Context-Aware Converged Communications

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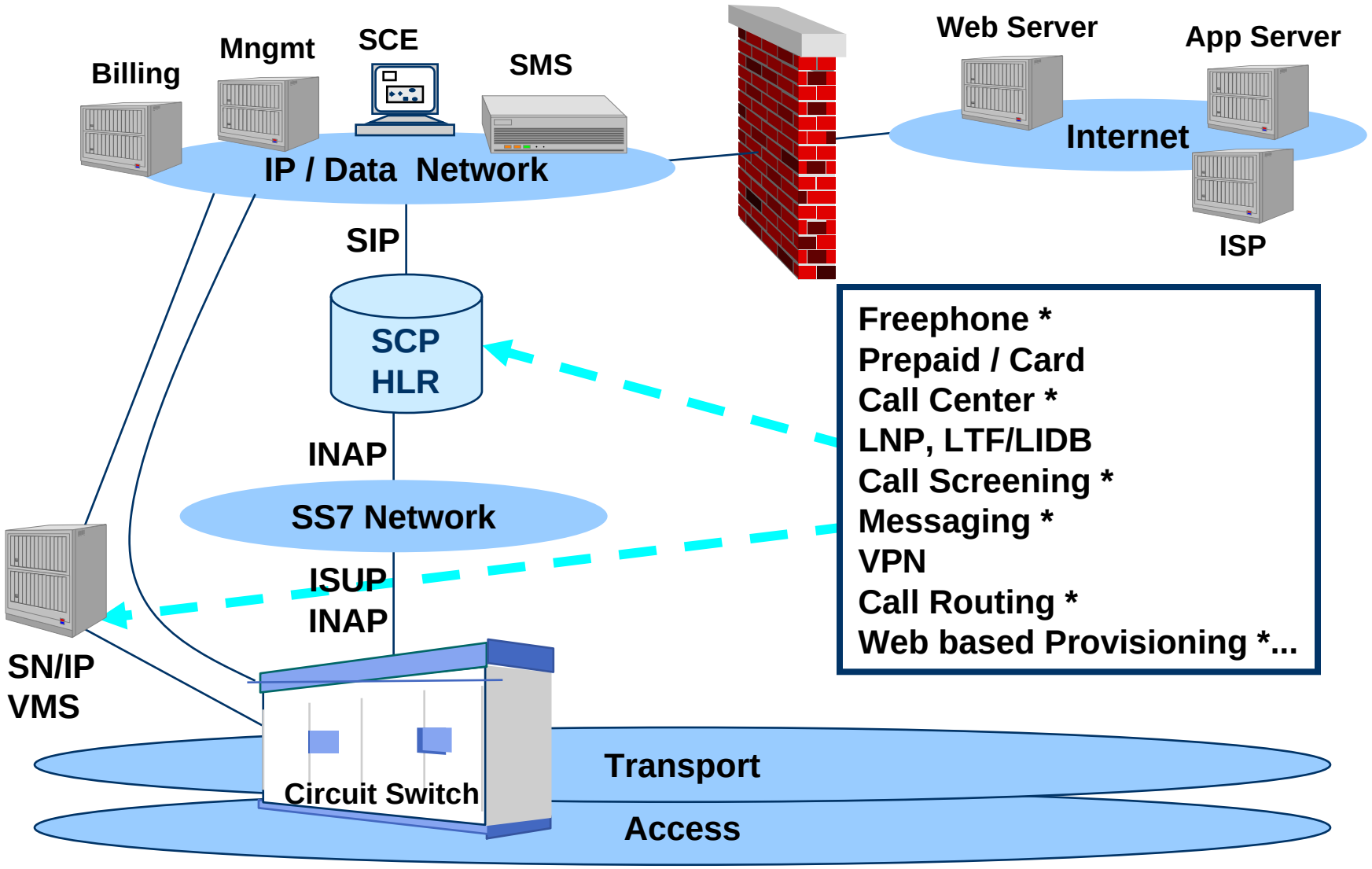
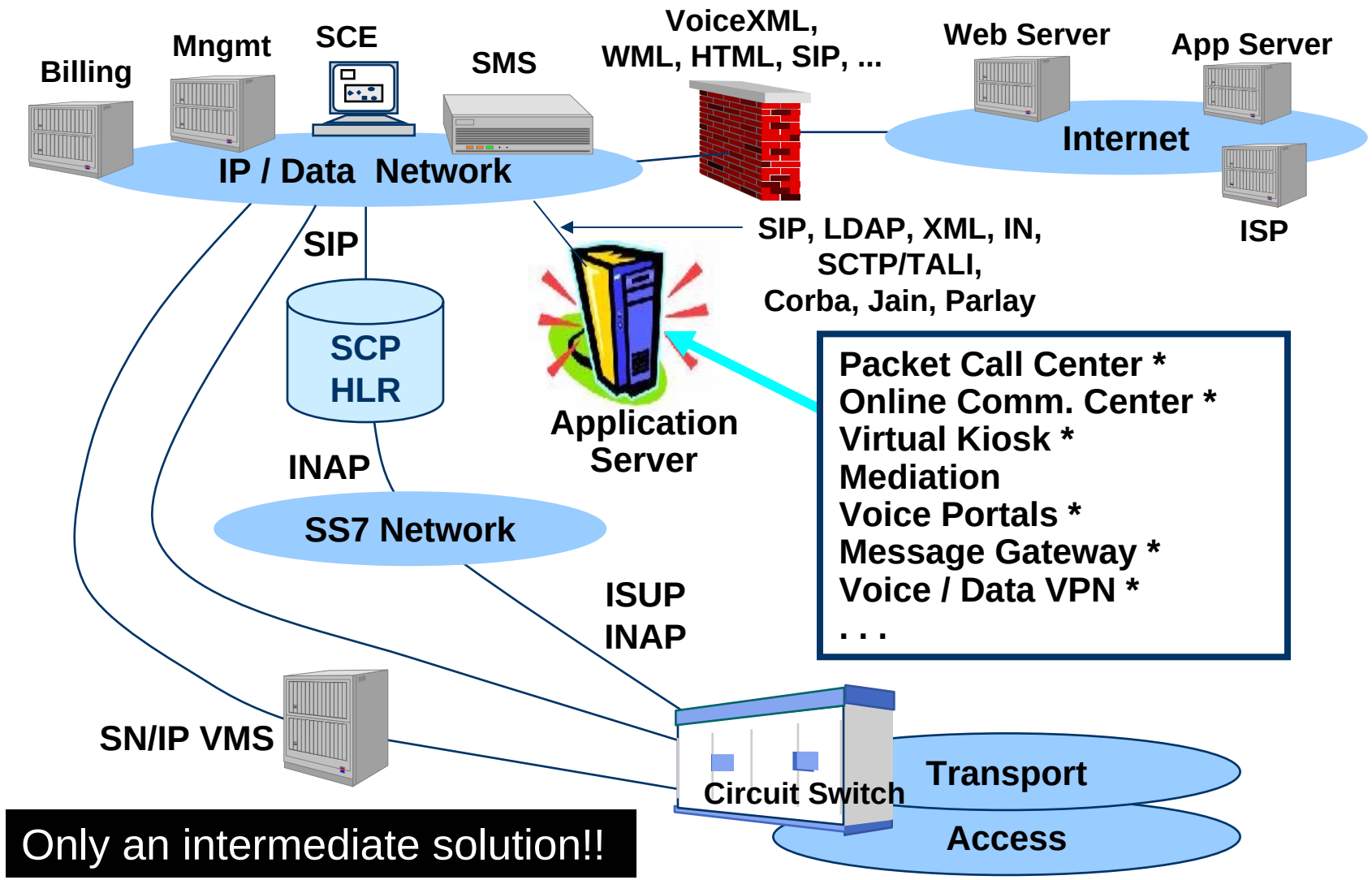
Communication Services Today – IN Perspective



Towards Converged Voice/Internet Services



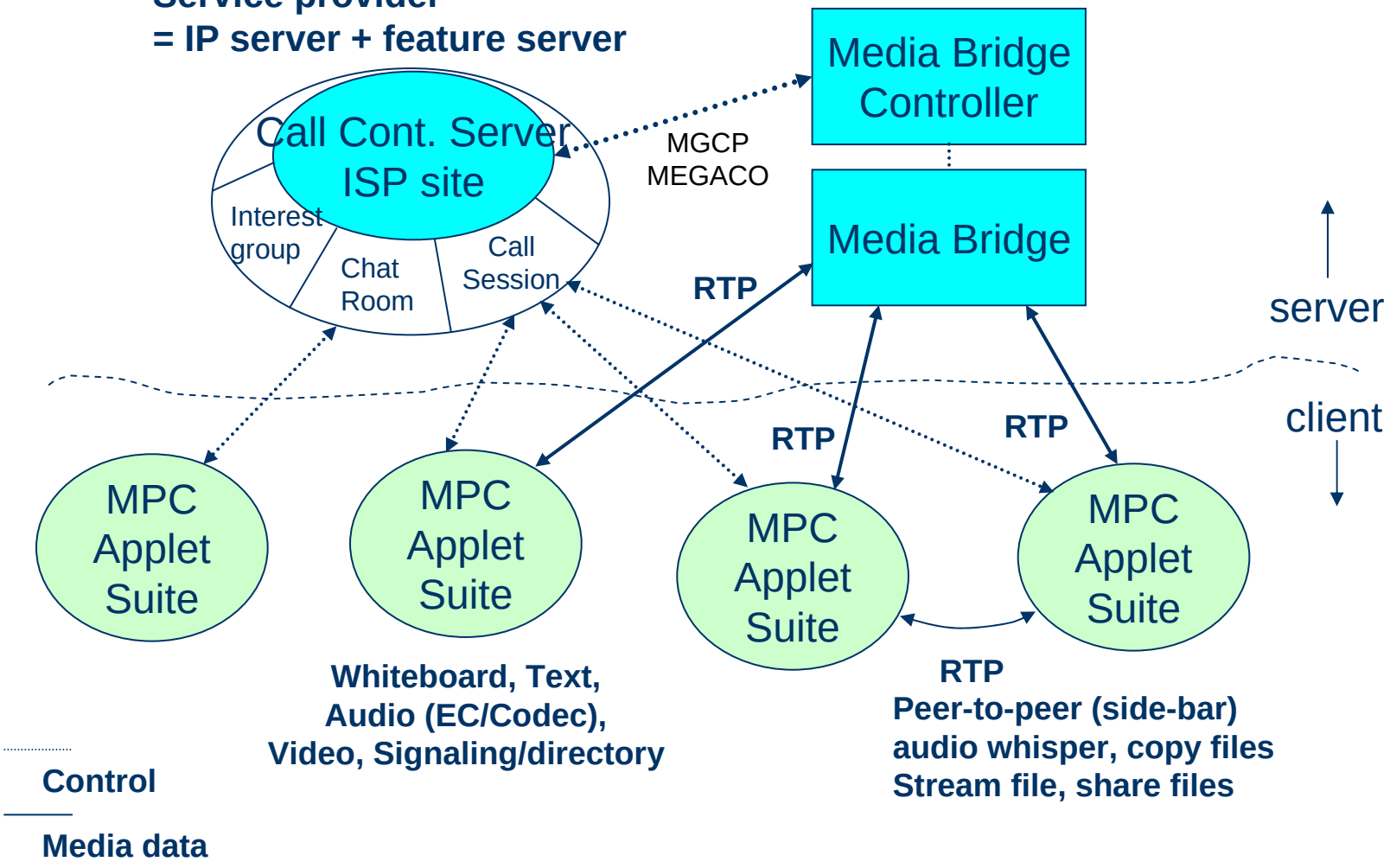
Only an intermediate solution!!

Example – Multiparty Communication Services

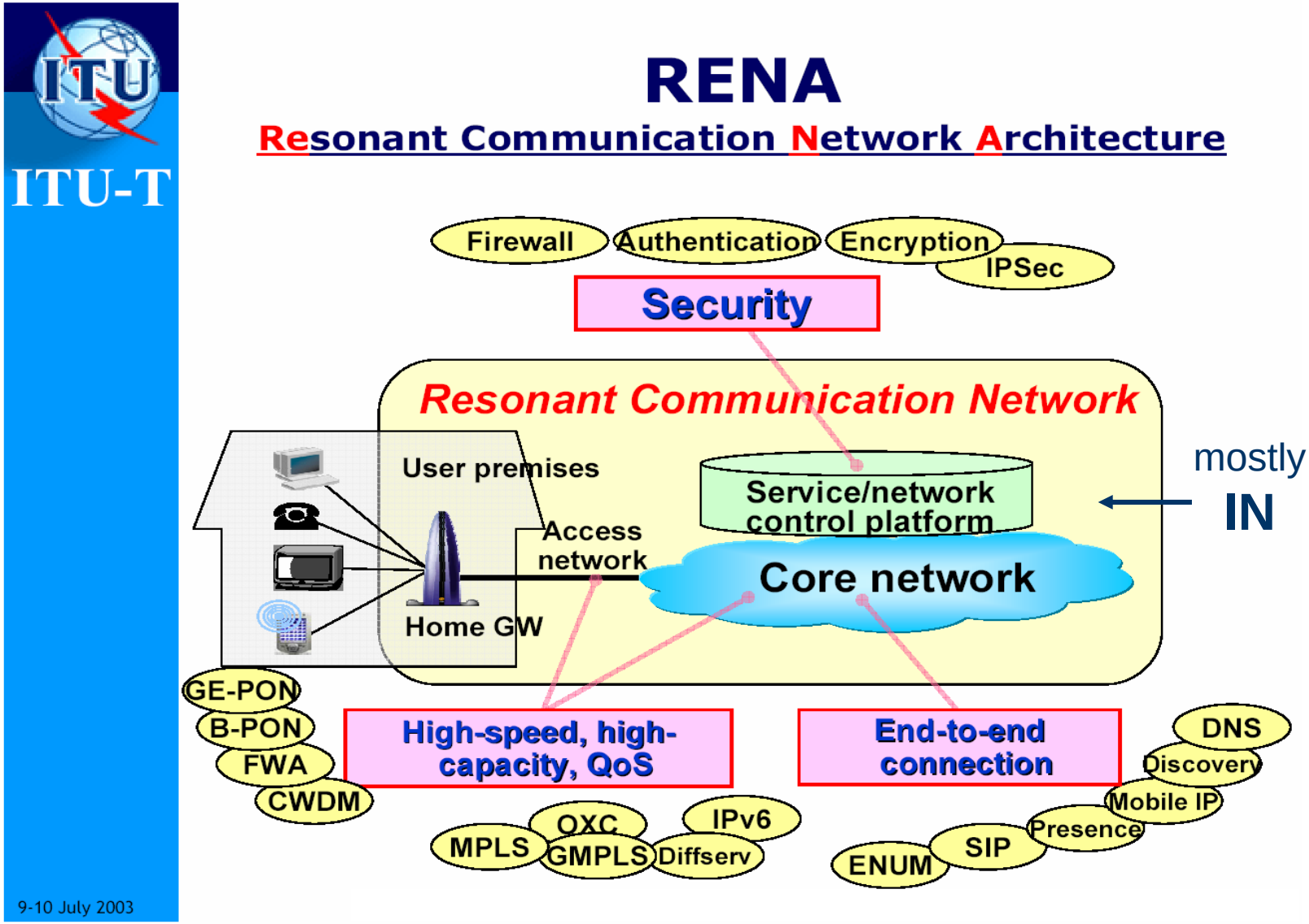
Business model:

Service provider

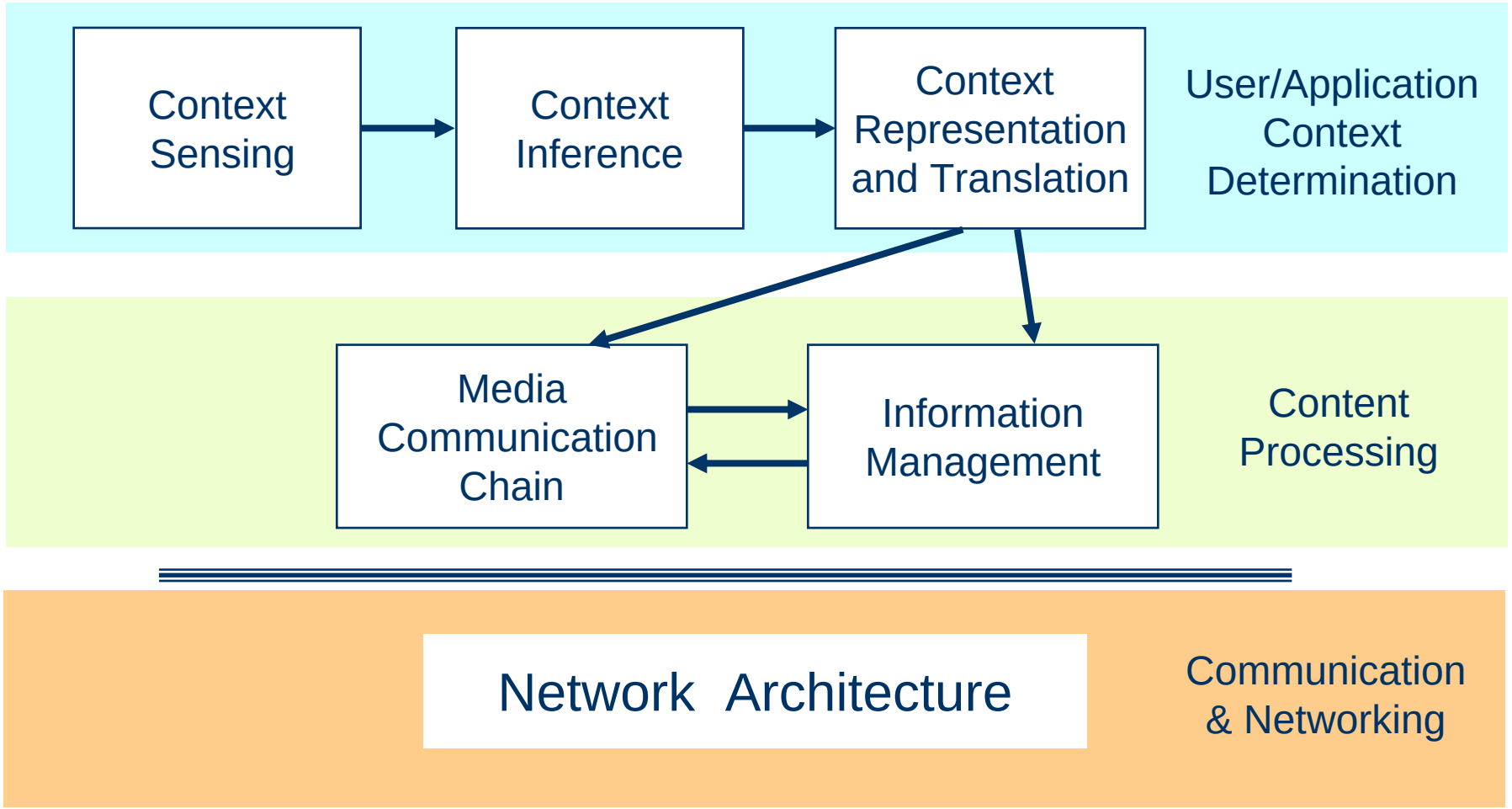
= IP server + feature server



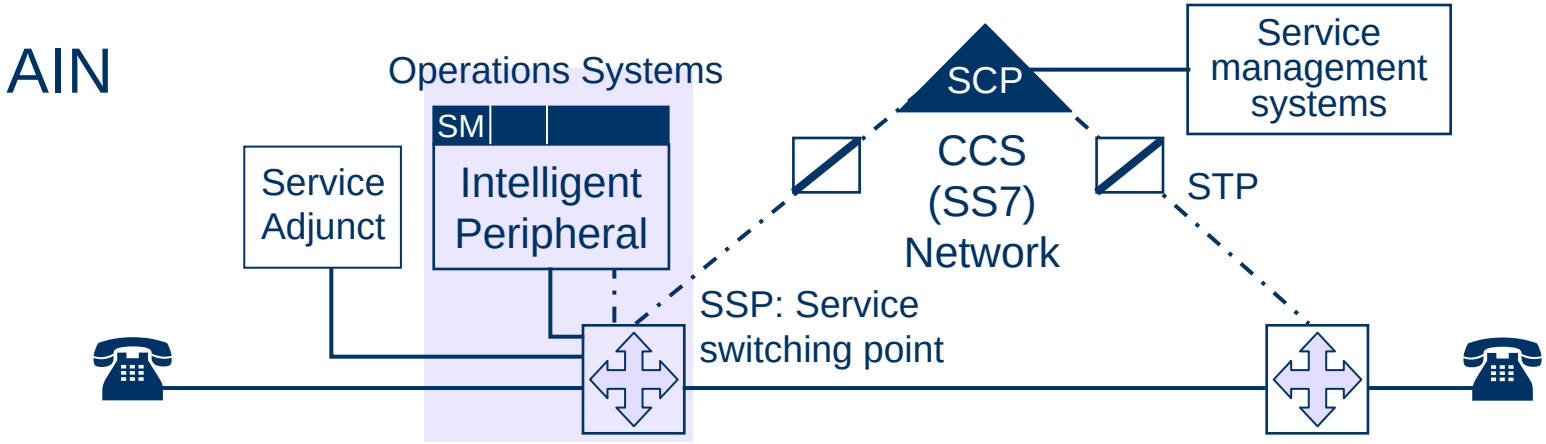
NTT's Resonant Communication Networks



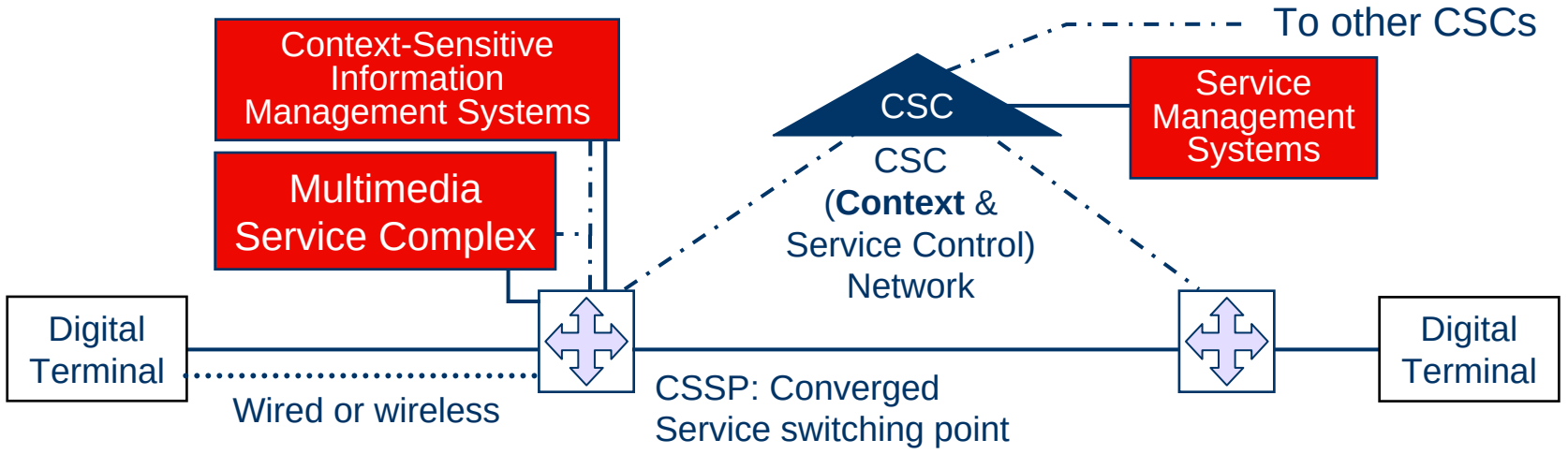
Context-Aware Communications



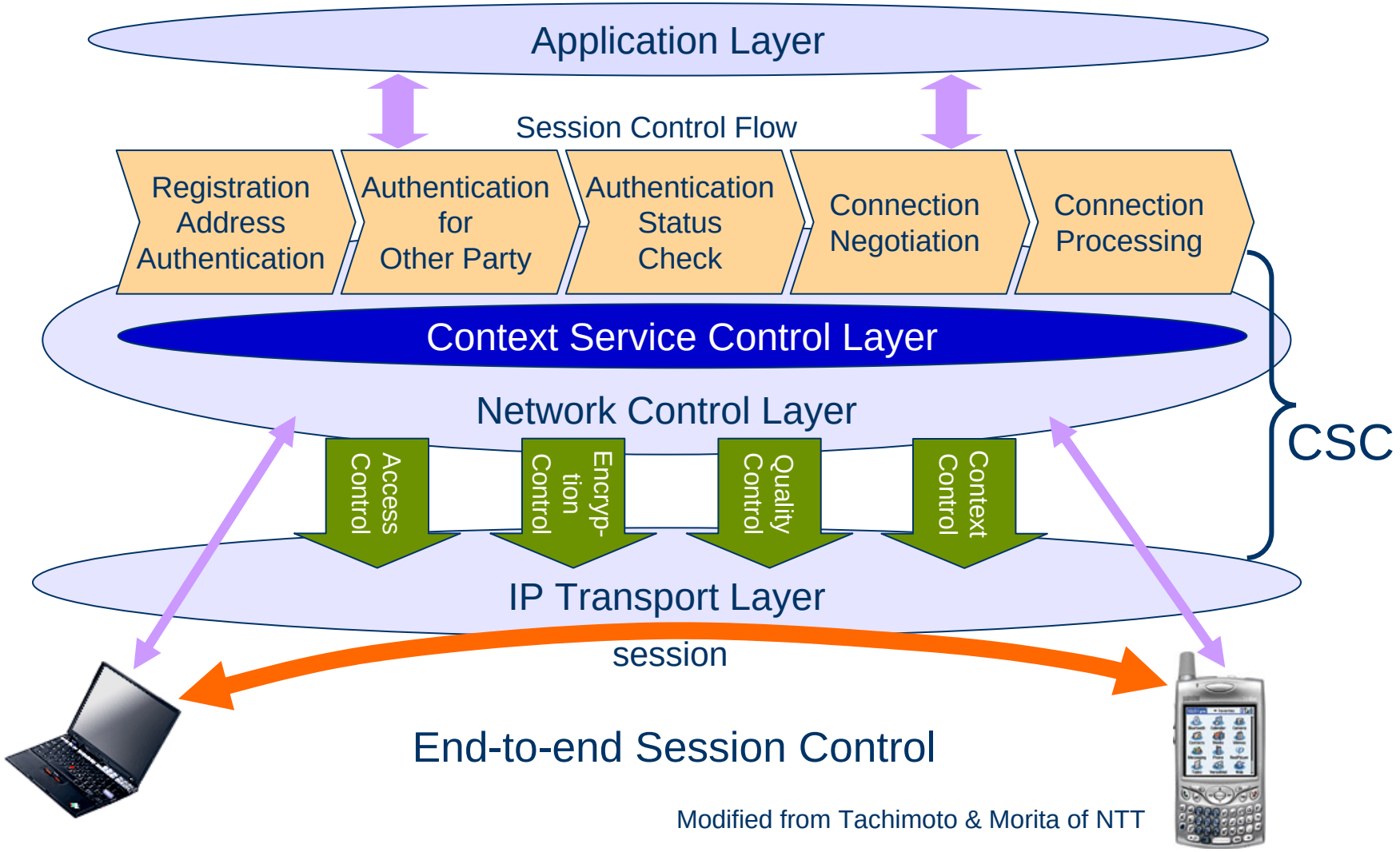
Architectural Evolution



CCN (Context-sensitive Converged Networks)



Network Architecture for CCN



Modified from Tachimoto & Morita of NTT

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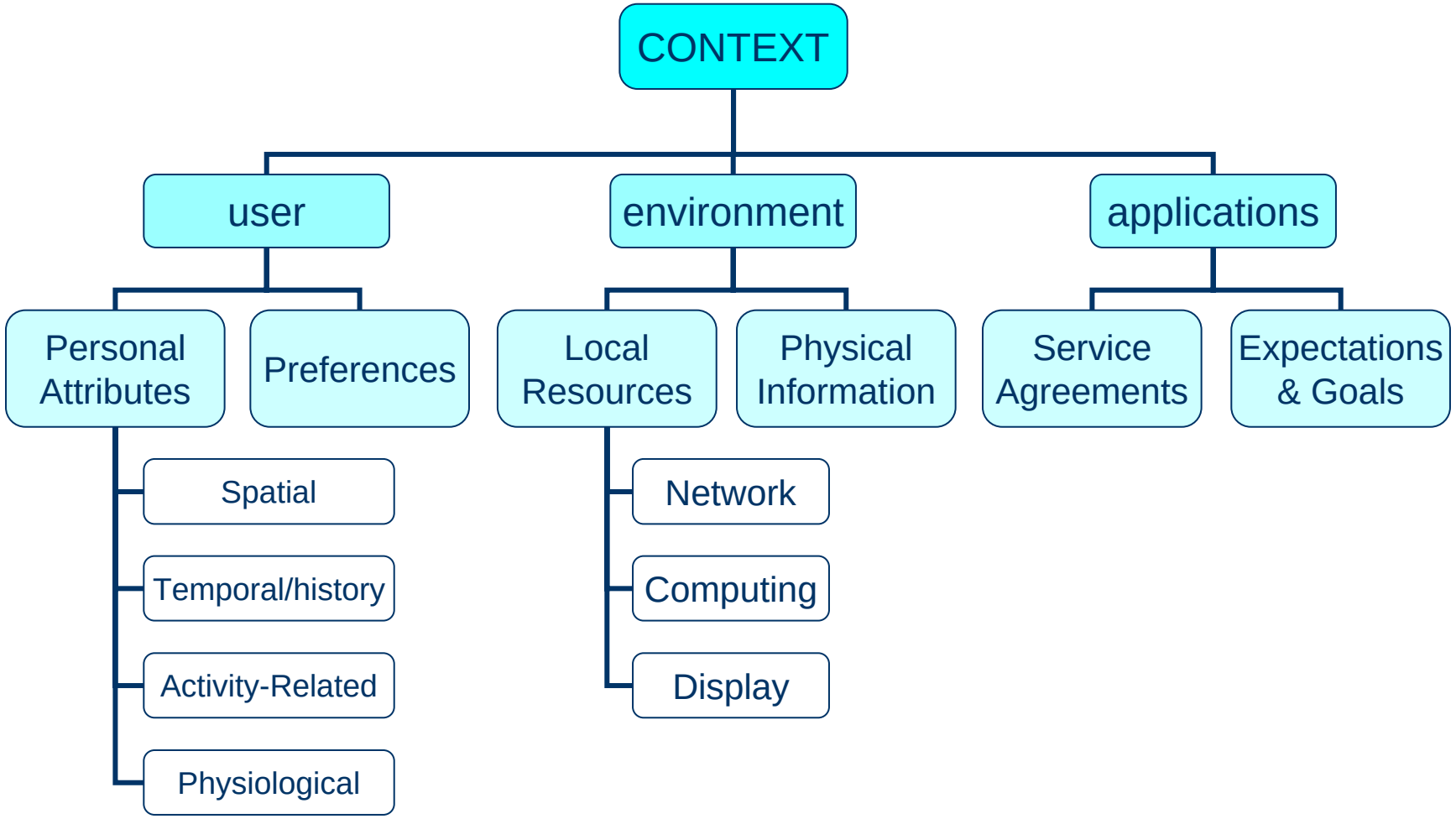
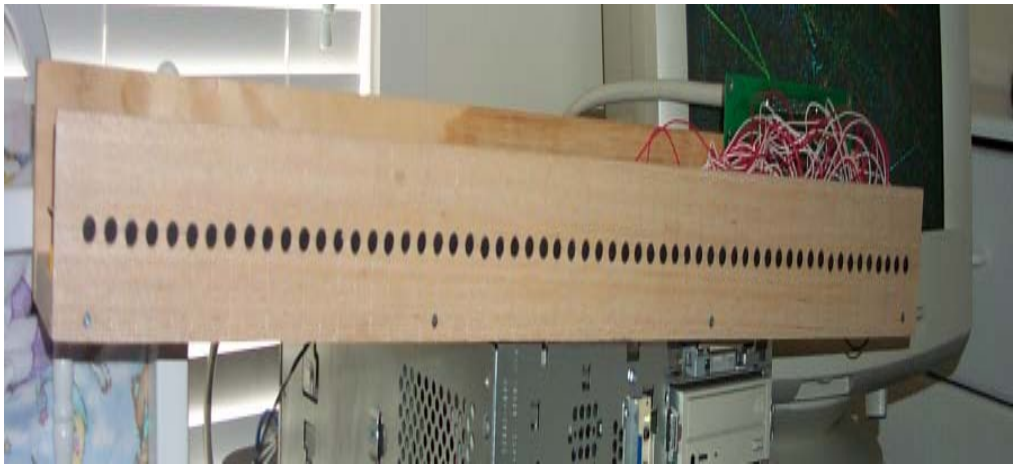
Dimensions of Context

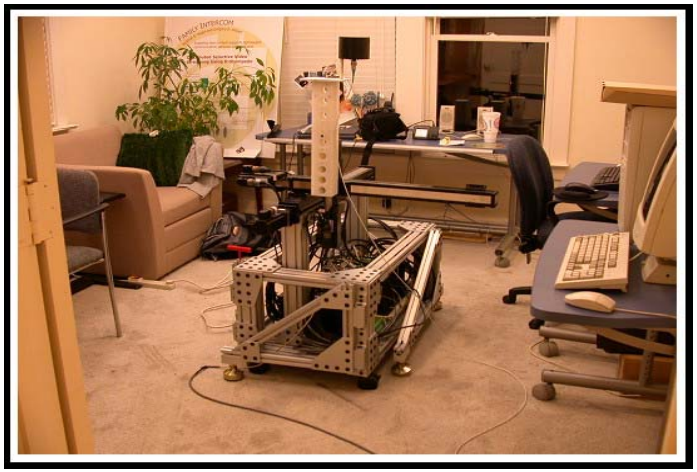


Sensors in the Labs at Gatech

Video



Audio



Wireless

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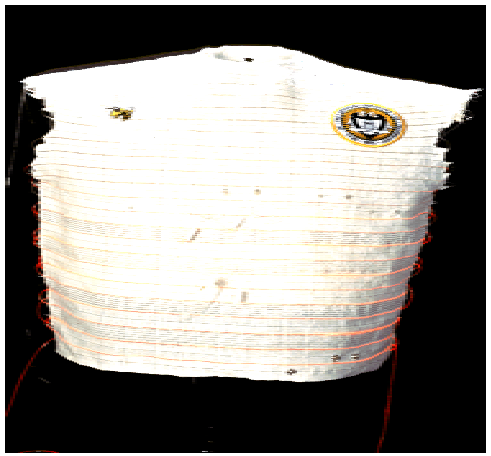
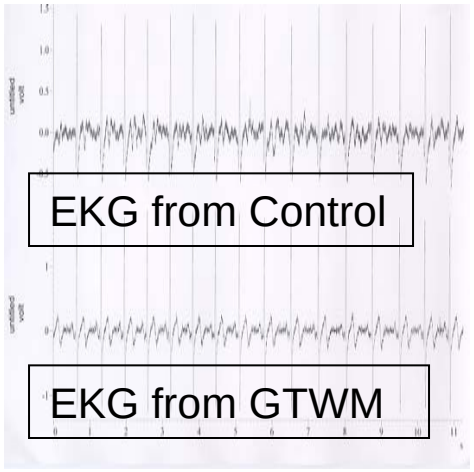
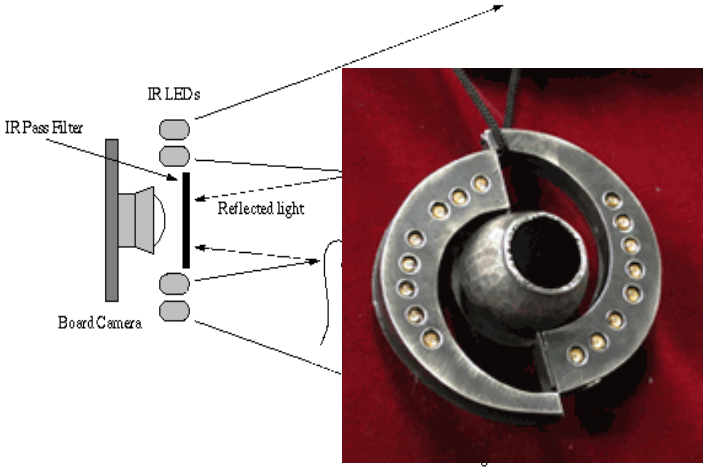
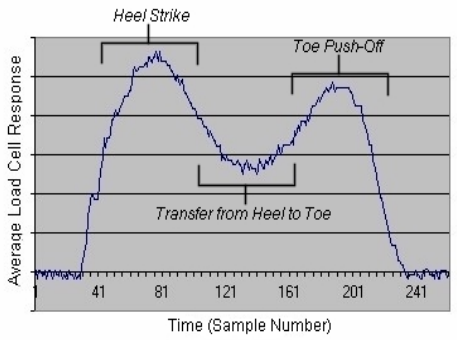
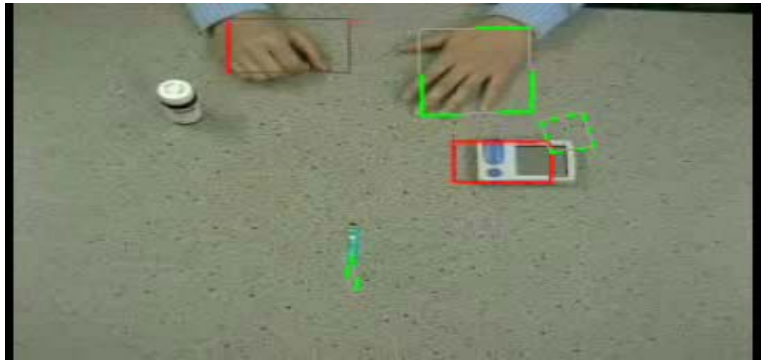
Devices for Aging in Place







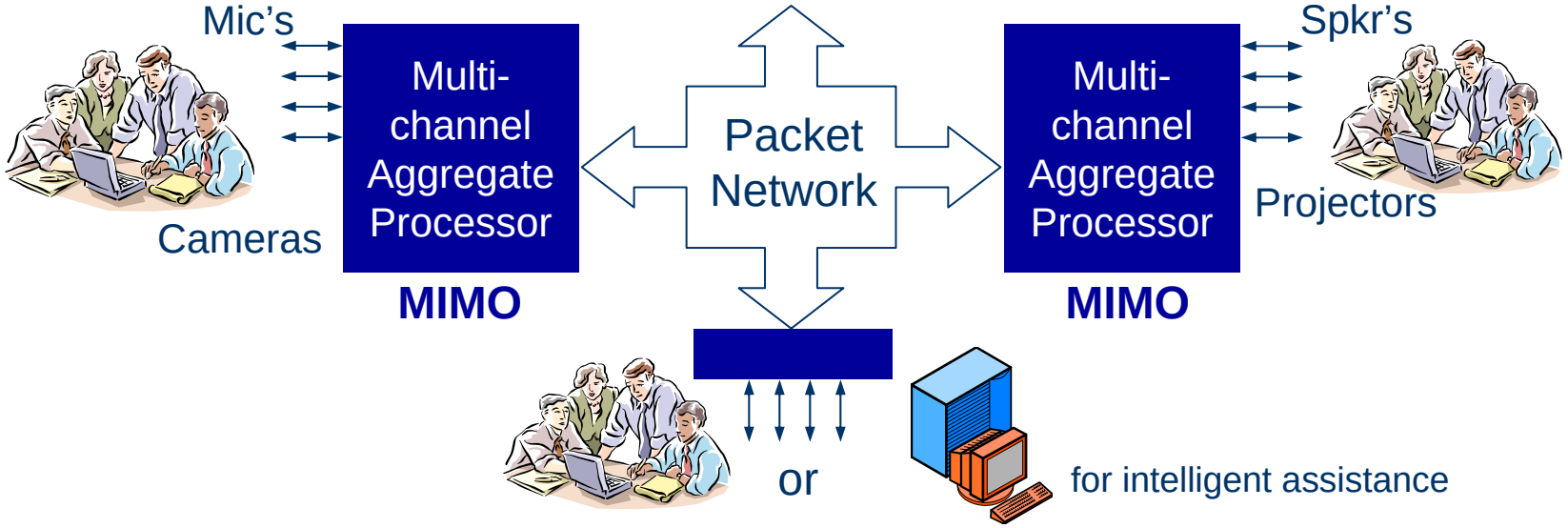




Multi-channel Hi-Fi Telecommunication

Traditional telephony

New multi-channel network for information sharing



Spatialization & The Perceptual Dimension

Sound spatialization *makes talker-tracking easier in multi-party conferencing environments, resulting in improved effectiveness in communication*

Binaural Hearing & Cocktail Party Effect

Spatial separation plays a role.

- Compare mono with stereo

Stream segregation also plays a role.

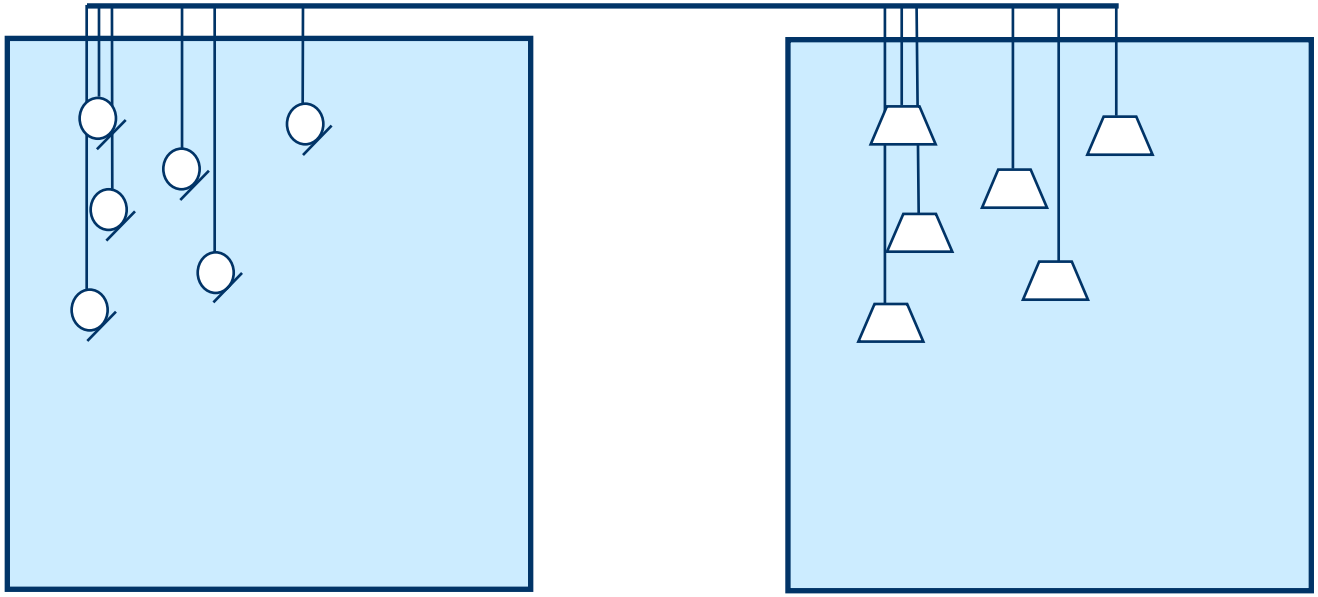
- Compare one talker (m1+m2) with two (m1+f2)

  (m1 m2 f2)

Stereophonic Conferencing Demonstration

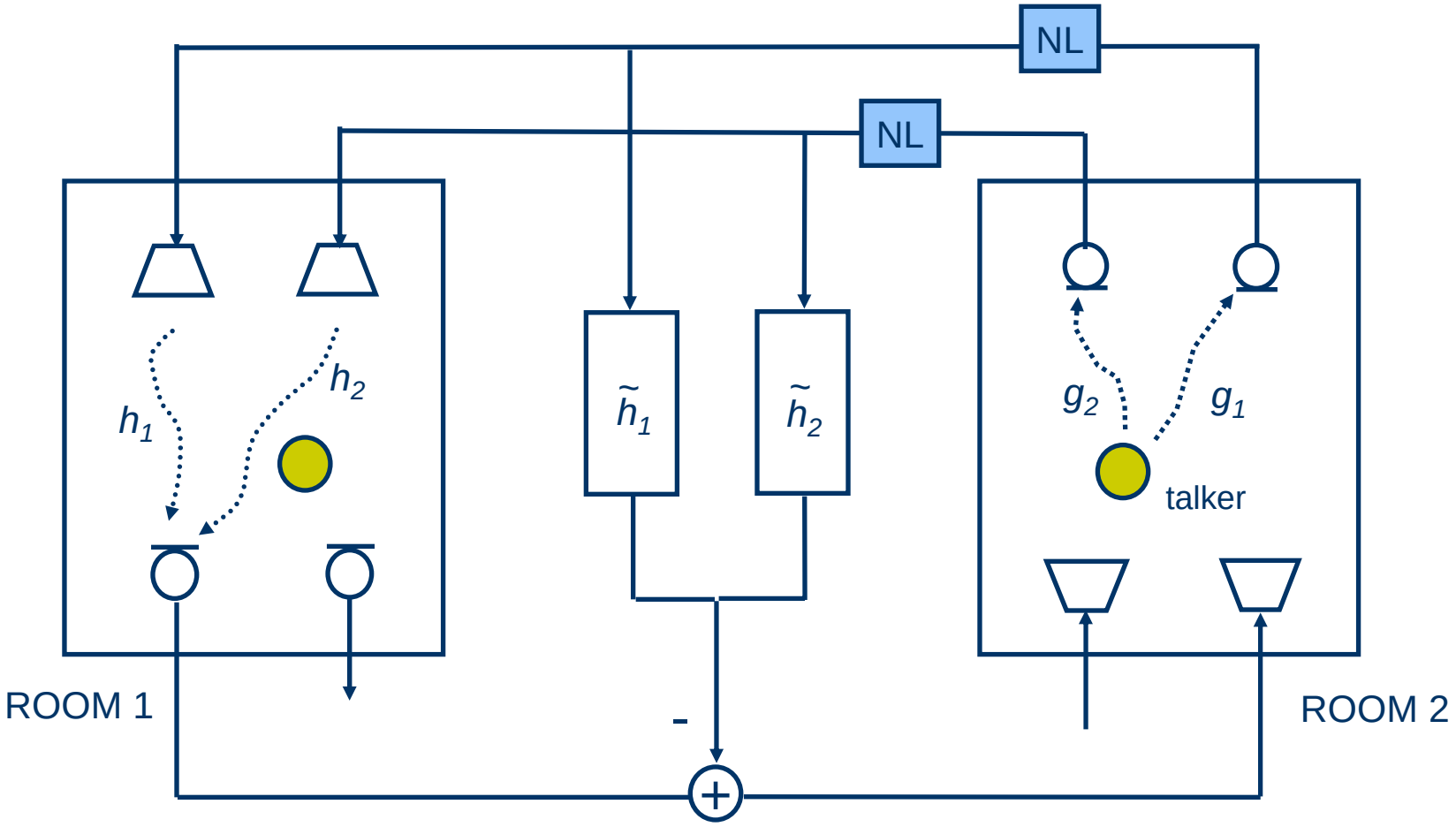
Multi-channel Communications

Human communication is a spatial-temporal event.

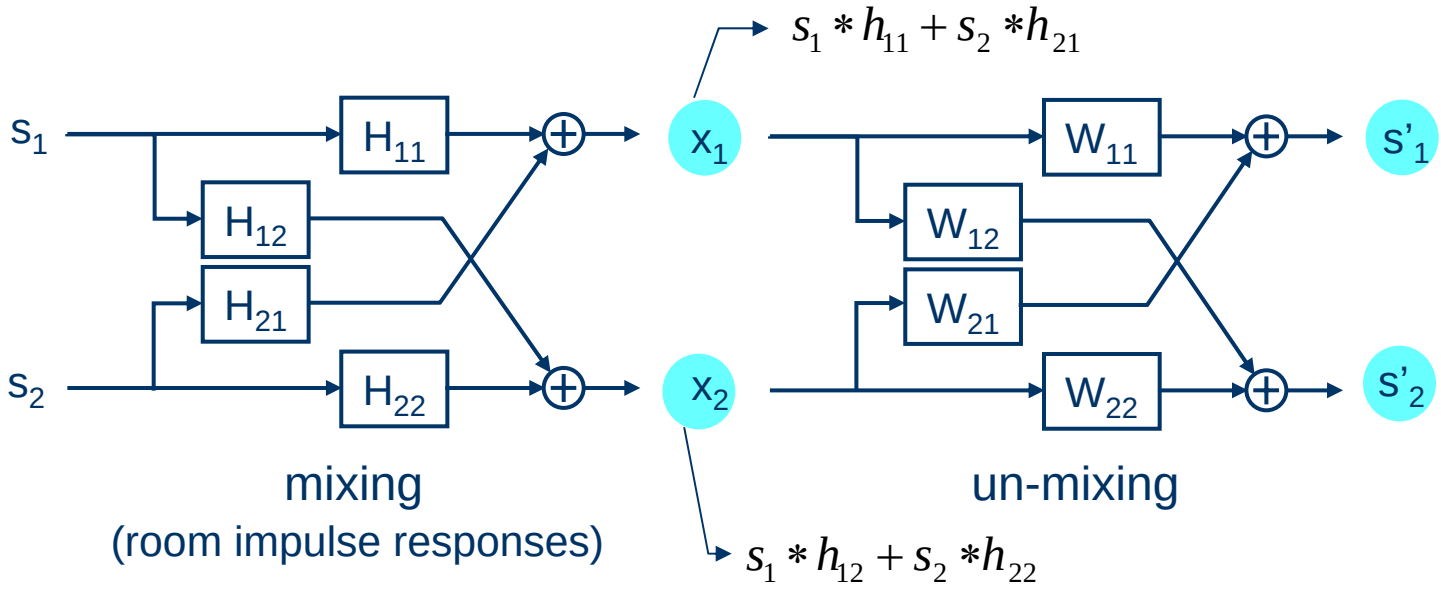


It is important to track the source objects.

Stereophonic Acoustic Echo Cancellation



Multi-channel Source Separation



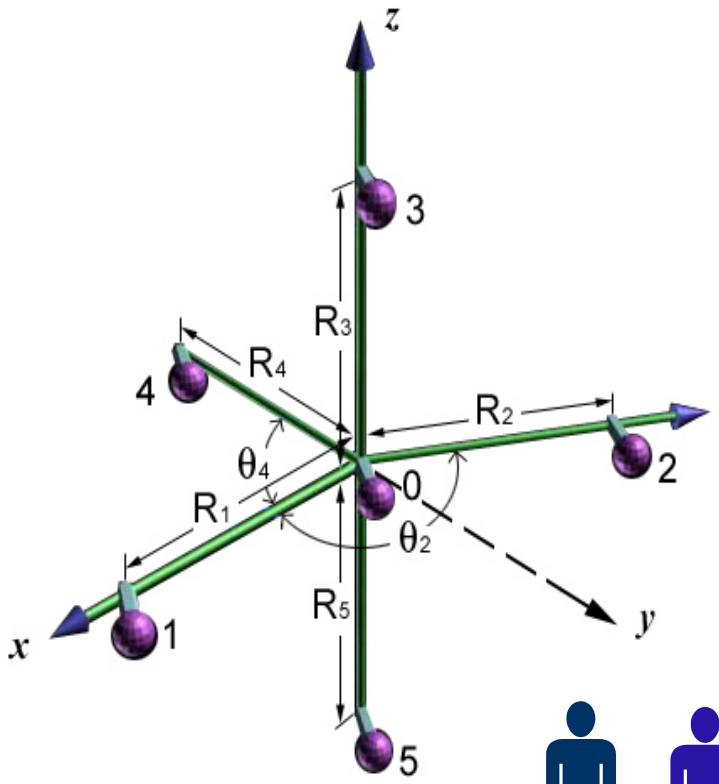
One possible approach (Ikram of Gatech and Morgan of Bell Labs):

x = H s **R' = <x x^H>** **s' = Wx**

Find un-mixing filter matrix **W** such that

$\Lambda_{s'} = \mathbf{W R' W}^H$ is diagonalized by minimizing the squared Frobenius norm of the off-diagonal matrix of $\Lambda_{s'}$

Sound Source Localization



Developed at Bell Labs
& Georgia Tech

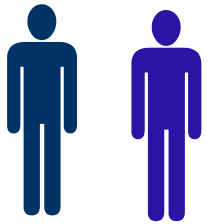
1. Time Delay Estimation
2. Source Location Estimation

Various methods:

- triangulation - solve a set of hyperbolic equations
- spherical intersection - solve a set of linearized spherical equations
- spherical interpolation - similar to SI, but with reduced constraint
- **one-step-least-squares** – transforms the problem into an estimation/minimization problem; works the best

Applications:

- Conferencing with participant tracking
- Improved sound and sight pickup



talker

Further challenge

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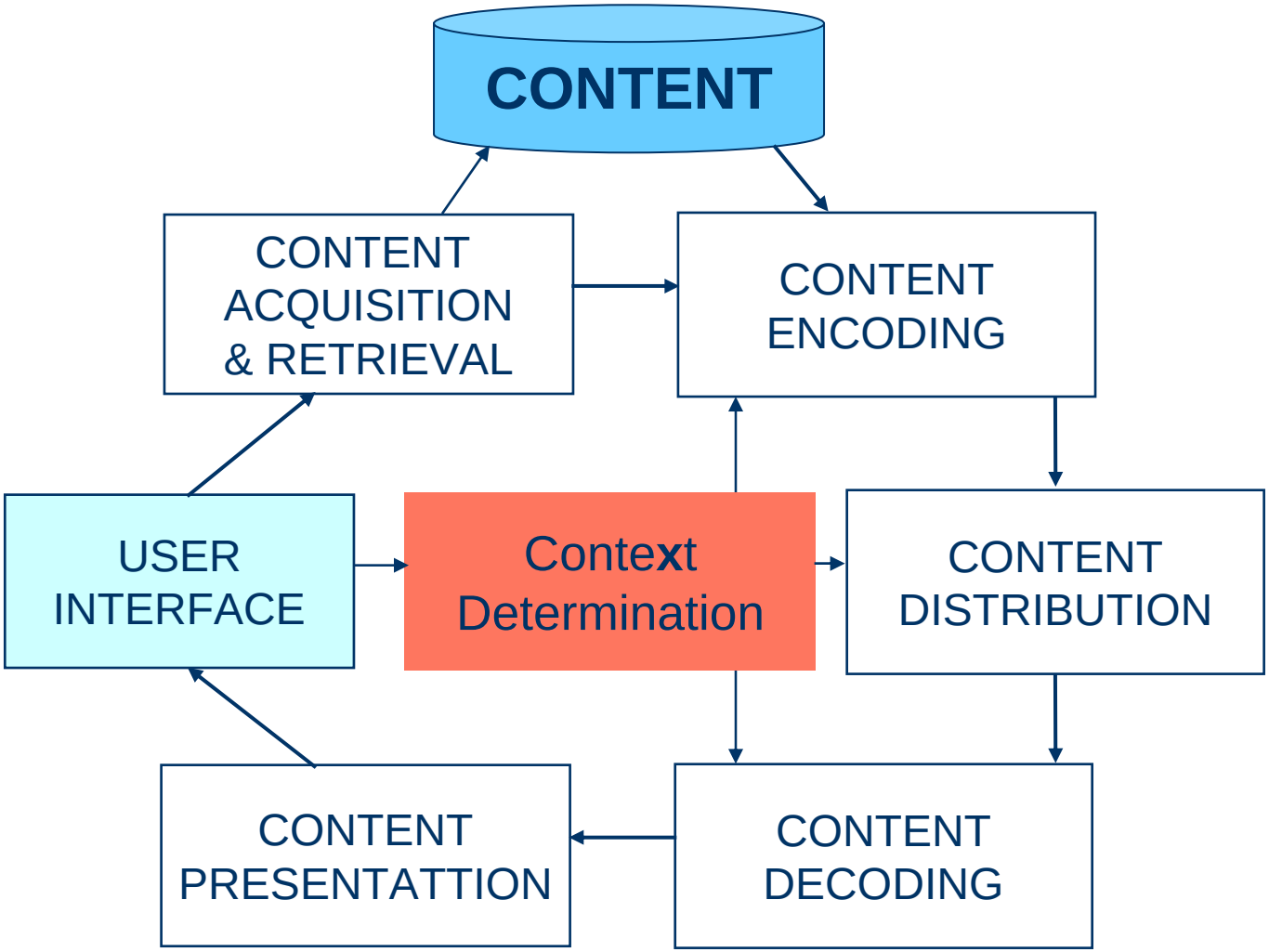
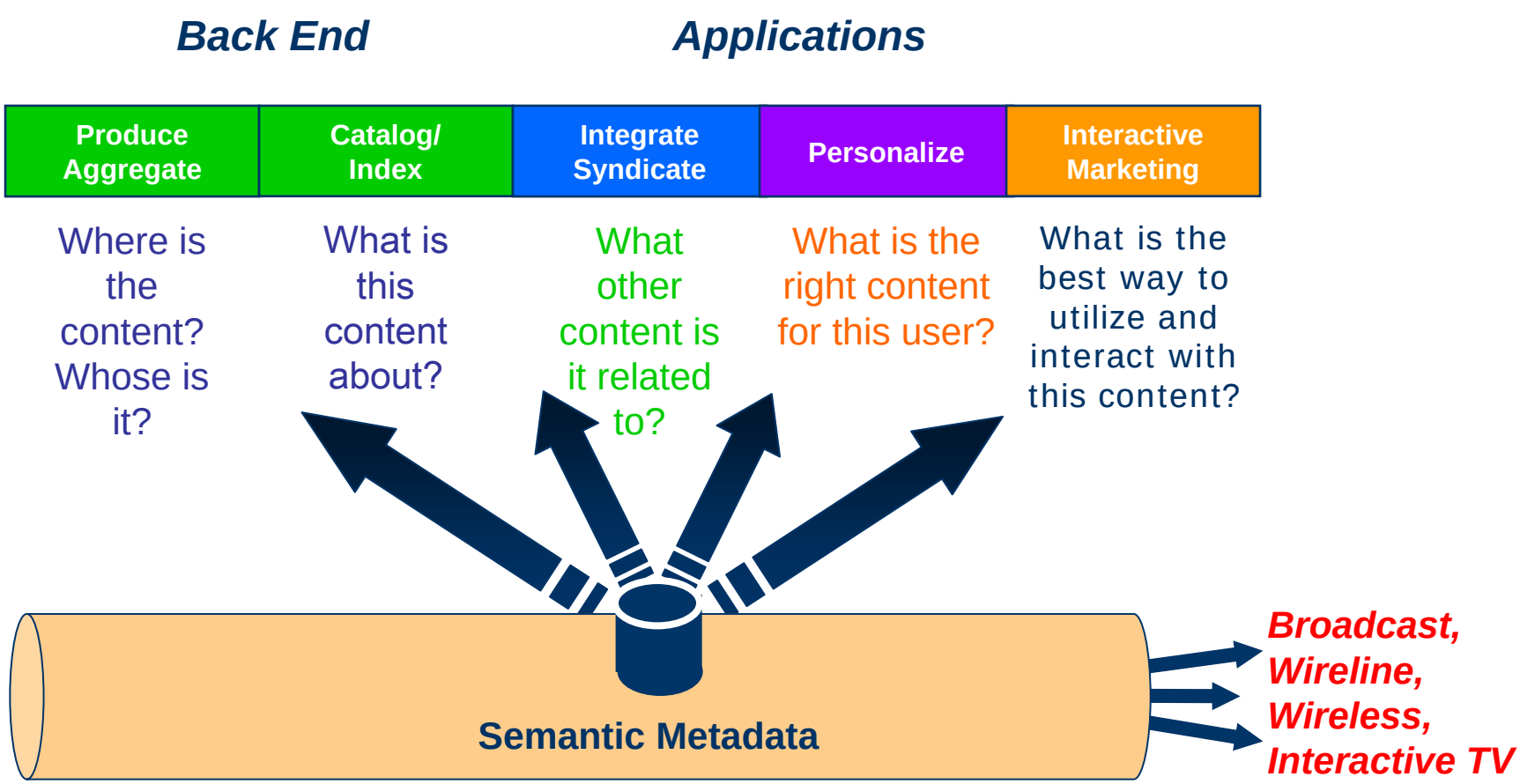
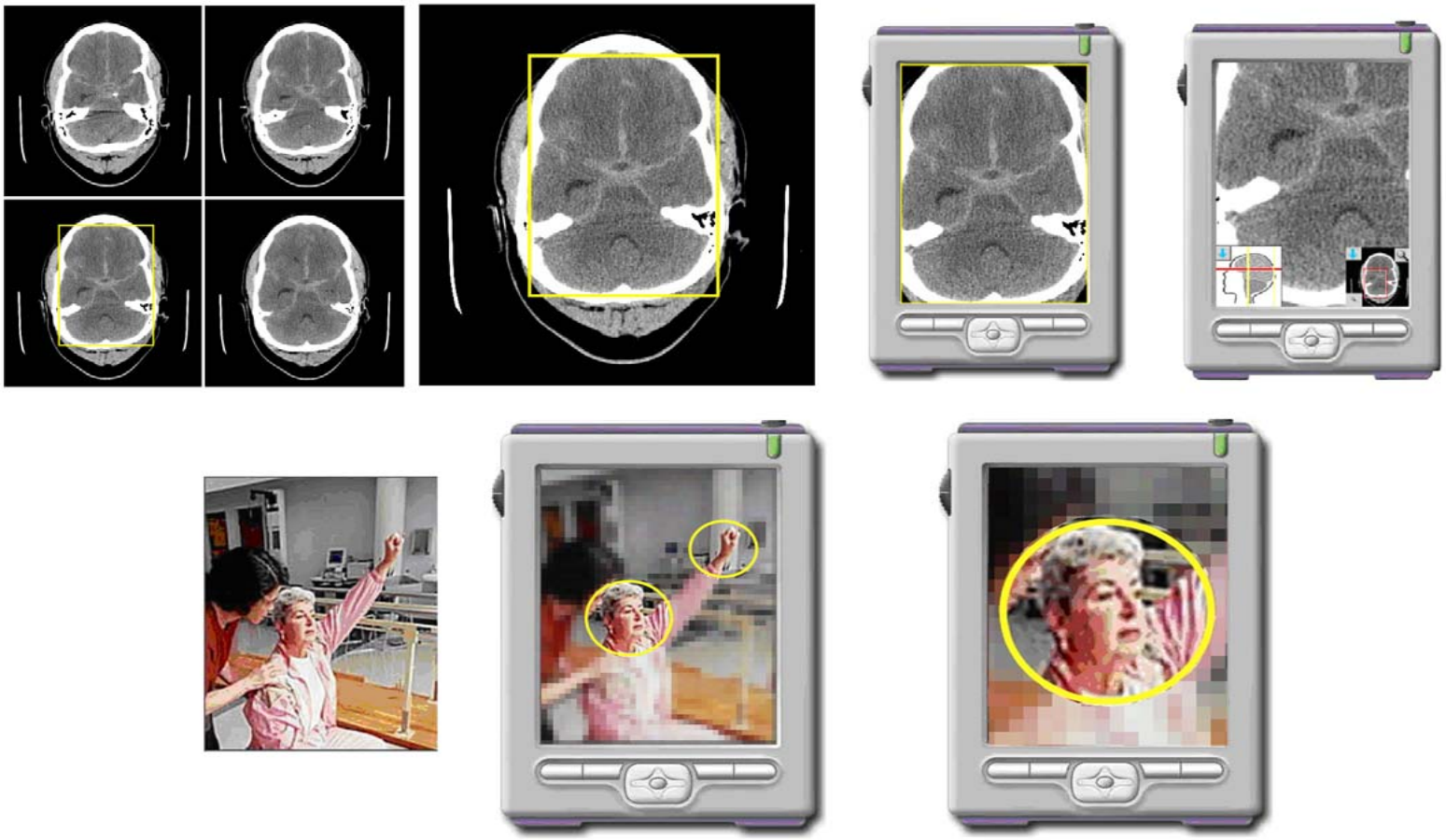
The Content Processing Chain



Managing Content for CAC – Semantic Metadata



Communication with Region-of-Interest



ROI Algorithms for: Lossless Coding Progressive Transmission Electronic Zooming

Integration with VoIP, VUI, TIVO and Array Processing Technologies

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Context-Aware Content Distribution

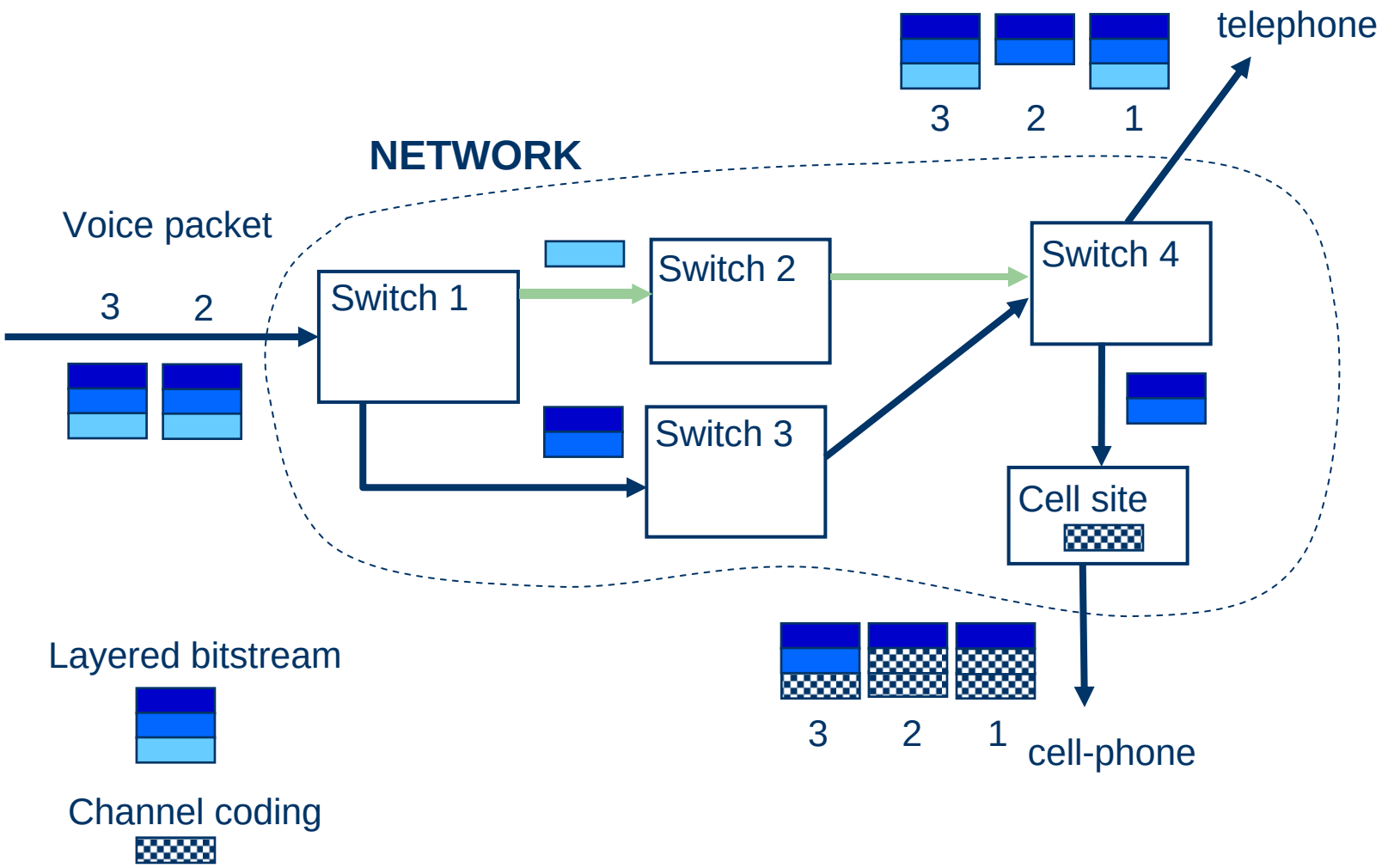
Multimedia Transport Protocol - MMTP

UDP + FEC+ error concealment

UDP+ MMTP + selective retransmission

Over-provisioning / Packet Loss Rate for Perfect Q:
7 for UDP 2 for MMTP [Theoretical Limit is 1]

Embedded and Layered Coding



Information Management & Support Layers

MetaServices

Adaptive and Customized Information Services

Context Management

Context-Aware Convergent Communications

Research Vision

- Imbue **Converging Digital Services** with the attributes and perception of personalization, flexibility, richness and privacy;
- Incorporate **Context**, broadly defined, into the deep fabric of wired and wireless networks for information, transactions and entertainment;
- Harness the capabilities of multimedia processing, **embedded computing and pervasive broadband** for Context-Aware Telecommunications;
- Spawn a new generation of applications of interest to the end user, the communications industry and society, using the exemplary test domains of tele-health, distributed education and entertainment.

Summary

Convergent & Converged Communication Networks need research advances in:

- ***Infrastructure for User-Centric Converged Services***
- ***Context-Aware Media Processing***
- ***Context-Aware Information Management***
- ***The Science and Engineering of Context***