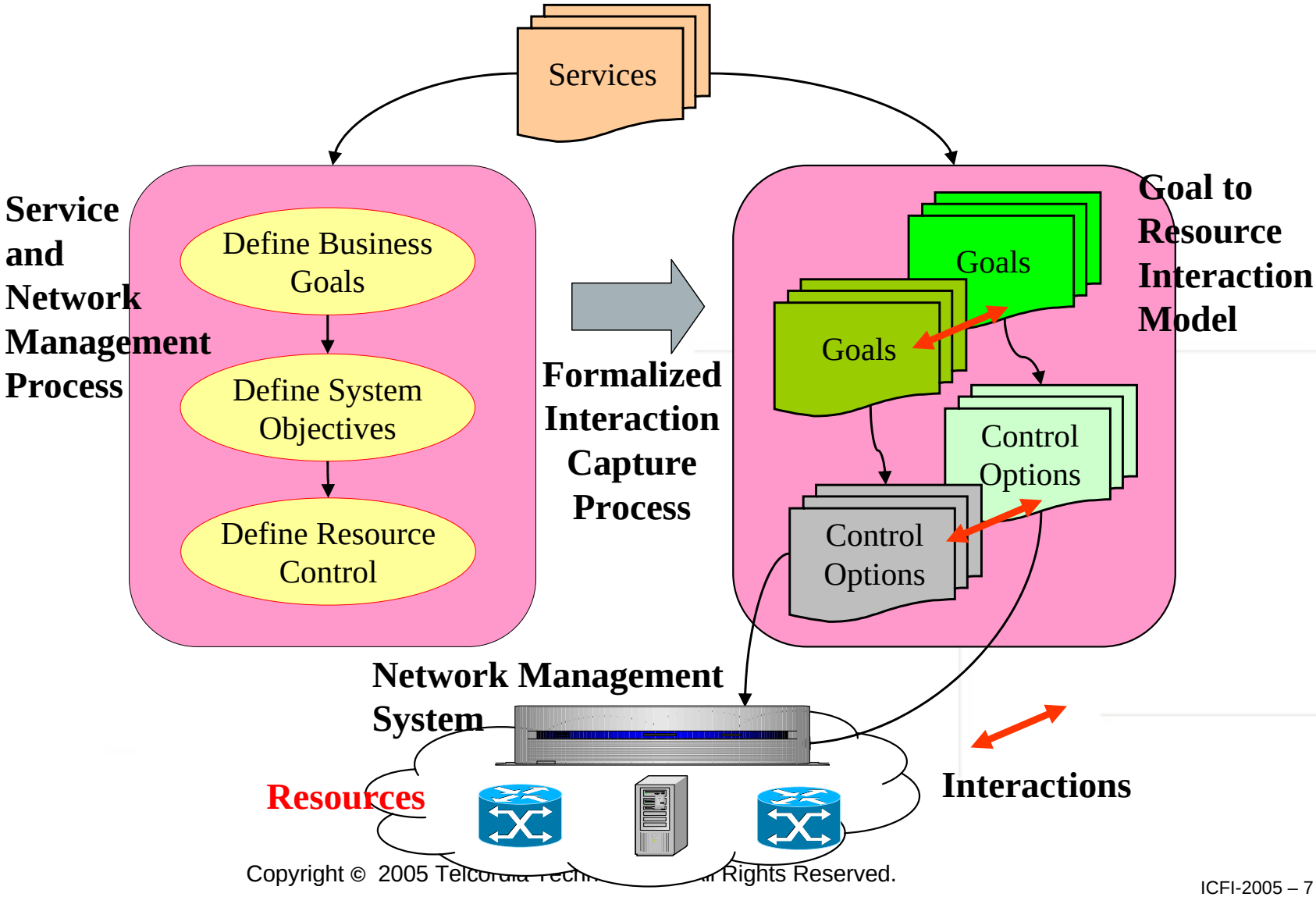
Challenges (2)

- Challenges include managing interference and dependency across different:
  - Types of services that require different treatment from the same set of resources e.g. voice (low jitter), data (high BW)
  - Functional areas e.g. configuration and assurance policies that may create conflicts
  - Infrastructure layers that require interworking between existing and new elements e.g. applications, servers and terminals
  - Network partitions and administrative domains e.g. different security requirements especially involving mobility, and
  - Business and systems objectives that may be inconsistent e.g. maximizing network utilization does not necessarily translate to maximizing revenue return

Methodology (1)

- Capture high level goals of a service and refine them into sub-goals
- Sub-goals are defined as control (configuration and monitoring) actions that can be performed on a set of service dependent resources
- Example of VoIP service goals
  - Met or exceed VoIP service quality goal. Sub-goals may include
    - Guarantee network jitter, delay and packet loss, appropriate bandwidth allocation, assure DTMF accuracy for highly IVR services
  - Maximize # VoIP calls in the network. Sub goals may include
    - Minimize BW per call configuration
    - Reduce BW of existing data services
  - Increase VoIP service revenue. Sub goals may include
    - Admit $ generating call & data sessions
    - Preempt non-$ generating sessions
- Apply the iterative refinement process to each service and generates an unified interaction model for control options and resources across goals and services.

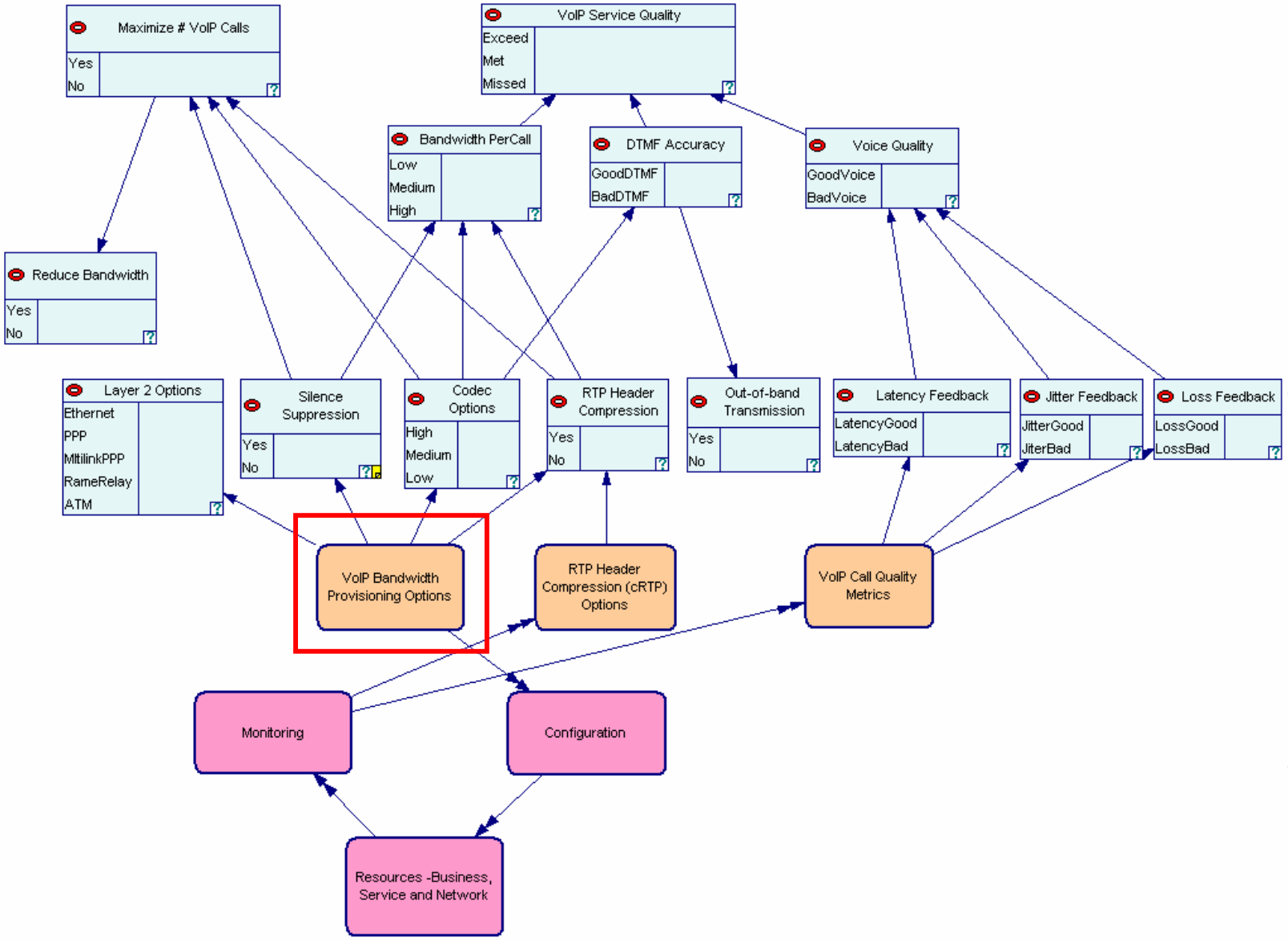
Methodology (2)



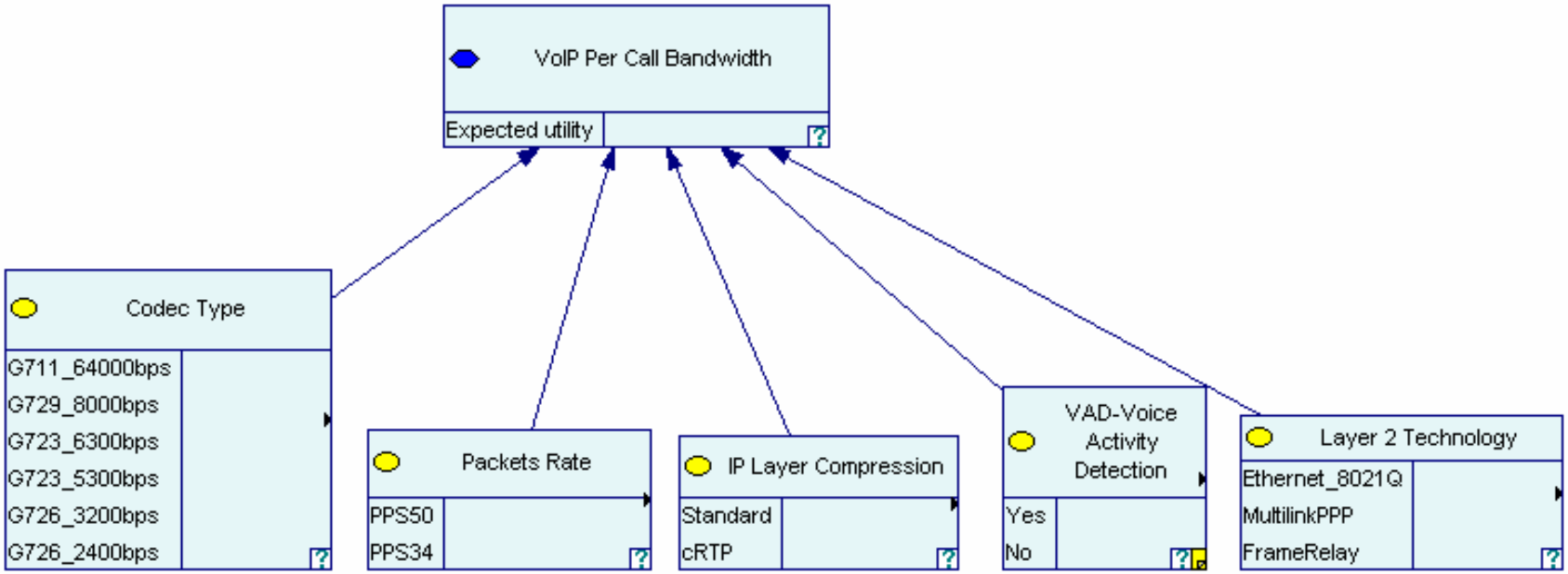
Business and System Goals Refinement

Goals	Sub-Goals	Sub-Goals	Control Options
Reduce costs	Reduce operational costs by 40%	Reduce application configuration modification time on 25 servers by 95%	Policy based configuration for application (monitoring & feedback)
		Reduce OS upgrade time on 500 servers by 95%	Policy based configuration for OS
	Reduce SLA penalty costs by 80%	Reduce SLA violation of VoIP service to 10 per month	Assurance policies on call setup delay, dropped calls, etc.
Increase revenue	Increase revenue by 10%	Increase revenue of voice services by 15%	Set high priority for voice call to outside home area, or from subscriber exceeding contracted minutes
			Set low priority to 'free minutes'
Increase customer satisfaction	Increase customer satisfaction of VoIP services	Reduce number of customer complaints of voice services by 20%	
		VoIP service quality equals PSTN quality 95% of the time	Packet loss (one way) < 1%, Jitter (one way) < 30ms, Latency < 150ms

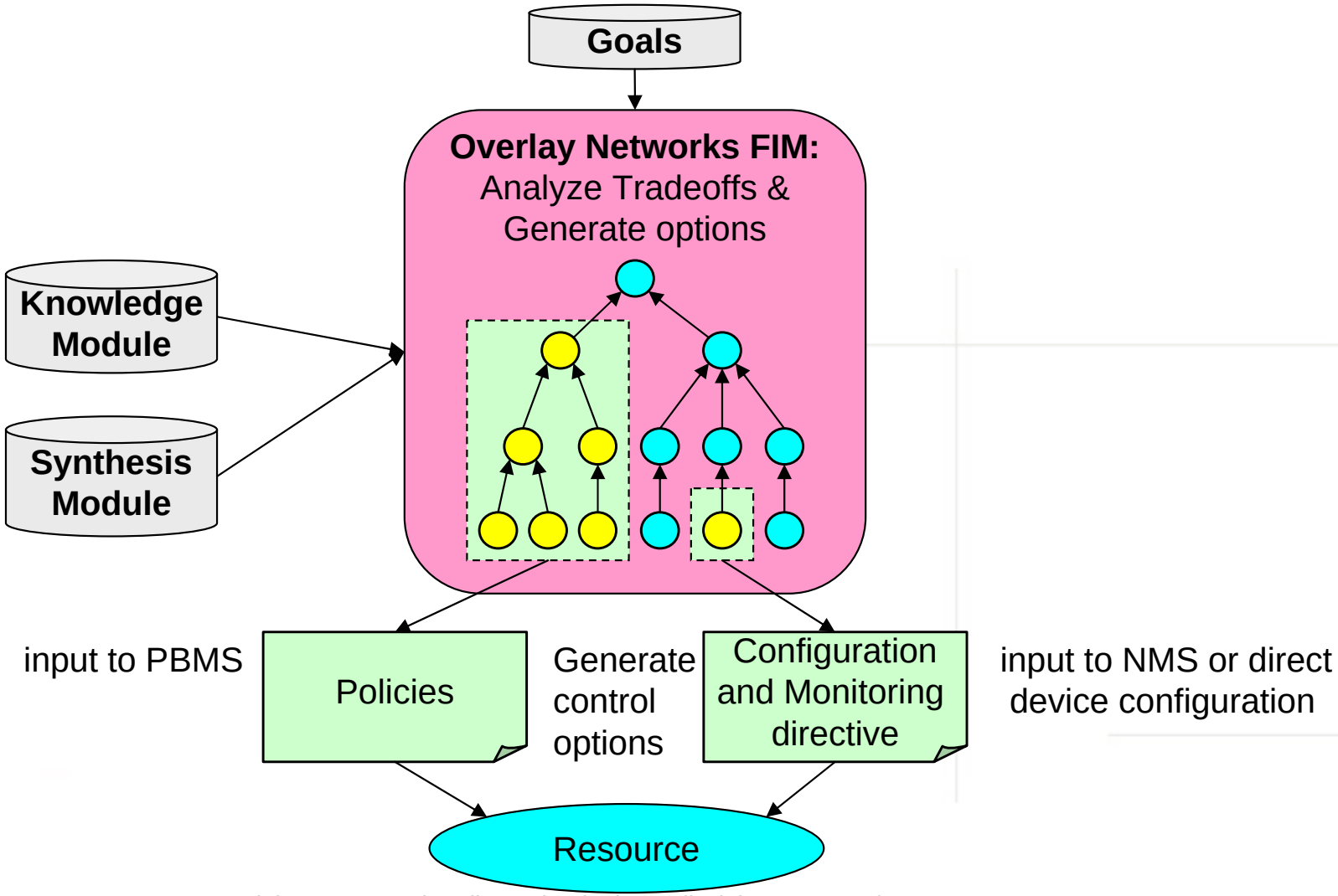
Goal Directed Interaction Model (1)



Goal Directed Interaction Model (2)



Interfaces to Overlay Networks Feature Interaction Manager



Summary

- Introduced a new approach and research direction for modeling and managing feature interactions in overlay networks.
- Could significantly enhance existing network management techniques by increasing awareness in traditional network management systems about business and service affecting goals and decisions.
- Experience to date indicates specification and management of interactions is complex for overlay network services, an inherit characteristic of the problem space. Need new techniques to manage associated complexity.
- Approach is promising:
  - Acts as a valuable tool for end-to-end service and network management and planning,
  - Formally captures interaction across layers in the model and potentially used for manual or automated analysis,
  - Facilitates elaboration of and decision making on control options that affect the network based on high level business and system goals,
  - Generates reusable and extensible knowledge

Revenue Potential for Delivery of Overlaid (Value-Add) Services on A Converged Infrastructure

Service Category	% US households willing to pay	Potential annual revenue
Entertainment	44%	6.6 Billion
Communications	42%	5.2 Billion
Education	39%	4.1 Billion
Personal/professional services	35%	2.3 Billion
Hobbies	30%	2.3 Billion
Medical/health	24%	2.5 Billion
Telework/work	17%	1.7 Billion

Sage Research 2002