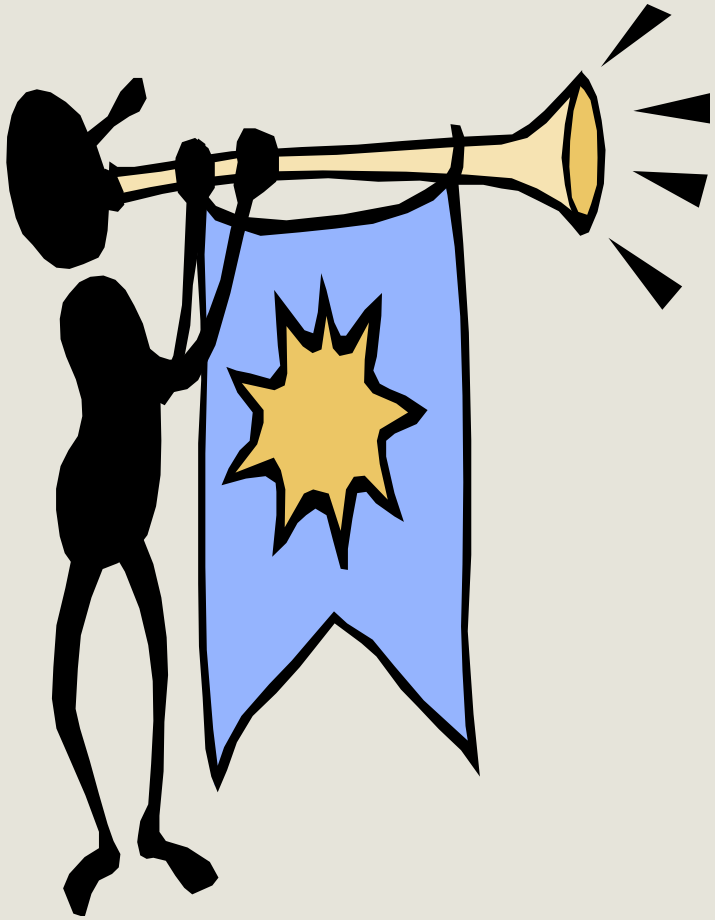
ERICSSON

Intelligent Networks

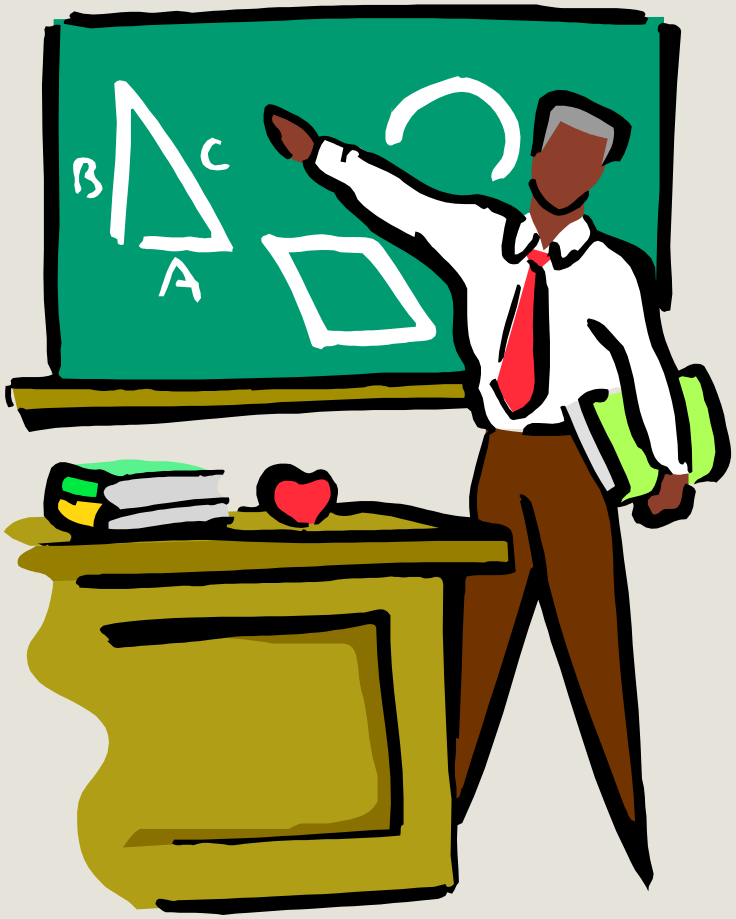
INSE 7110 – Winter 2004
Value Added Services Engineering in Next Generation Networks
Week #1

Outline



1. Essentials of circuit switched telephony
2. Introduction to value added services
3. IN fundamental principles and concepts
4. IN four plane architecture
5. References

Essentials of circuit switched telephony

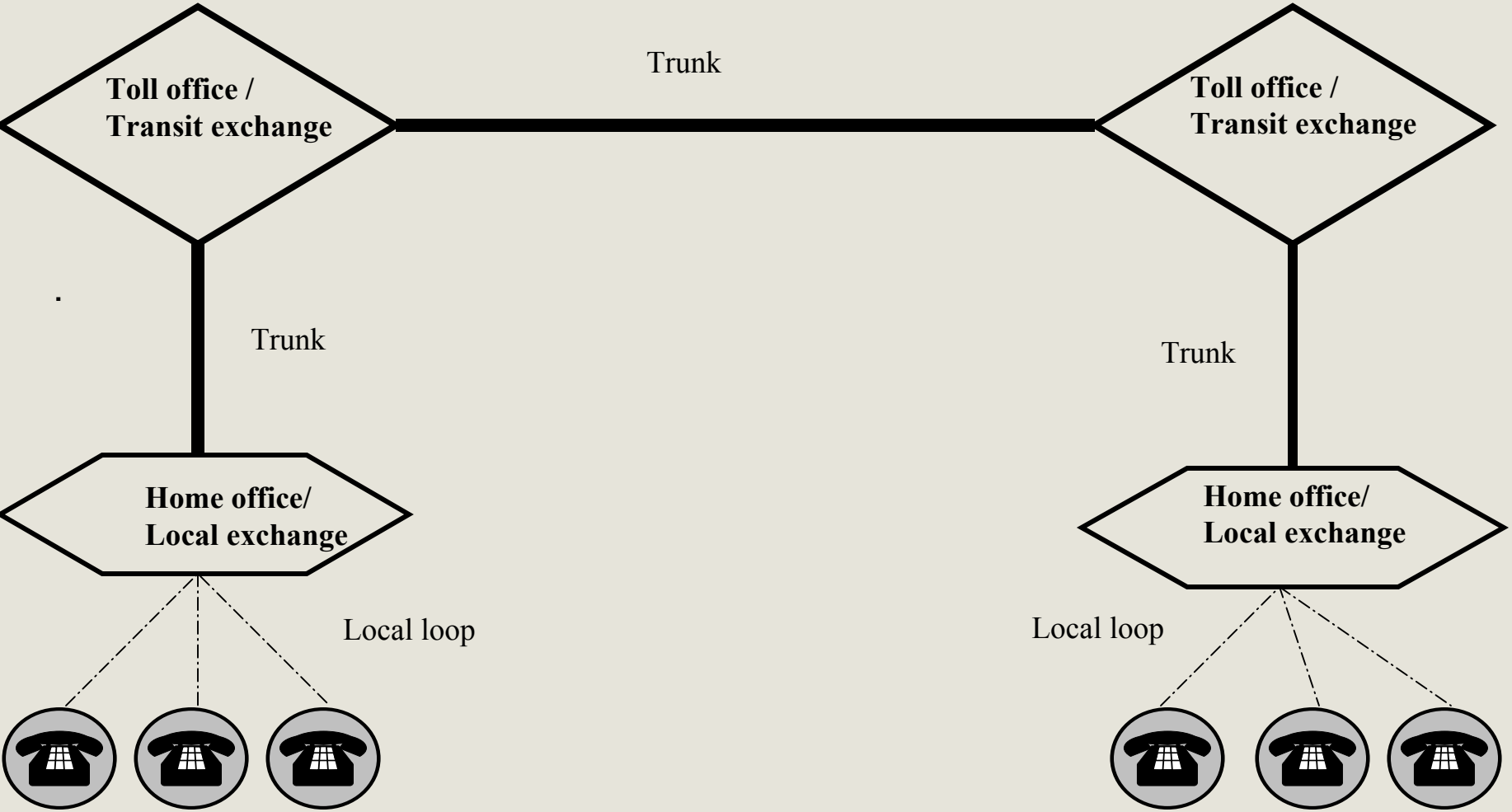


- Circuit switching vs. packet switching
- Local loops, telephone exchanges and trunks
- Signaling
- Beyond fixed telephony

Circuit switching vs. packet switching

Principal Criteria	Circuit switched	Packet switched
Dedicated Physical path	Yes/No	Yes/No
Derived criteria	Circuit switched	Packet switched
Call set up required	Yes/No	Yes/No
Possibility of congestion during communication	Yes/No	Yes/No
Fixed bandwidth available	Yes/No	Yes/No
Non optimal usage of bandwidth	Yes/No	Yes/No

A simplified telephony network …



Signaling ...

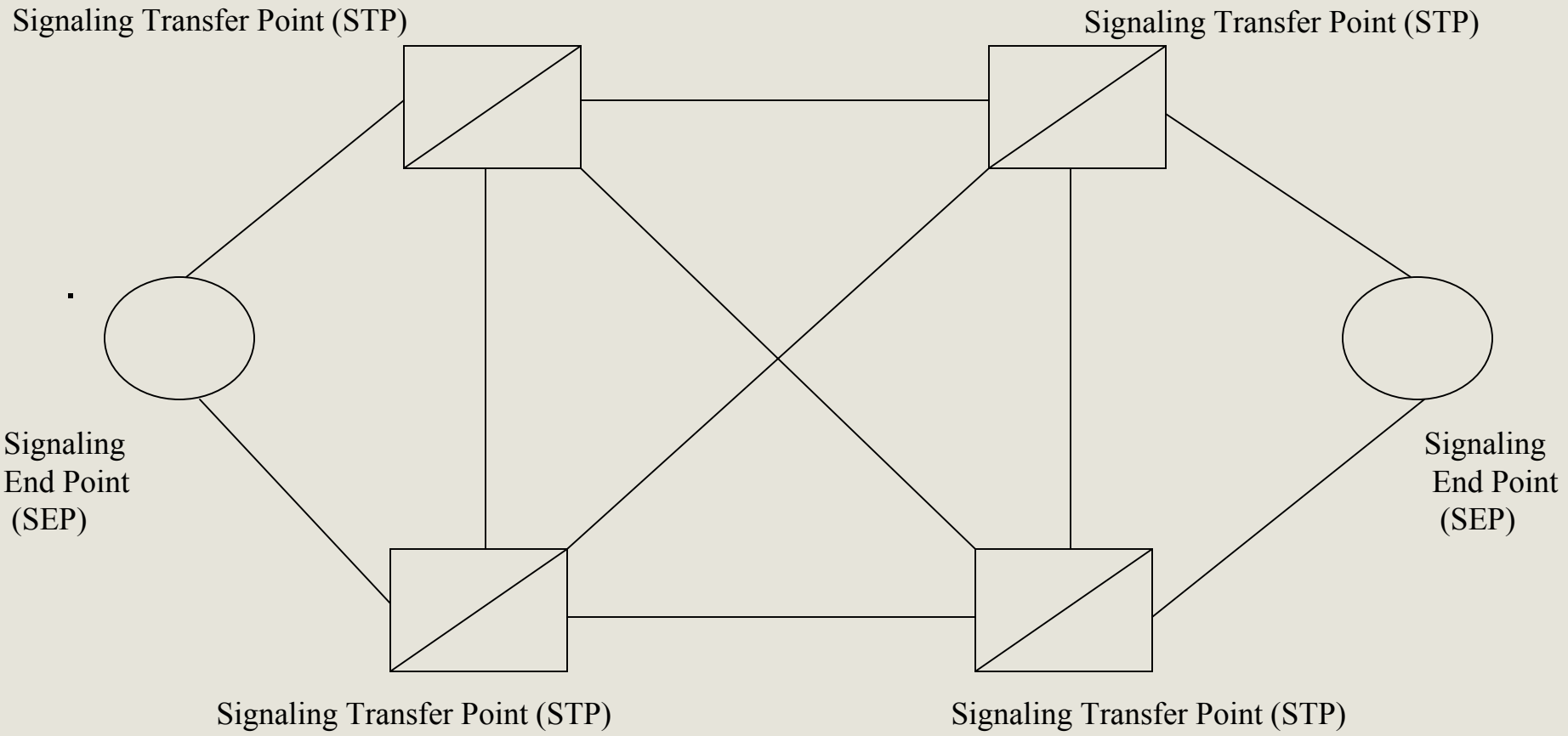
Establishment, modification and tear down of calls

- **User Network Signalling**
  - Between user and home office
  - On/off hook, dial tone …
  - Carried over local loops
- **Network – Network signalling**
  - Between telephone exchanges
  - Initially in-band (Same trunks as voice)
  - Out-band in modern circuit switched telephony
    - Signalling data carried over a separate and overlay packet switched network (Signalling System no7 – SS7)

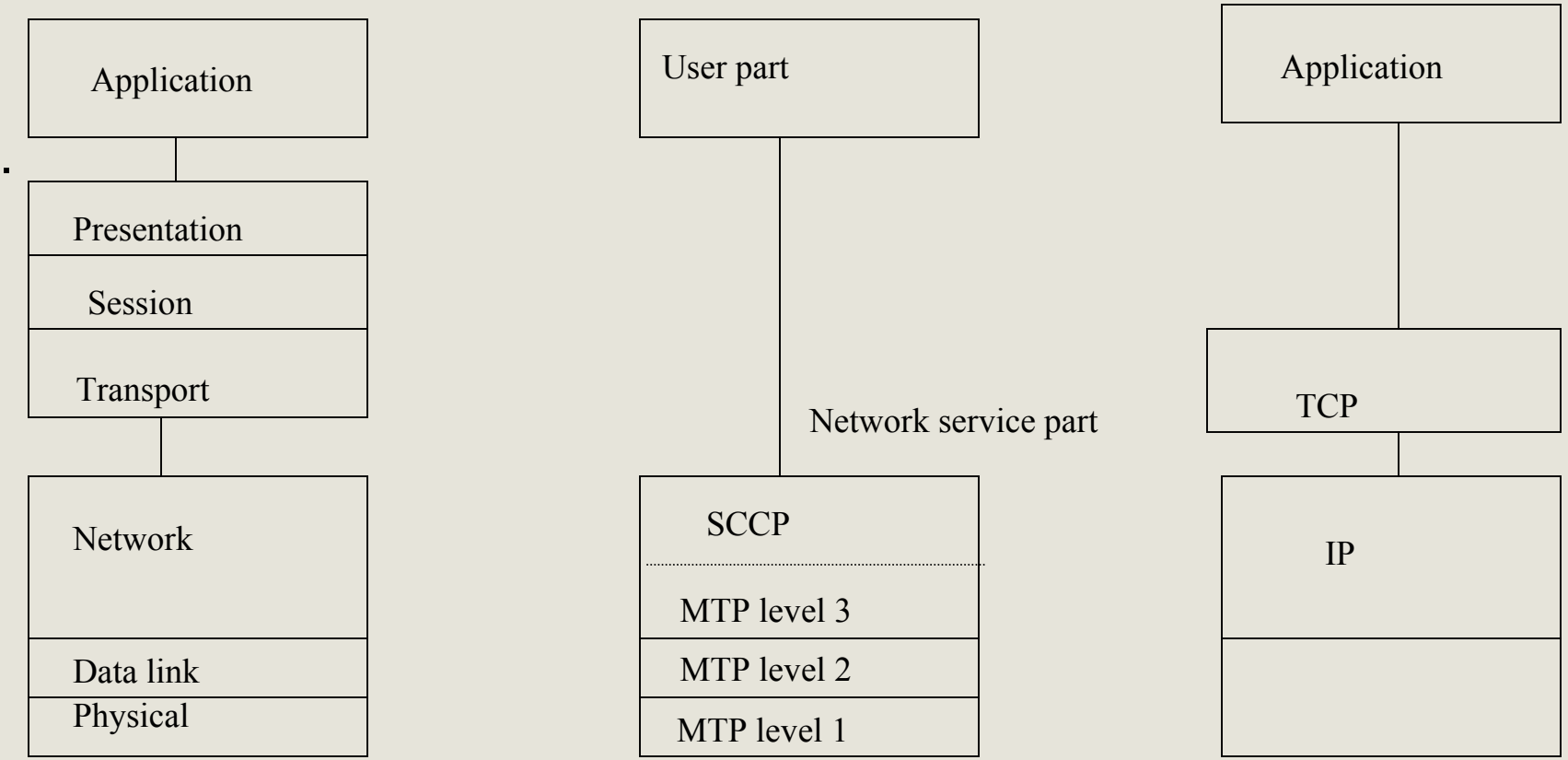
Signaling ...

Criteria	In-band signaling	Out-band Signaling
Potential capacity	More / less	More / less
Potential speed	More/less	More/less
Room for fraud	More/less	More/less
Flexibility (e.g. mid-call signaling)	More / less	More / less

A Simplified SS7 network architecture ...



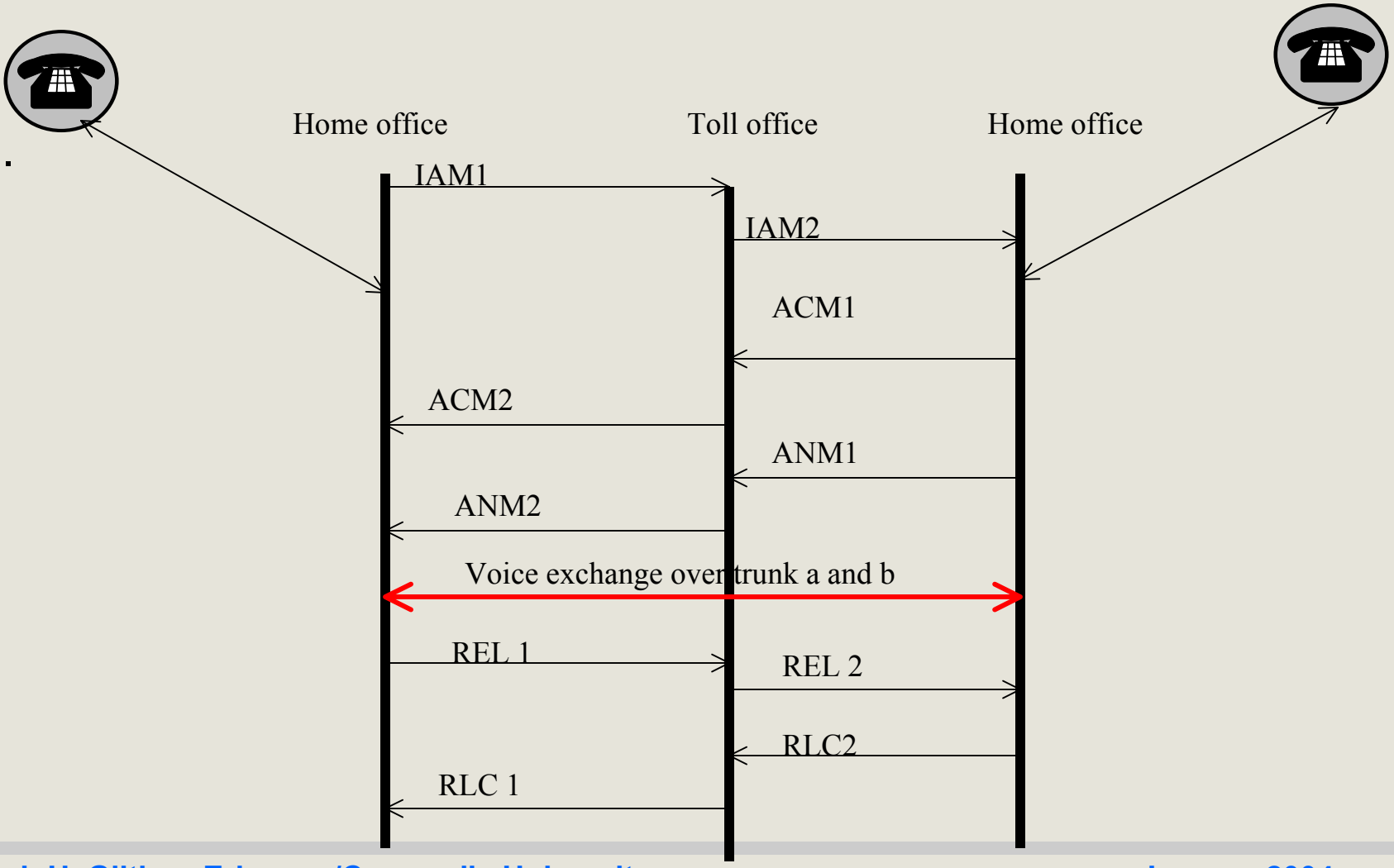
SS7 Protocol stack ...



SS7 Network Service Part ...

- **Message Transfer Part (MTP)**
  - Level 1
    - Physical layer (signalling data layer functions)
    - Bit rates: 56 kbps / 64 kbps
  - Level 2
    - Similar to data network bit oriented protocols (e.g. HDLC)
    - Adaptation to stringent performance requirements (e.g Fill in signalling units when there is no traffic)
    - Error correction, monitoring
    - Flow control
  - Level 3
    - Message handling (e.g. routing, distribution)
    - Signalling network management (e.g. diversion from an unavailable route with loss or duplication)
- Signalling Connection Control Part (SCCP): Add to MTP the possibility of having connection oriented communication

Integrated Service Digital Network (ISDN) - User Part

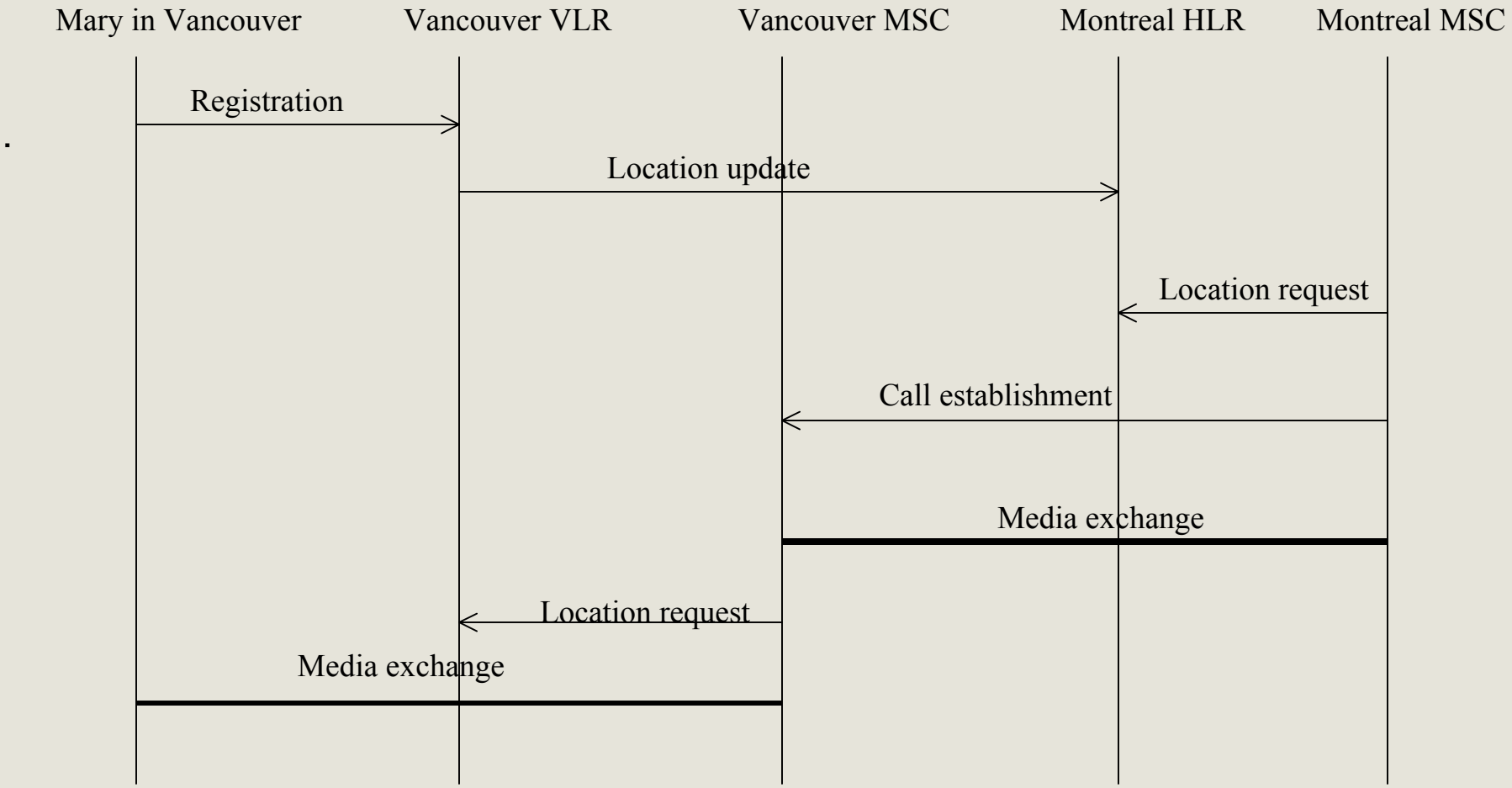


Beyond fixed telephony ...

Cellular telephony

- Mobile Switching Centre
  - Switches used in cellular telephony – Additional features for mobility management
- Home location register (HLR) /Visitor location register (VLR)
  - Keep information on user location
- Base stations
  - Access point to cellular networks
  - Communicate with end user terminals
  - Control cells
- Signalling in cellular networks
  - SS7 based

Mary a Montreal subscriber receives a call while in Vancouver



Beyond fixed telephony ...

First generation cellular networks (70s – 80s)

- Analog systems, circuit switching based
  - Total Access Communications Systems (TACS) – UK
  - Advanced Mobile Phone Systems (AMPS) – USA/Canada
  - Nordic Mobile Telephone System (NMT) – Scandinavia

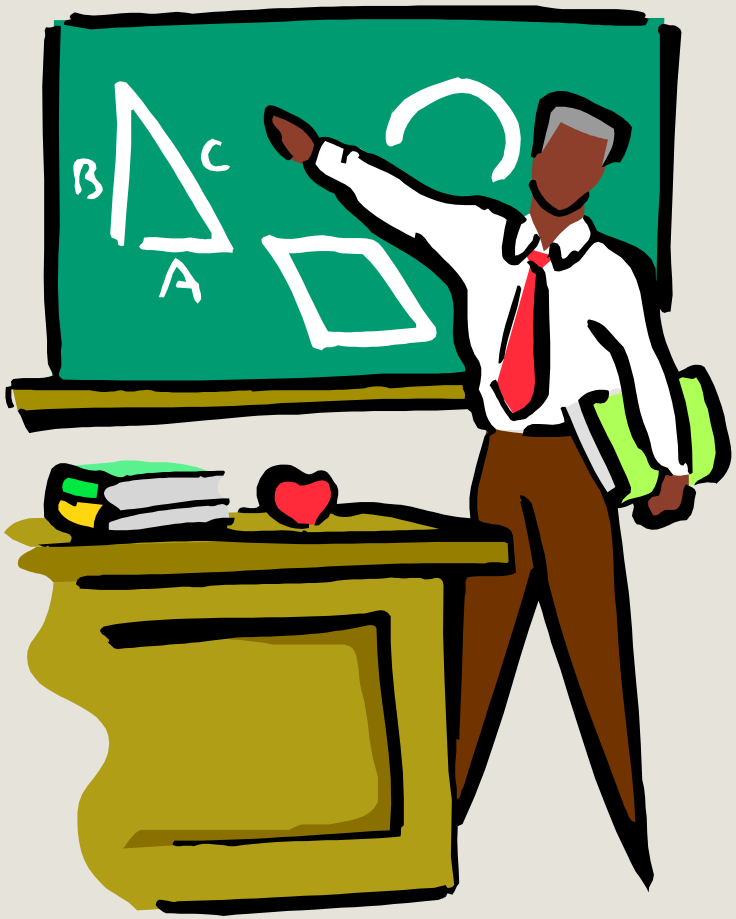
Second Generation (90s – early 00s)

- Digital systems, circuit switching based
  - GSM – Europe mainly – However, gaining ground in North America
  - D-AMPS (Digital version of AMPS)
  - PDC (Japan)

Second Generation (90s – early 00s)

  - Still digital, but more capacity
  - Packet switching based
  - Two main standards
    - UMTS
    - CDMA 2000

Introduction to value added services …



1. Services
2. Life Cycle
2. Service Engineering

Services ...

Basic service offered by circuit switched telephony:
Two party voice call

Value added services

Anything that goes beyond two party voice call

- Telephony services
  - interact will call control
    - » Call diversion
    - » Call screening
- Non Telephony services
  - Web access from a cell phone
    - » Surfing
    - » Email

Service life cycle ...

Four phases

- **Creation (also known as construction)**
  - Specification, design/coding, and testing
- **Deployment**
  - Service logic (or executable) resides on specific node(s) and needs to be deployed there
- **Usage**
  - Subscription/billing, triggering, features interactions
- **Withdrawal**
  - Removal from network

Service Engineering ...

Key issue: How to engineer "cool" services

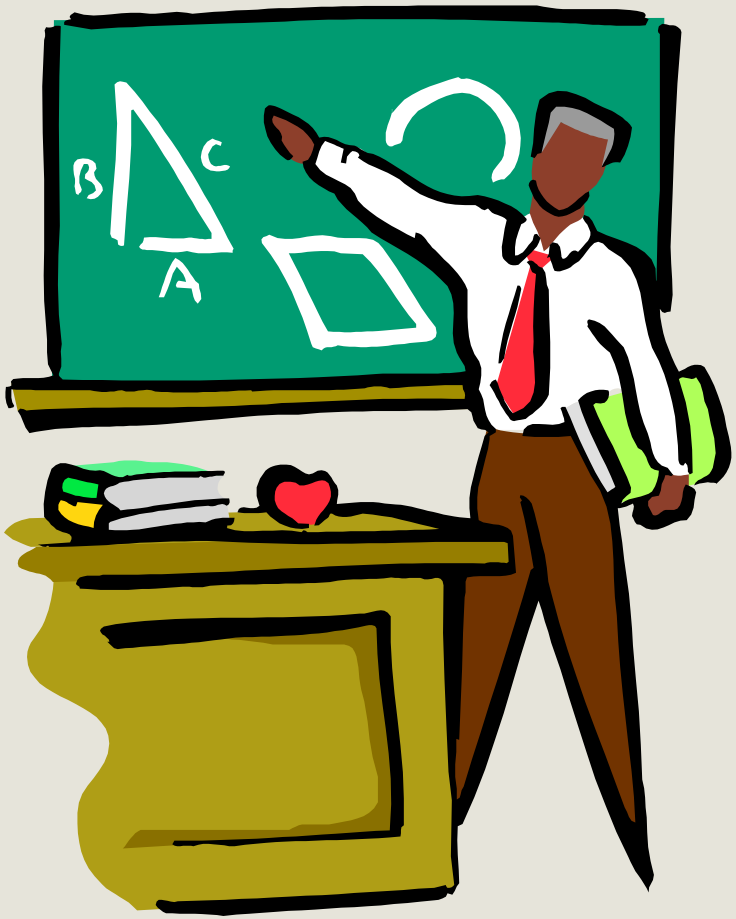
- **In more academic terms**
  - Issues related to the support of all the phases of the life cycle.
    - Creation
    - Deployment
    - Usage
    - Withdrawal
  - These issues are architectural issues
    - Concepts, principles, rules
    - Functional entities, interfaces and algorithms

Service Engineering ...

Why is it an important discipline?

- **Business standpoint**
  - High quality two party voice call is now a commodity
  - Value added services are needed to attract subscribers and generate revenues.
- **Engineering standpoint**
  - It is less than trivial
  - Example: Service creation
    - Secure and selective access to network resources is required
    - Related issues: Level of abstraction, security framework, service creation tools …etc.

IN Fundamental concepts and principles



1. Introduction
2. The 2 principles
3. Concepts

Introduction …

The pre-IN era

- Service logic embedded in switching software

IN

- Has emerged in the ITU-T based on work done at Telcordia (alias Bellcore), in the late 80s
- Basis for:
  - AIN (North America - fixed network)
  - Wireless Intelligent Networks (WIN) - (D-AMPS - wireless network)
  - Customized Application Mobile Enhanced Logic (GSM - wireless network)

IN: Fundamental Principles

1. **Separation of switching software and service logic**
   - Main implication: Need for an interaction model between switching and service
     - Functional entities / nodes
     - Protocols

2. **Standardization of capabilities for building services**
   - Main implication: Need for “components” that can be used in various ways for building services

IN: Fundamental Concepts

Call model

Phases for setting up and tearing down calls

- **IN call model or basic call process: call model with the possibility to invoke service**
  - » **Point of invocation**
  - » **Point of return**

Service independent building blocks (SIB)

Components used to build services

- Have a logical start and one or more logical ends
- Are chained to build services

Capabilities set

- A set of potential services
- A given call model
- A set of SIBs
- A set of functional entities
- A protocol

IN: A Brief History of Capability Sets

Capability set 1 (CS1) - 1992

- Most widely deployed
- Developed in the context of state monopoly fixed networks operators
  - Little/no support for internetworking and mobility
- Focus on two party call call related services (e.g. call forward, call screening)
  - No support for multiparty, multimedia
- Used in the rest of this course to illustrate IN

Capability set 2 (CS2) - 1997

- Much less deployed
- Developed in the context of deregulation and mobile telephony
- Much more complex than CS1. E.g.
  - Call party handling for conferencing (e.g. call leg, connection point)
  - Call unrelated functions

IN: A Brief History of Capability Sets

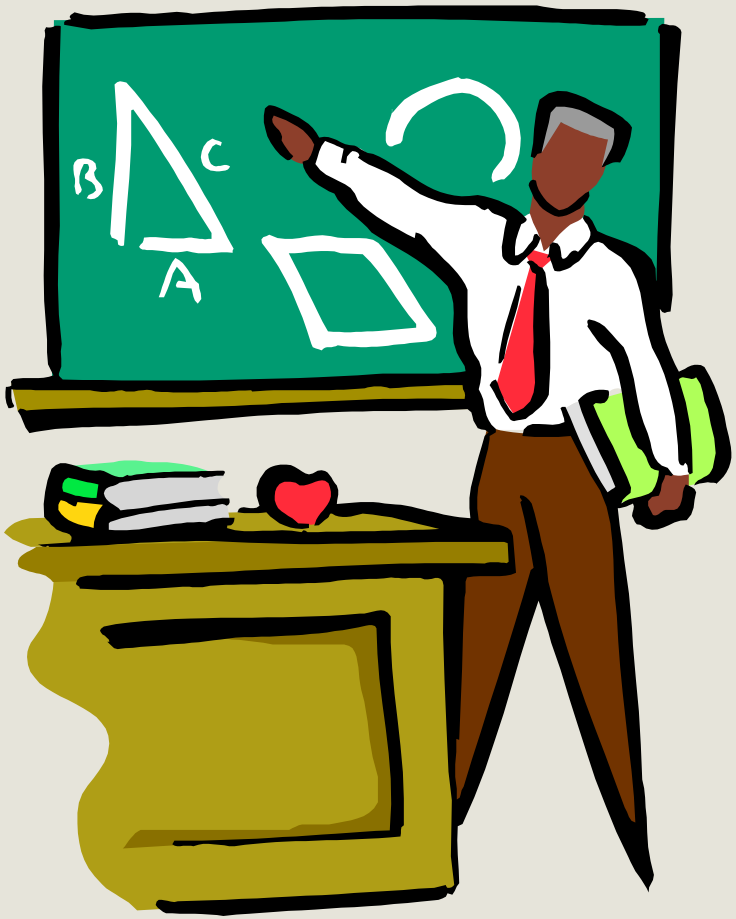
Capability set 3 (CS3) - 1999

- No known commercial deployment
- Attempt to correct the numerous mistakes / ambiguities in CS2
- A few new features: number portability

Capability set 4 (CS4) – 2001 (The end of the road)

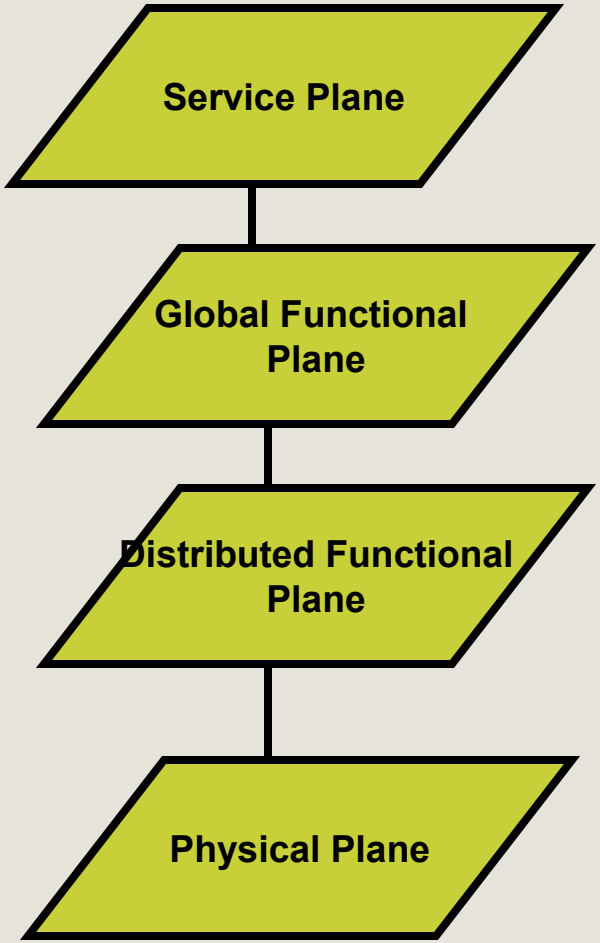
- No known commercial deployment
- Very high level of ambition
  - Object oriented components
  - Videoconferences
  - And much more
- Too little in terms of output
- Emergence of alternatives (e.g. Parlay, JAIN)

IN Four Plane Architecture …



1. Service plane
2. Global functional plane
3. Distributed functional plane
4. Physical plane

IN: A four planes conceptual architecture



Services as seen by end-users

Functionality required to build the services (e.g. Service independent building blocks)

Functional entities that make the IN network

Physical nodes

IN: Service Plane

Services as seen by end-users are made of features and features are specified in groups

Examples of CS1 Feature groups

- Charging
  - Split, reverse
- Routing
  - Call forward
- Restriction
  - Originating call screen, terminating call screening
- Numbering
  - One number, abbreviated dialling, private numbering plan
- User interactions
  - Originating user prompting, destination user prompting
- Other features
  - Call transfer, call hold

IN: Service Plane

Examples of services made of specific features

Free phone

- One number (800 in North America) feature
- Reverse charging feature

Calling card

- Charging feature
- Originating user prompting

IN: Global Functional Plane

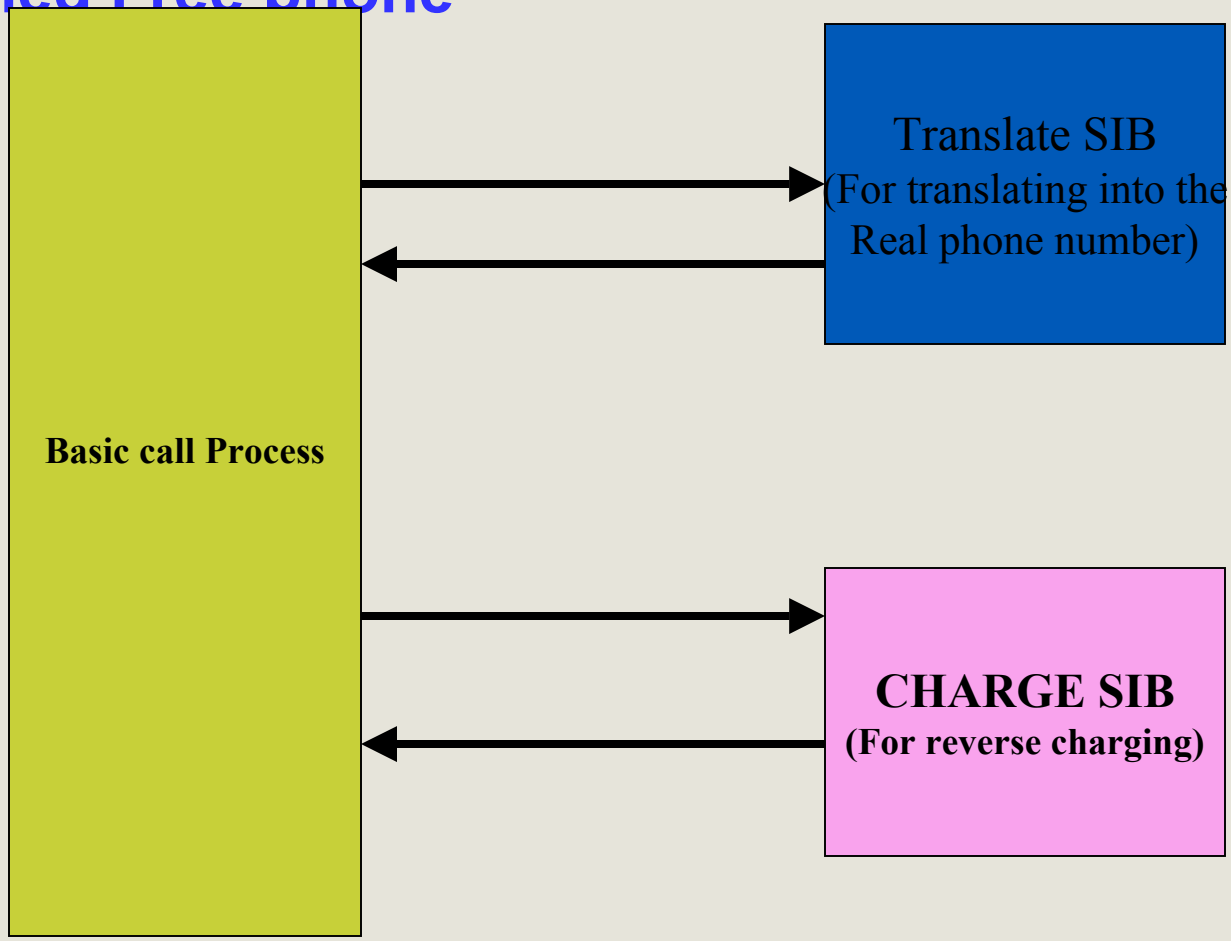
Components (I.e. SIBs) used to build the services

Examples of SIBs from CS-1

- Basic call process
  - Basic SIB
    - Point of invocation
    - Point of return
  - Passes the call data (e.g. caller / callee) to the first SIB in the chain)
- Screen
- Charge
- Compare
- Translate
- Service data management

IN: Global Functional Plane

…Simplified Free phone



IN: Distributed Functional Plane ...

The functional entities

- Service Control Function (SCF): the entity that contains the service logic

Usually implemented as a separate node - The Service Control Point (SCP)

- Service Switching Function (SSF): the entity that implements the call model – Enables the switching between “switching software and service logic)
- Call Control Function (CCF): the entity that contains the switching software - Knows at any given time the call state (e.g. busy, ringing)

SSF and CCF are usually implemented in a separate node – The Service Switching Point (SSP)

- Service data point (SDP): data base that keeps service data such as number translation tables

Usually integrated with SCP

- Service management function (SMF): subscriber management and service management
- (SRF): Functions such as announcement playing, conference bridging

IN: Physical Plane ...

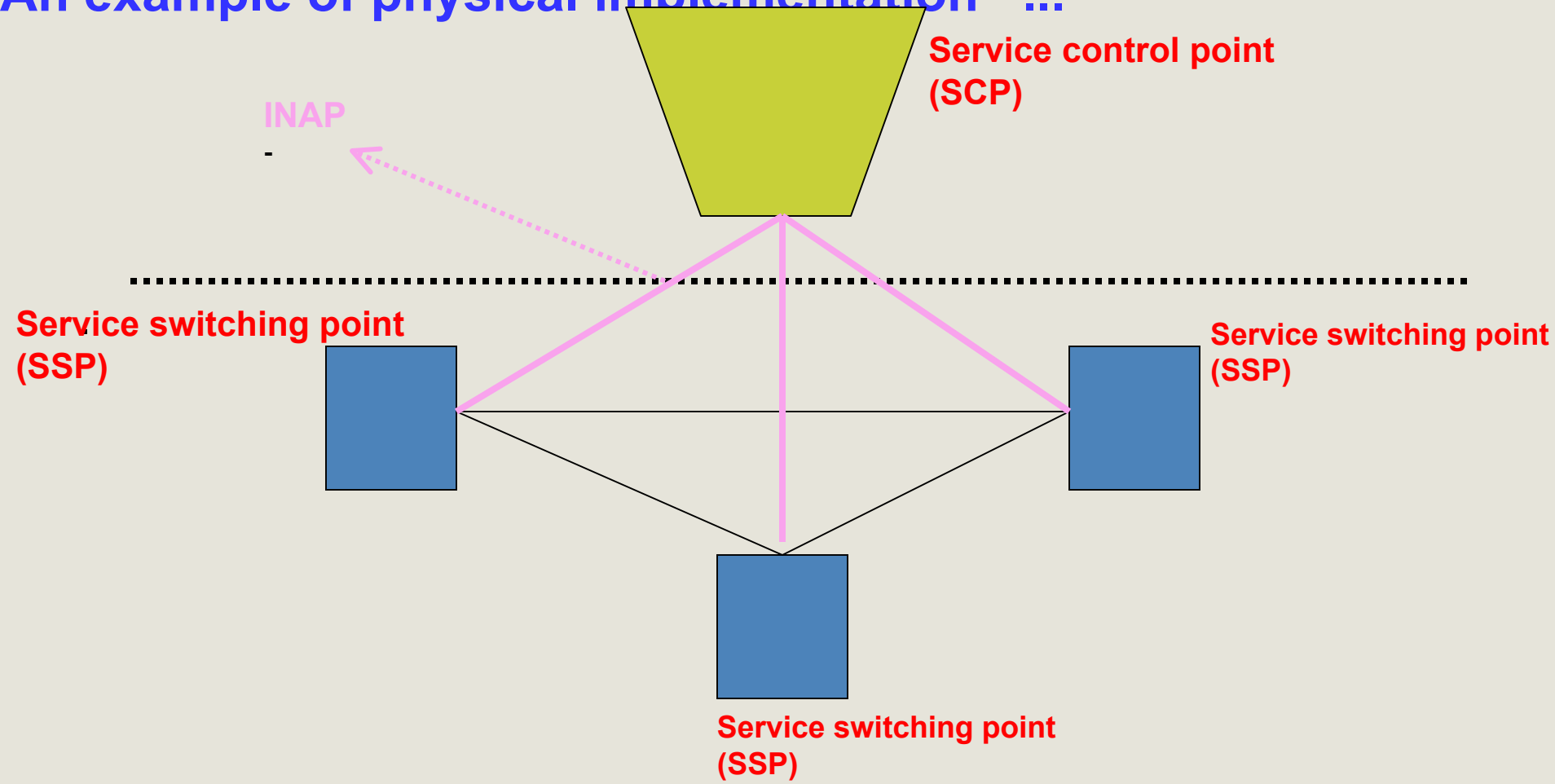
Functional entities can be grouped in nodes as manufacturers wish

The Intelligent Network Application Protocol (INAP) is used for communications between nodes.

- Request / Reply application level protocol
- Messages transported over SS7
- SS7
  - Overlay packet switched networks
  - Used for outband signalling
  - Made of
    - Message transport part
    - Application part

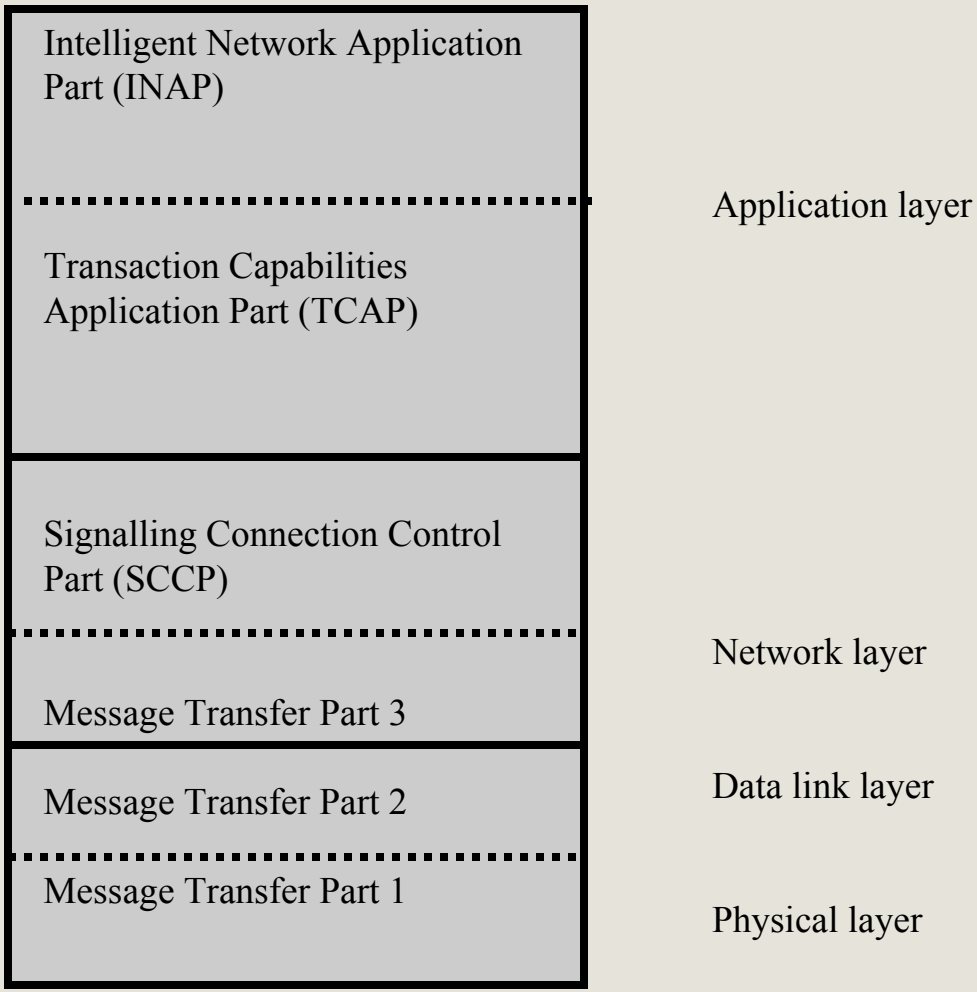
IN: Physical plane

An example of physical implementation ...



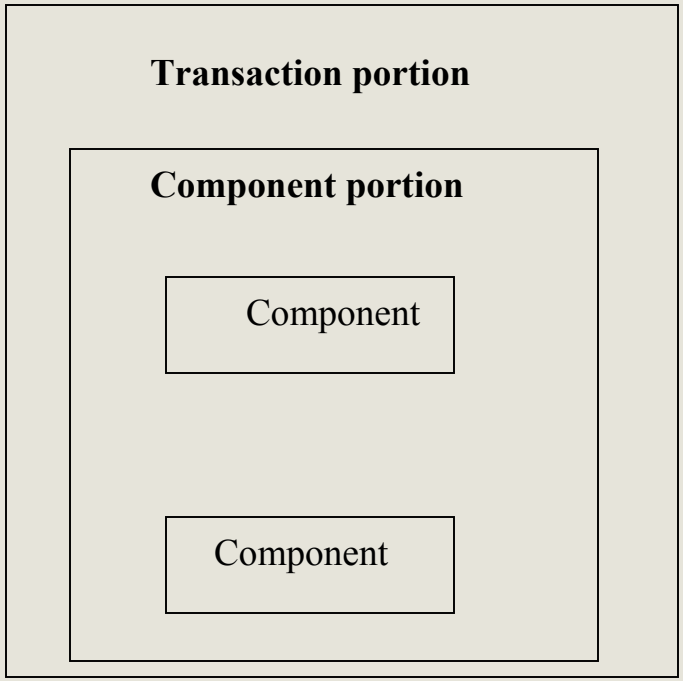
IN: Physical Plane ...

INAP protocol stack



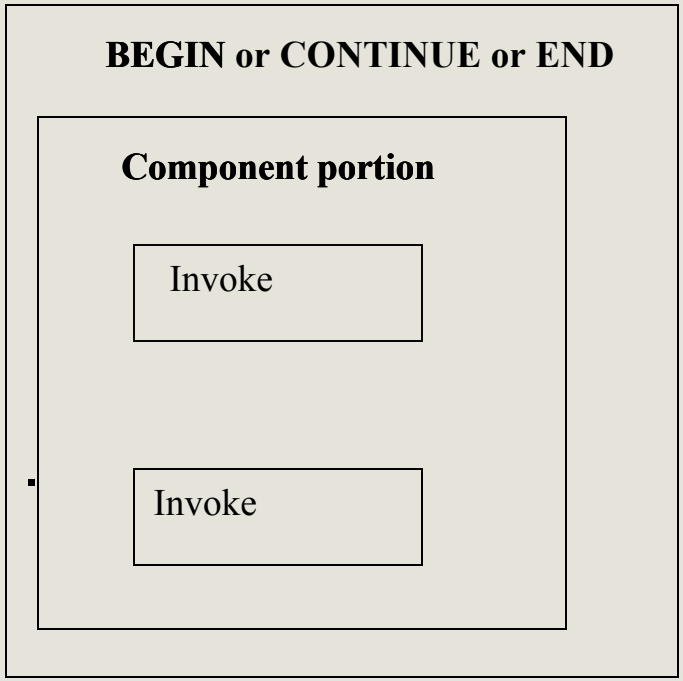
IN: Physical Plane ...

Transaction Capabilities Application Part – Message structure

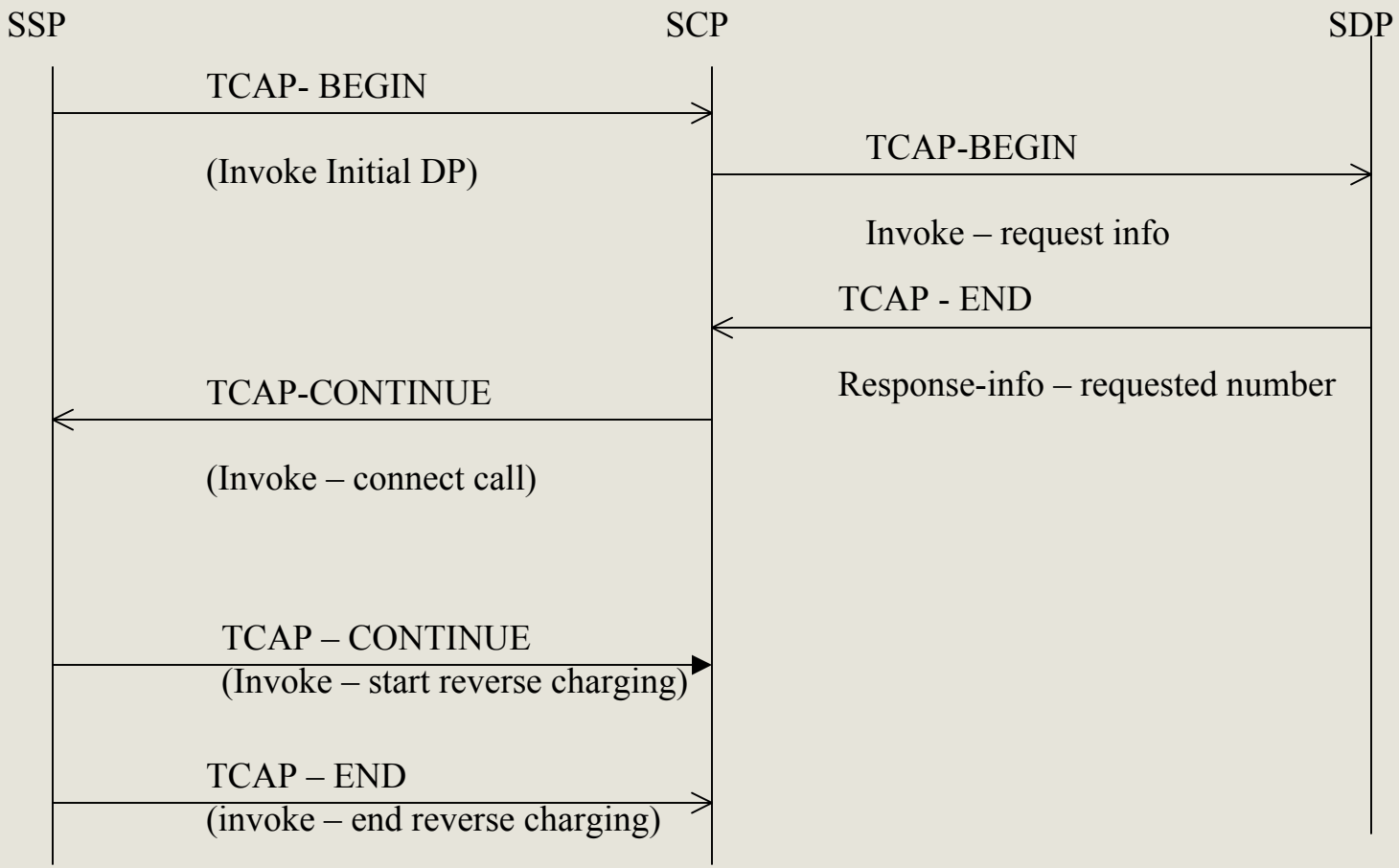


IN: Physical Plane ...

Transaction Capabilities Application Part Message



IN: Physical plane - INAP/TCAP for free phone



IN: Retrospective ...

A revolutionary concept

- Separation between service logic and switching software
- Standardisation of service capabilities instead of services

With mixed results

- Reasonable installed basis, but
- Lack of openness
  - Standardised building blocks (e.g. SIBs) did not open telecommunication networks to third parties
    - Components are not interfaces
    - Too many “proprietary” SIBs
- Service creation and deployment remain relatively slow
    - Immaturity of methodologies and tools
    - New service logic in SCPs often required “adjustments” to call model in SSP

References ...

1. J. Zuidweg, Next Generation Intelligent Networks, Artech House 2002 (Chapter 2 – Intellligent Networks)
2. A. R. Moderassi and R. Skoog, Signaling System No7: A Tutorial, IEEE Communications Magazine, July 1990, available at:http://www.comsoc.org/livepubs/surveys/public/4q98issue/reprint4q.html
3. A. Tanembaum, Computer Networks, 4th edition, Prentice Hall 2003 (Chapter 2.5 – The public switched telephone system network)