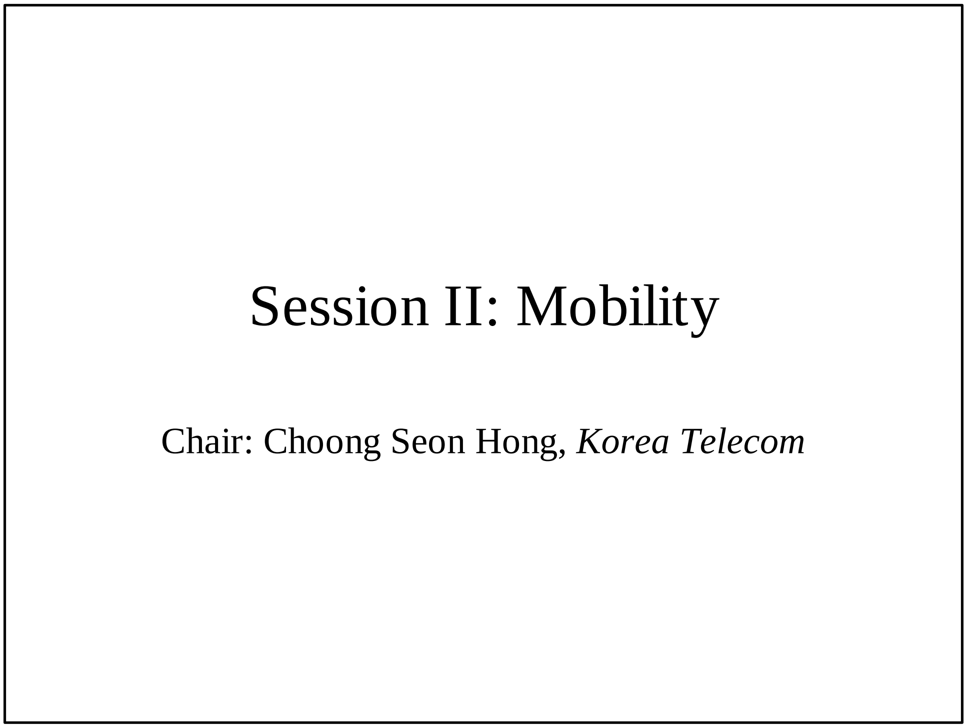


Session II: Mobility

Chair: Choong Seon Hong, *Korea Telecom*

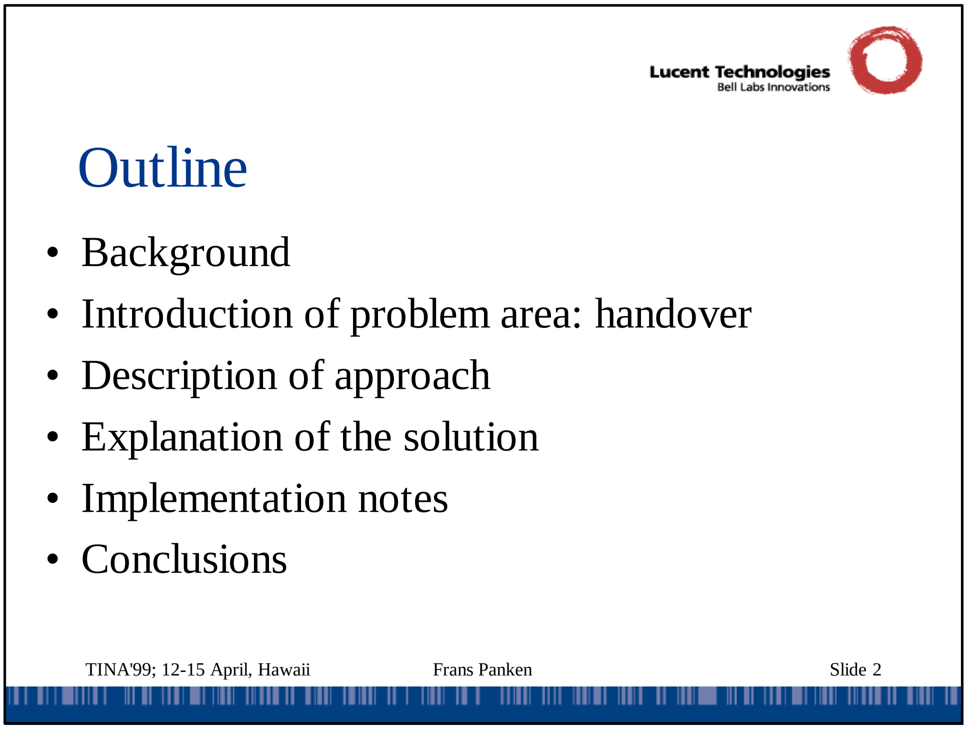
TINA architecture extensions to support terminal mobility

Frans Panken: Lucent Technologies

Spyros Batistatos, Kostas Zygourakis: Intracom

Kimmo Raatikainen : University of Helsinki

Sebastiano Trigila : Fondazione Ugo Bordoni



Outline

- Background
- Introduction of problem area: handover
- Description of approach
- Explanation of the solution
- Implementation notes
- Conclusions

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Background: ACTS project DOLMEN

Develop, validate and promote a service architecture applicable to fixed and mobile, heterogeneous and multi-provider, telecommunications networks

1. By extending TINA models and definitions
2. By implementing a service machine
3. By exercising the service machine

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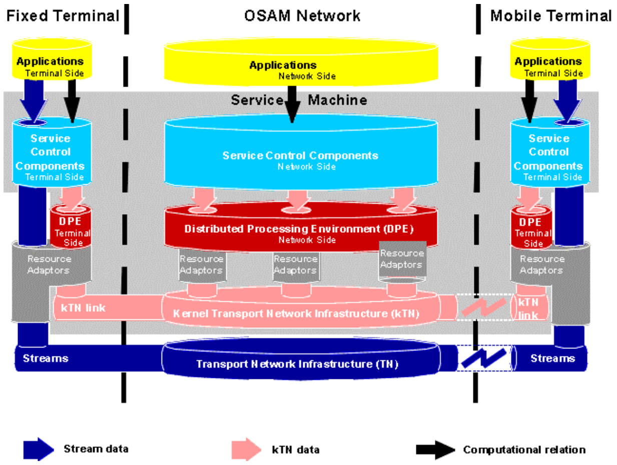
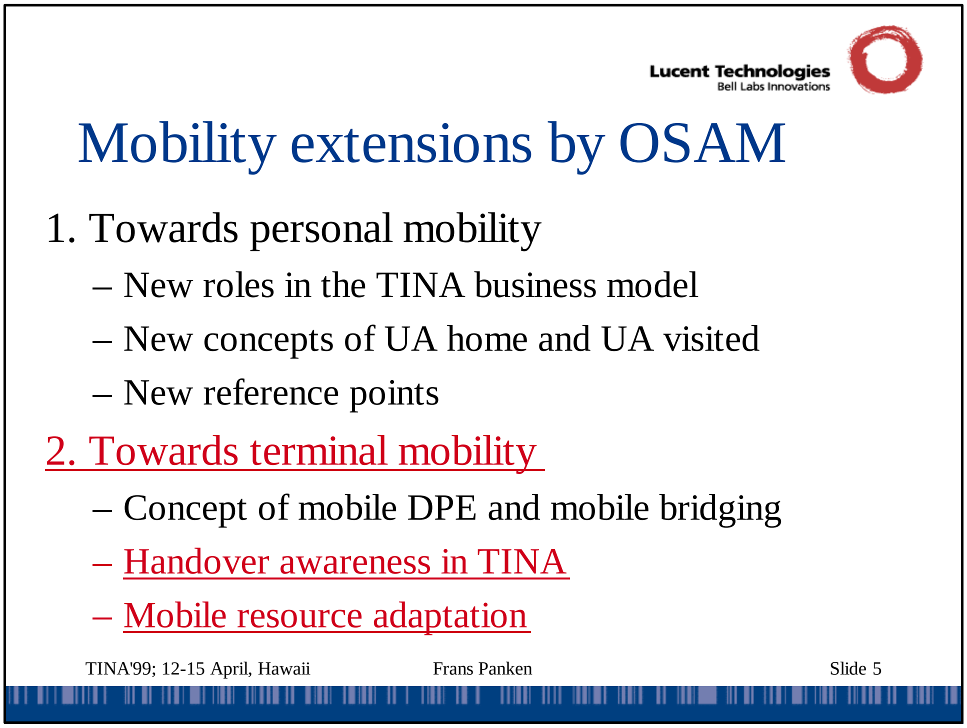
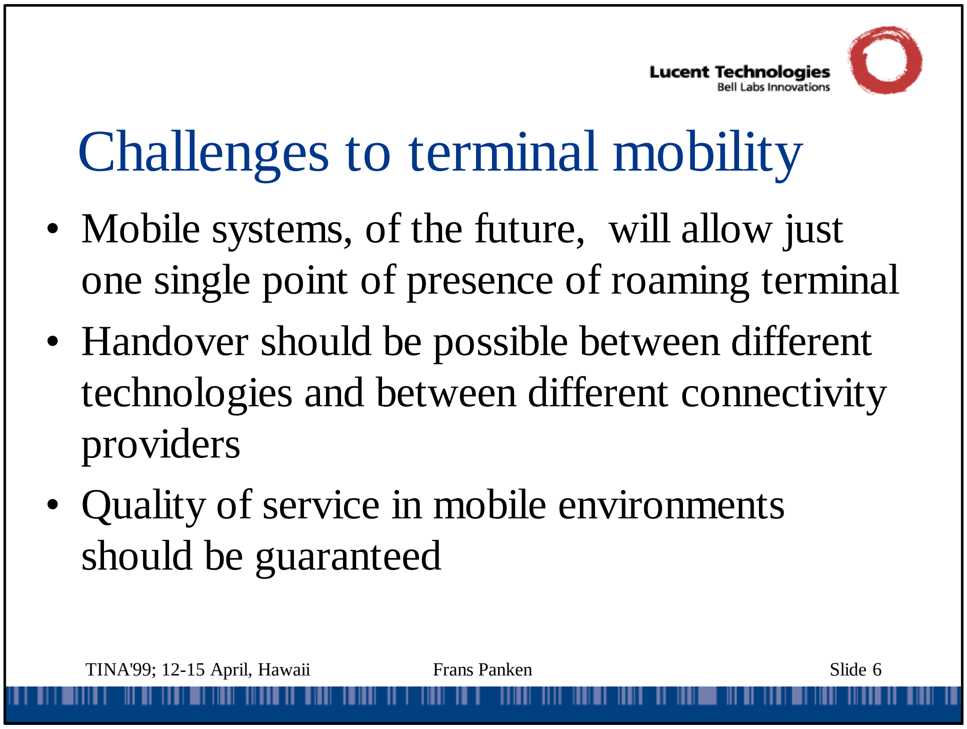
TINA + Mobility Extensions = OSAM


Fixed Terminal
OSAM Network
Mobile Terminal
Applications Terminal Side
Applications Network Side
Applications Terminal Side
Service Machine
Service Control Components Terminal Side
Service Control Components Network Side
Service Control Components Terminal Side
DPE Terminal Side
Distributed Processing Environment (DPE) Network Side
DPE Terminal Side
Resource Adaptors
Resource Adaptors
Resource Adaptors
Resource Adaptors
Resource Adaptors
kTN link
Kernel Transport Network Infrastructure (kTN)
kTN link
Streams
Transport Network Infrastructure (TN)
Streams
Stream data
kTN data
Computational relation



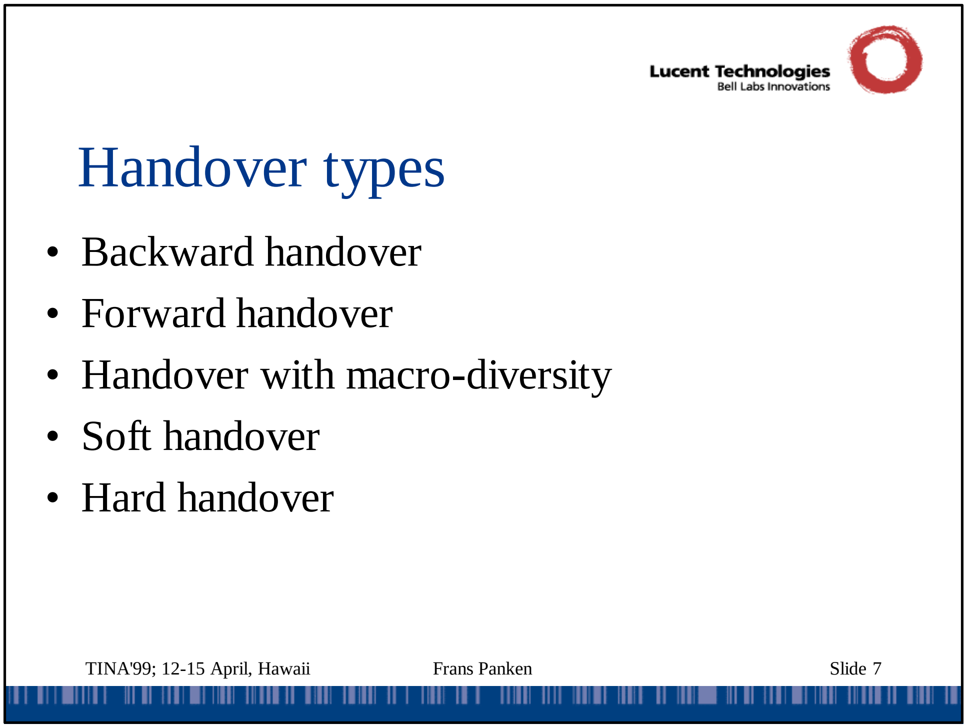
Mobility extensions by OSAM

1. Towards personal mobility
   - New roles in the TINA business model
   - New concepts of UA home and UA visited
   - New reference points
2. Towards terminal mobility
   - Concept of mobile DPE and mobile bridging
   - Handover awareness in TINA
   - Mobile resource adaptation



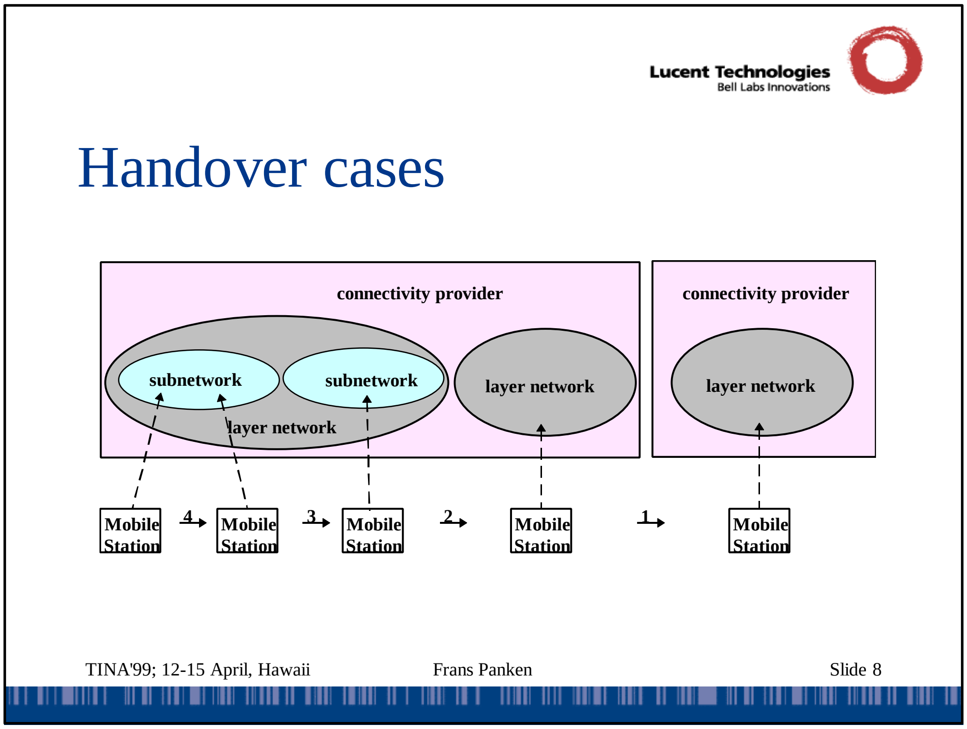
Challenges to terminal mobility

- Mobile systems, of the future, will allow just one single point of presence of roaming terminal
- Handover should be possible between different technologies and between different connectivity providers
- Quality of service in mobile environments should be guaranteed

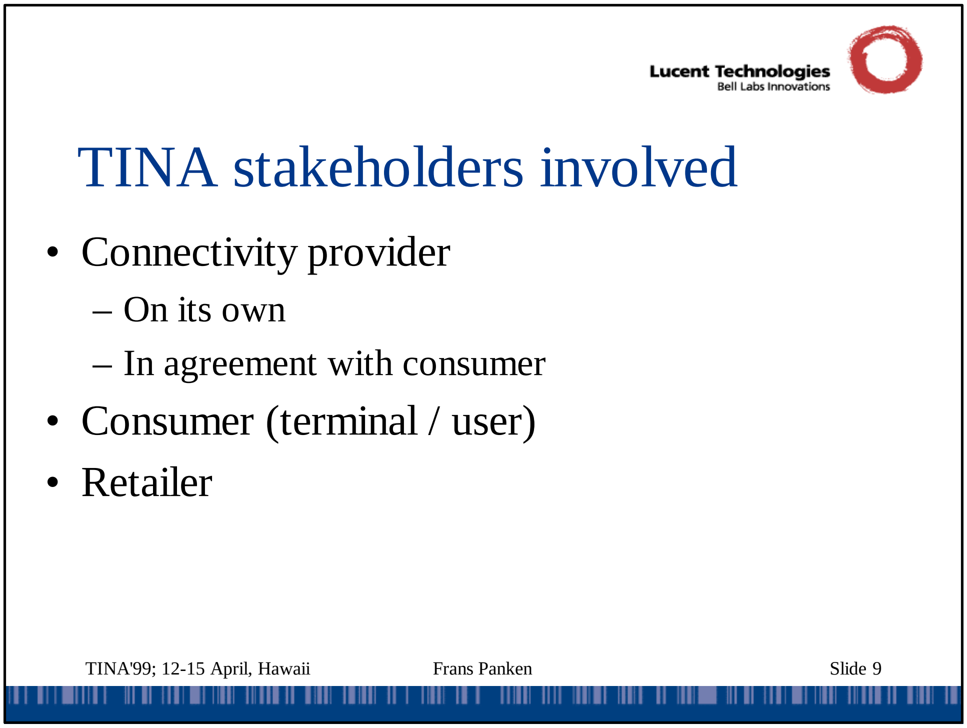


Handover types

- Backward handover
- Forward handover
- Handover with macro-diversity
- Soft handover
- Hard handover



Handover cases



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TINA stakeholders involved

- Connectivity provider
  - On its own
  - In agreement with consumer
- Consumer (terminal / user)
- Retailer

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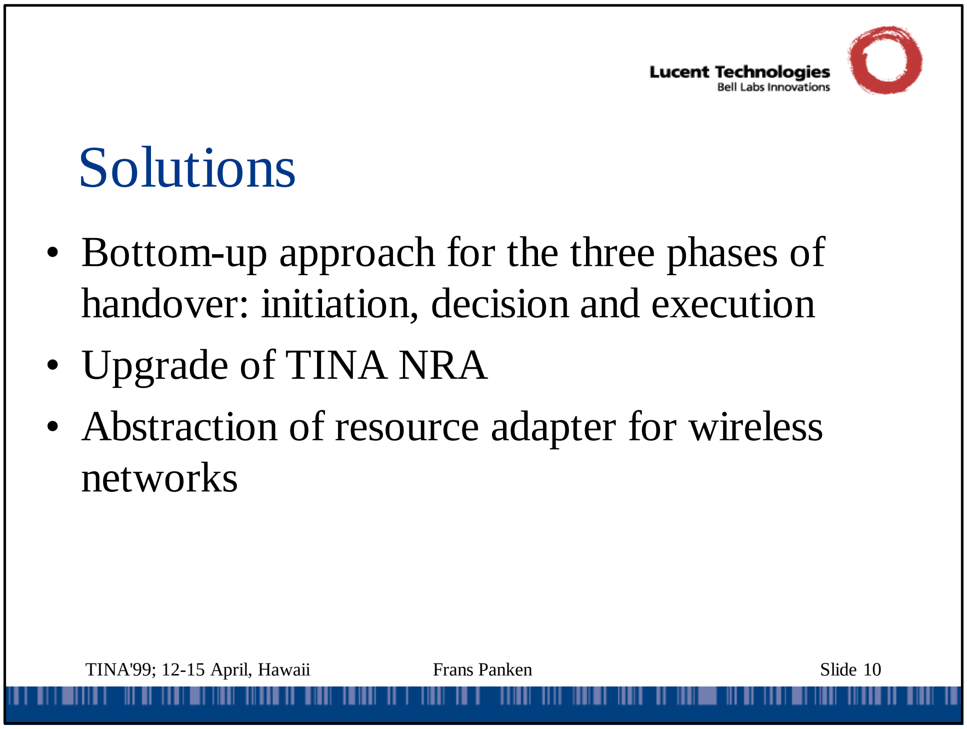

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Solutions

- Bottom-up approach for the three phases of handover: initiation, decision and execution
- Upgrade of TINA NRA
- Abstraction of resource adapter for wireless networks

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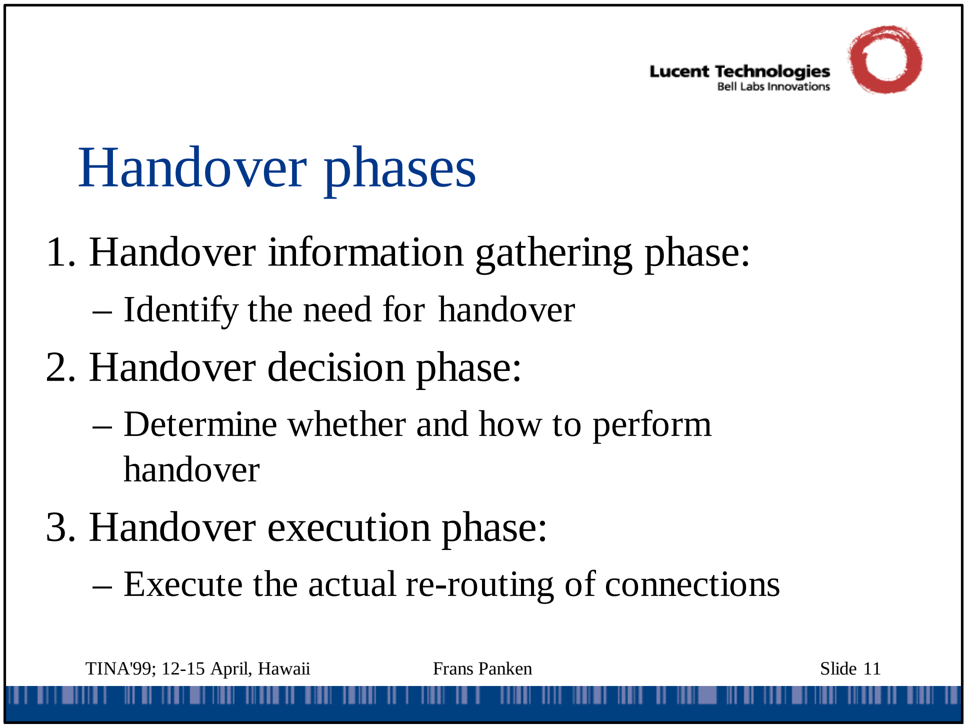
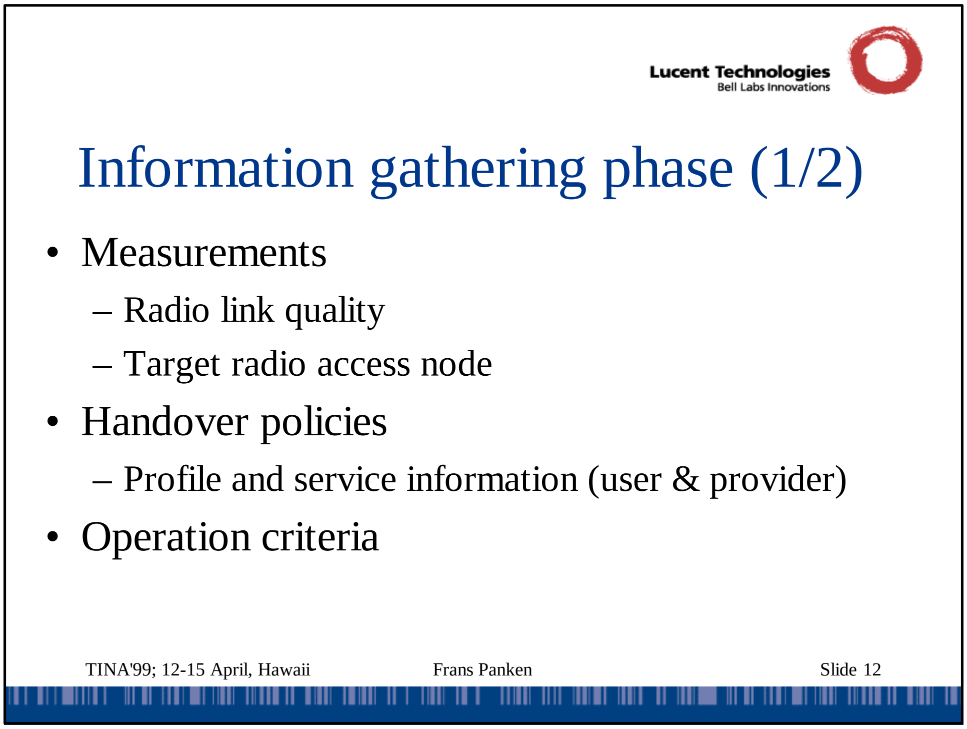


Handover phases

1. Handover information gathering phase:
   - Identify the need for handover
2. Handover decision phase:
   - Determine whether and how to perform handover
3. Handover execution phase:
   - Execute the actual re-routing of connections



Information gathering phase (1/2)

- Measurements
  - Radio link quality
  - Target radio access node
- Handover policies
  - Profile and service information (user & provider)
- Operation criteria

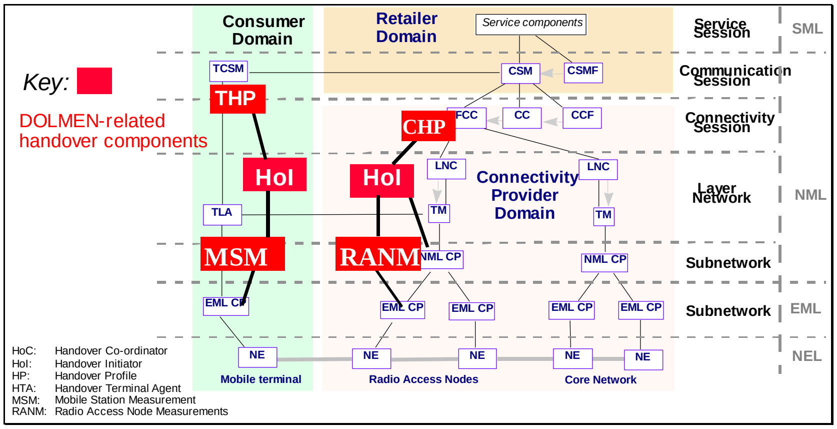
Information gathering phase (2/2)

Extending TINA’s computational model

- Measurements:
  - – Mobile station Measurements (MSM)
  - – Radio Access Node Measurement (RANM)
- Handover policies:
  - – User handover profile (UHP), Terminal Handover Profile (THP)
  - – Connectivity Provider Handover Profile (CPHP)
- Handover Initiator (HoI)

Computational model

Handover information gathering phase



Key: 🟥

DOLMEN-related handover components

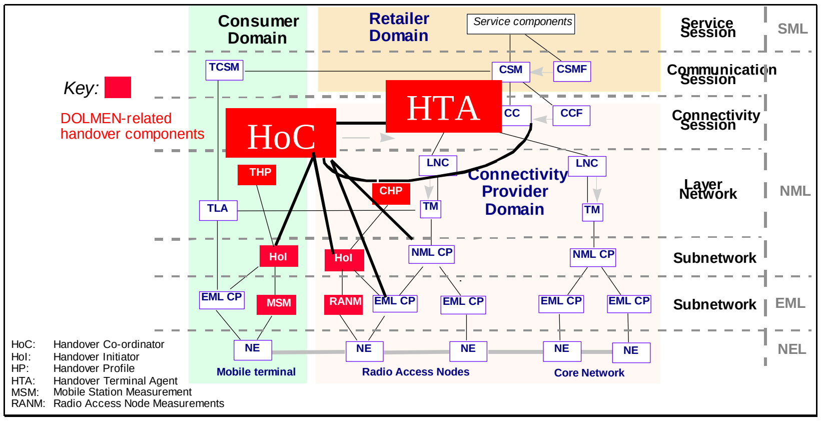
HoC: Handover Co-ordinator
HoI: Handover Initiator
HP: Handover Profile
HTA: Handover Terminal Agent
MSM: Mobile Station Measurement
RANM: Radio Access Node Measurements

Handover decision phase

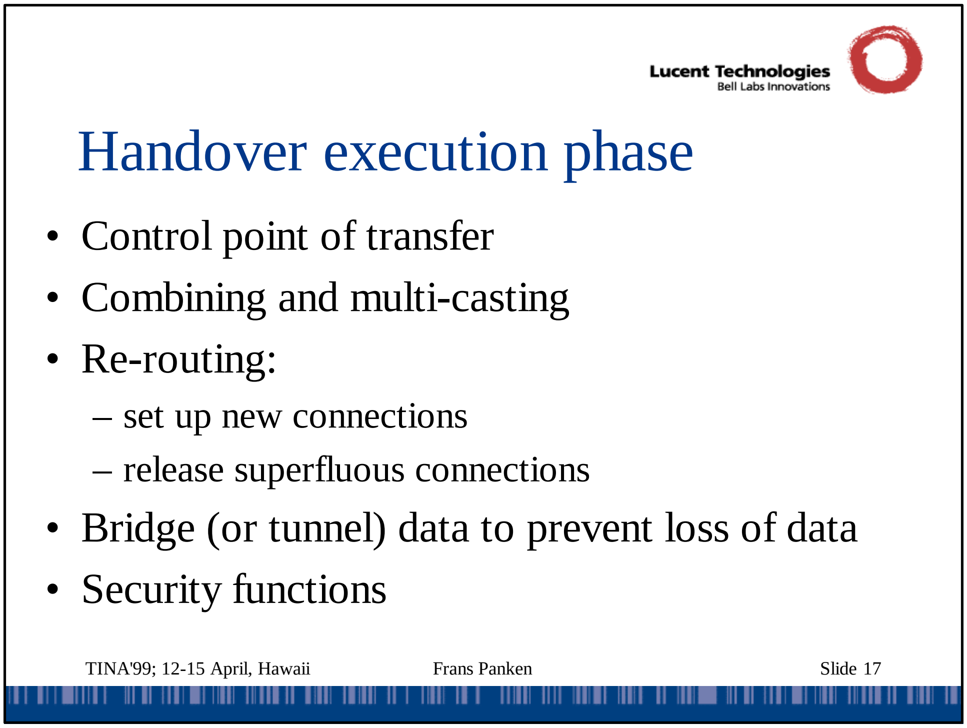
- Discover reason for handover
- Possible conflicts network / terminal
- Find the network control point
- Determine handover type
- Consider constraints on handover completion time
- Determine layer network limitations
- NRA extension: 2 components:
  - Handover Coordinator (HoC)
  - Handover Terminal Agent (HTA)

Computational model

Handover decision phase

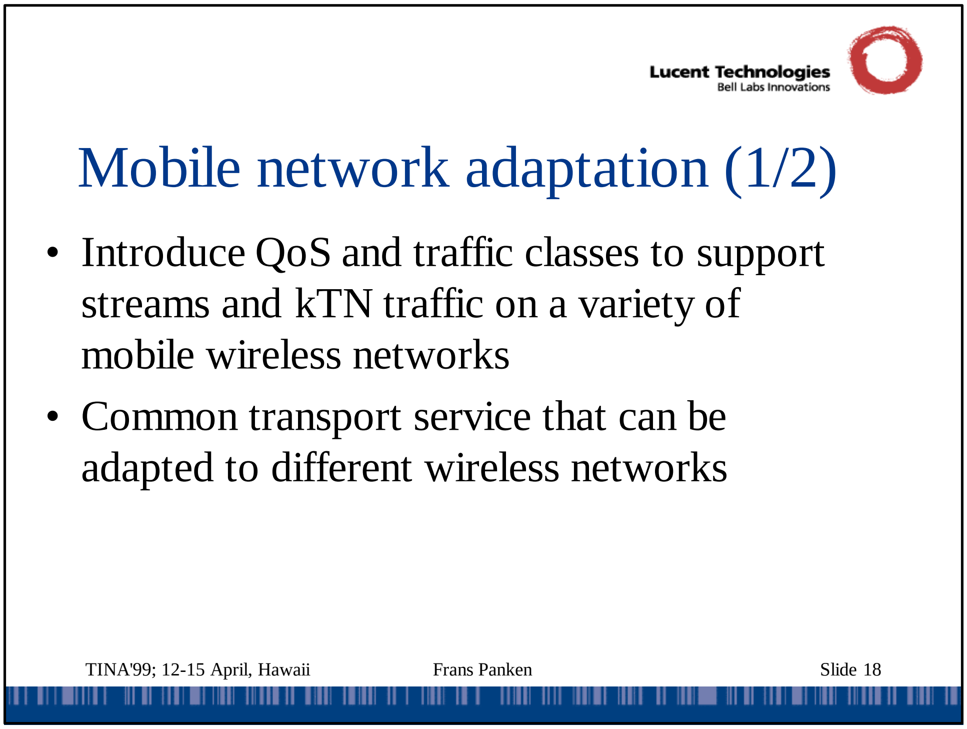


HoC:	Handover Co-ordinator
HoI:	Handover Initiator
HP:	Handover Profile
HTA:	Handover Terminal Agent
MSM:	Mobile Station Measurement
RANM:	Radio Access Node Measurements



Handover execution phase

- Control point of transfer
- Combining and multi-casting
- Re-routing:
  - – set up new connections
  - – release superfluous connections
- Bridge (or tunnel) data to prevent loss of data
- Security functions



Mobile network adaptation (1/2)

- Introduce QoS and traffic classes to support streams and kTN traffic on a variety of mobile wireless networks
- Common transport service that can be adapted to different wireless networks

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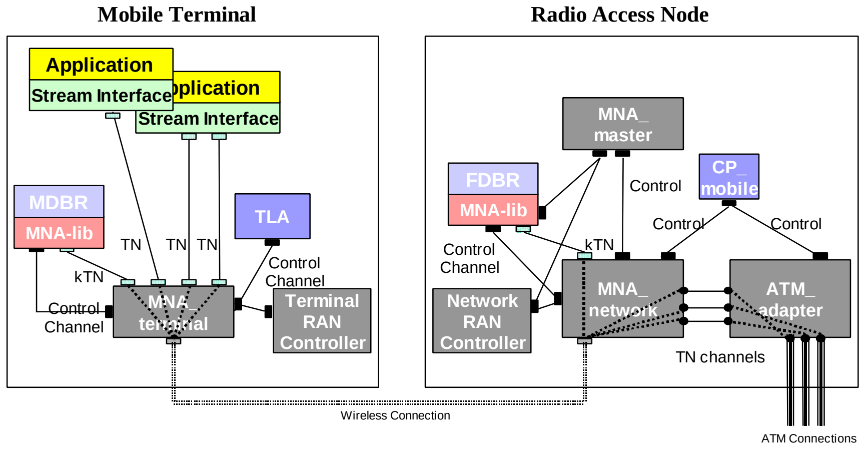
Mobile network adaptation (2/2)



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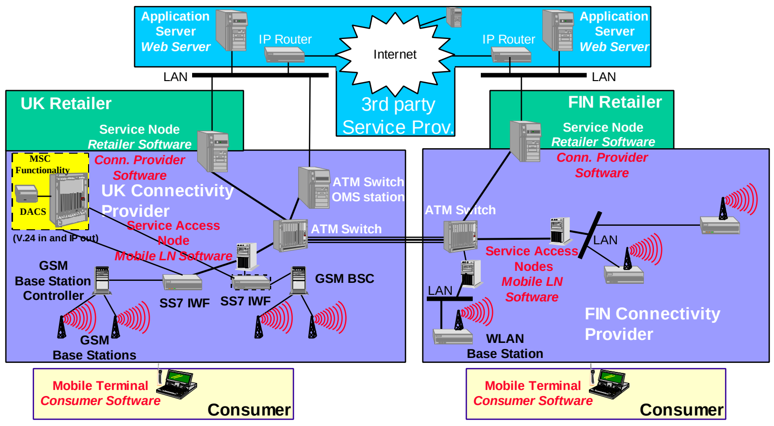
International trial



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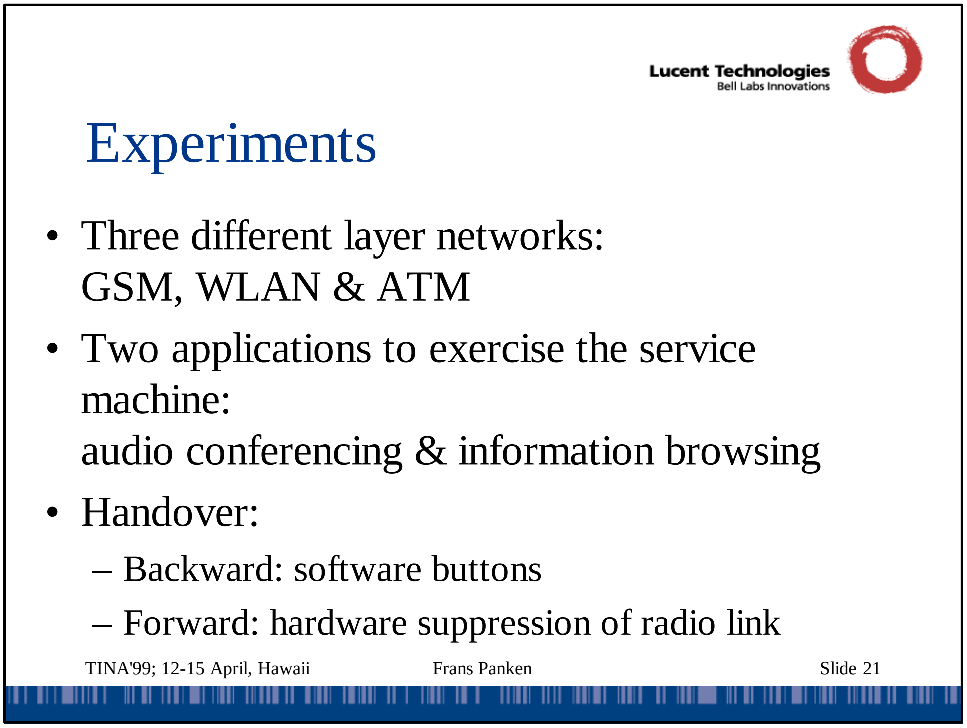

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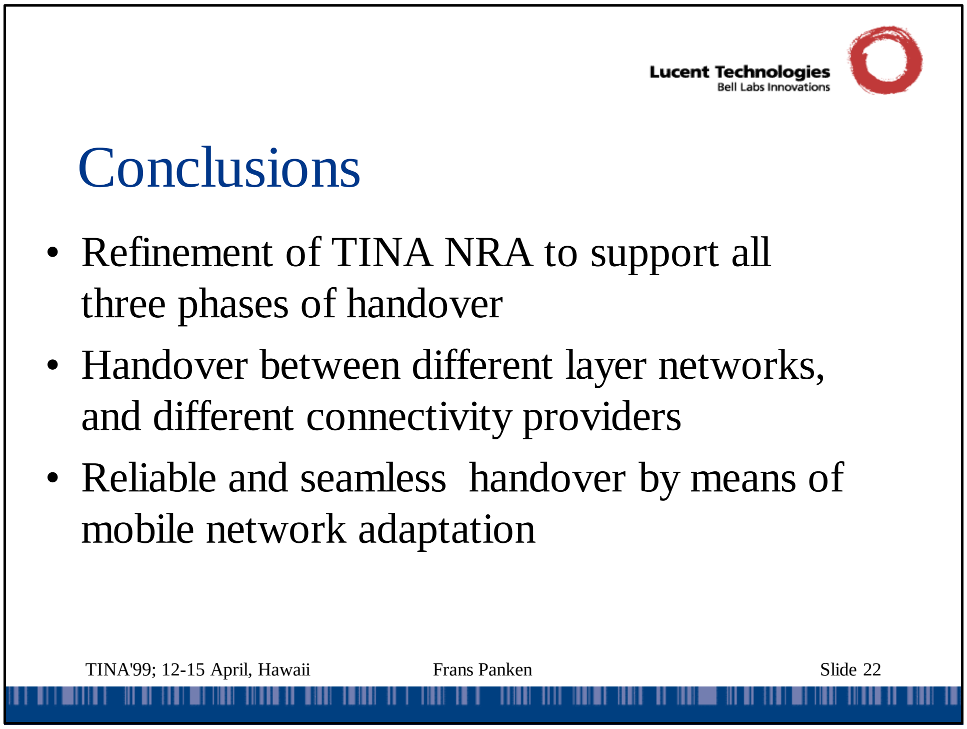
Experiments

- Three different layer networks:
  GSM, WLAN & ATM
- Two applications to exercise the service machine:
  audio conferencing & information browsing
- Handover:
  - Backward: software buttons
  - Forward: hardware suppression of radio link



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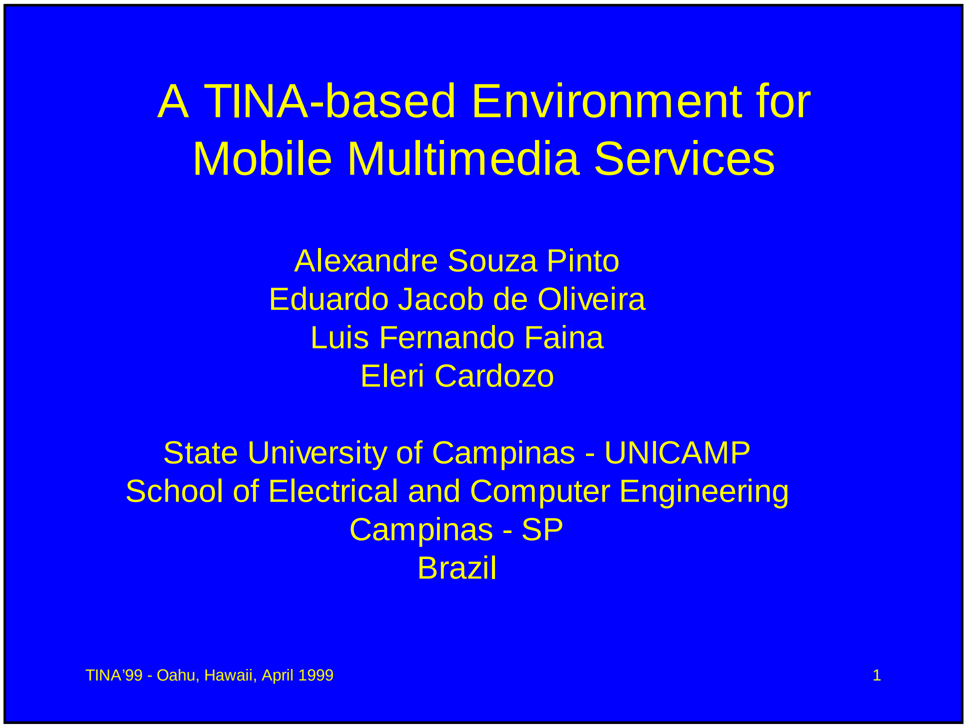
Conclusions

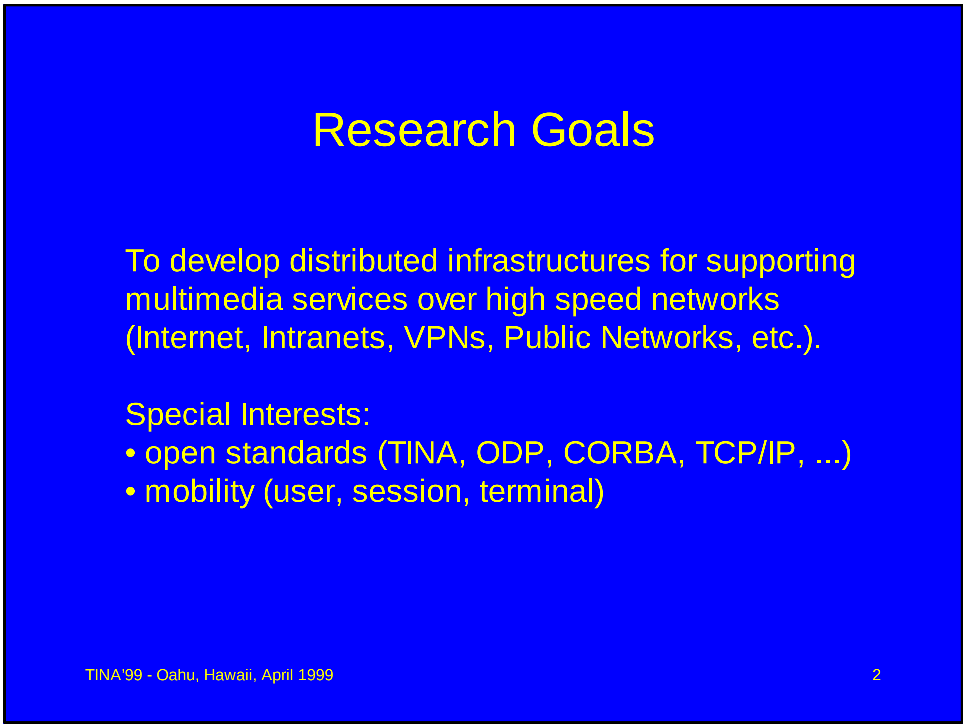
- Refinement of TINA NRA to support all three phases of handover
- Handover between different layer networks, and different connectivity providers
- Reliable and seamless handover by means of mobile network adaptation



A TINA-based Environment for Mobile Multimedia Services

Alexandre Souza Pinto
Eduardo Jacob de Oliveira
Luis Fernando Faina
Eleri Cardozo

State University of Campinas - UNICAMP
School of Electrical and Computer Engineering
Campinas - SP
Brazil



Research Goals

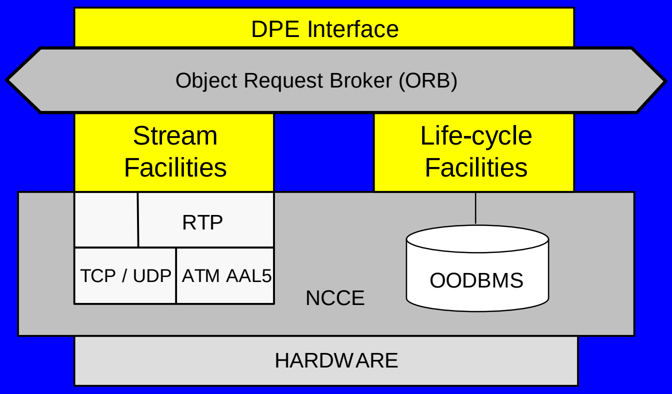
To develop distributed infrastructures for supporting multimedia services over high speed networks (Internet, Intranets, VPNs, Public Networks, etc.).

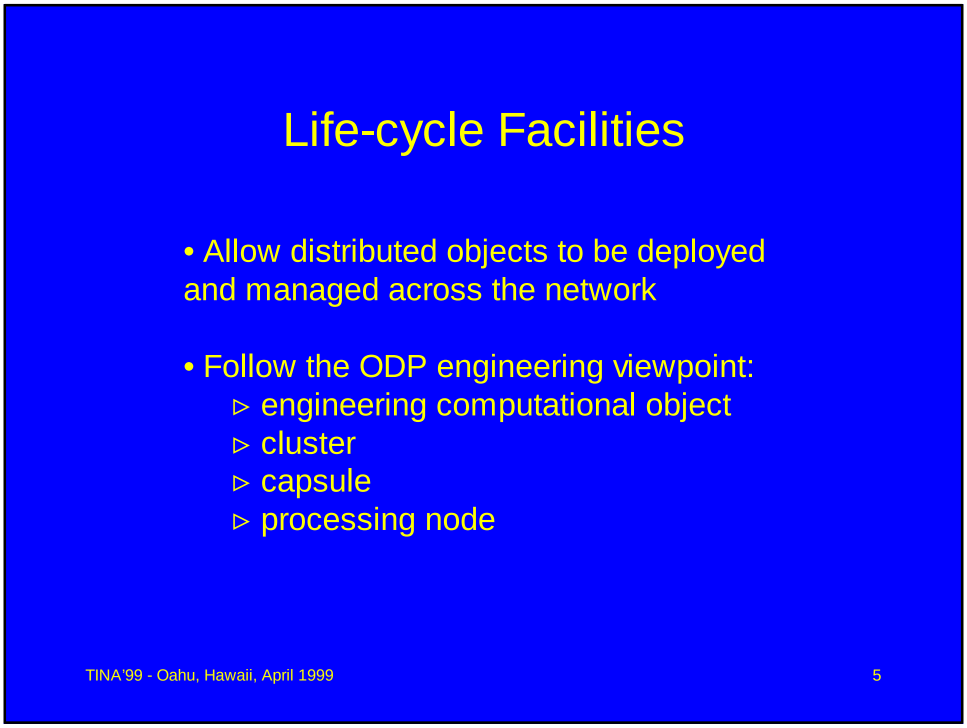
Special Interests:
• open standards (TINA, ODP, CORBA, TCP/IP, ...)
• mobility (user, session, terminal)

Research Status

- CORBA-compliant TINA DPE
- WWW-compliant TINA Service Architecture components

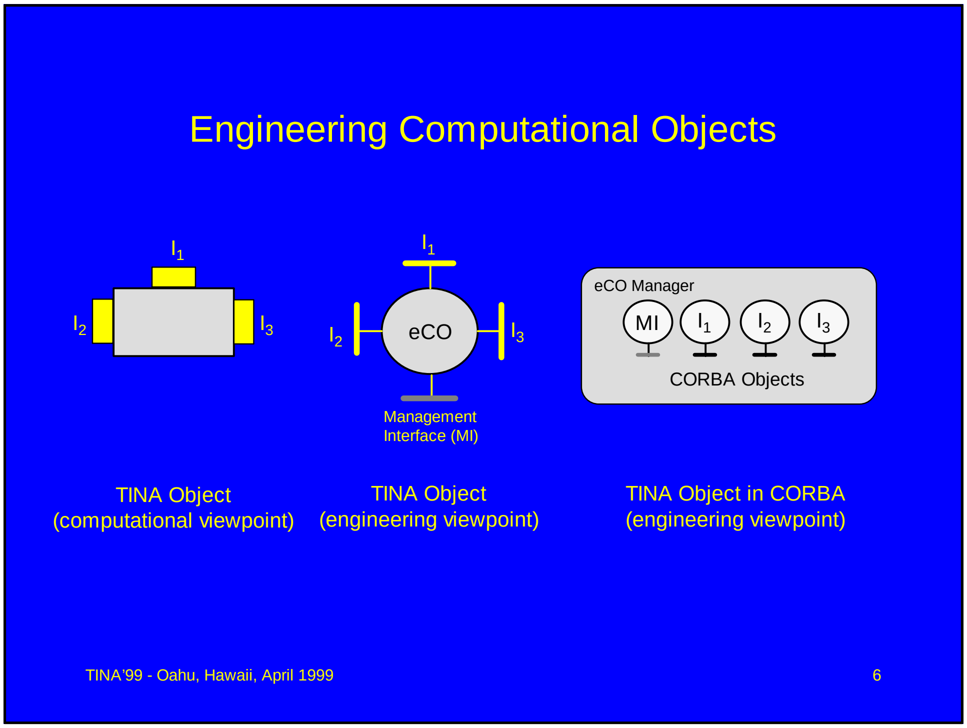
DPE Architecture





Life-cycle Facilities

- Allow distributed objects to be deployed and managed across the network
- Follow the ODP engineering viewpoint:
  - ▷ engineering computational object
  - ▷ cluster
  - ▷ capsule
  - ▷ processing node



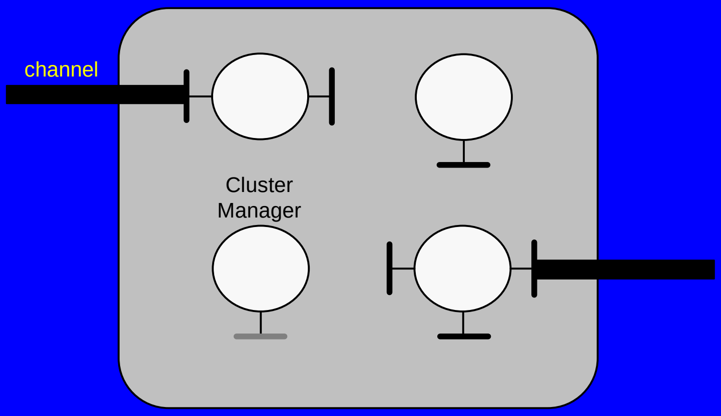
Engineering Computational Objects

TINA Object (computational viewpoint)

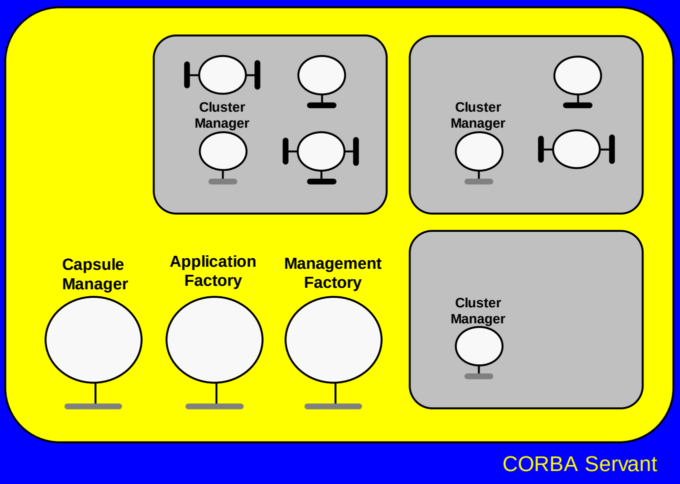
TINA Object (engineering viewpoint)

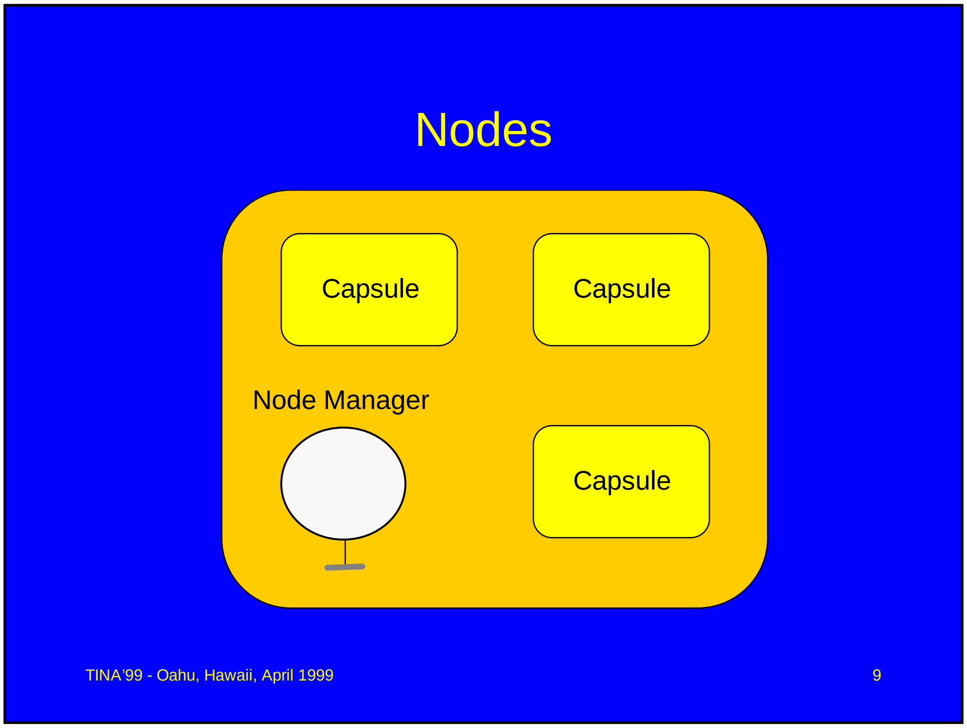
TINA Object in CORBA (engineering viewpoint)

Clusters



Capsules





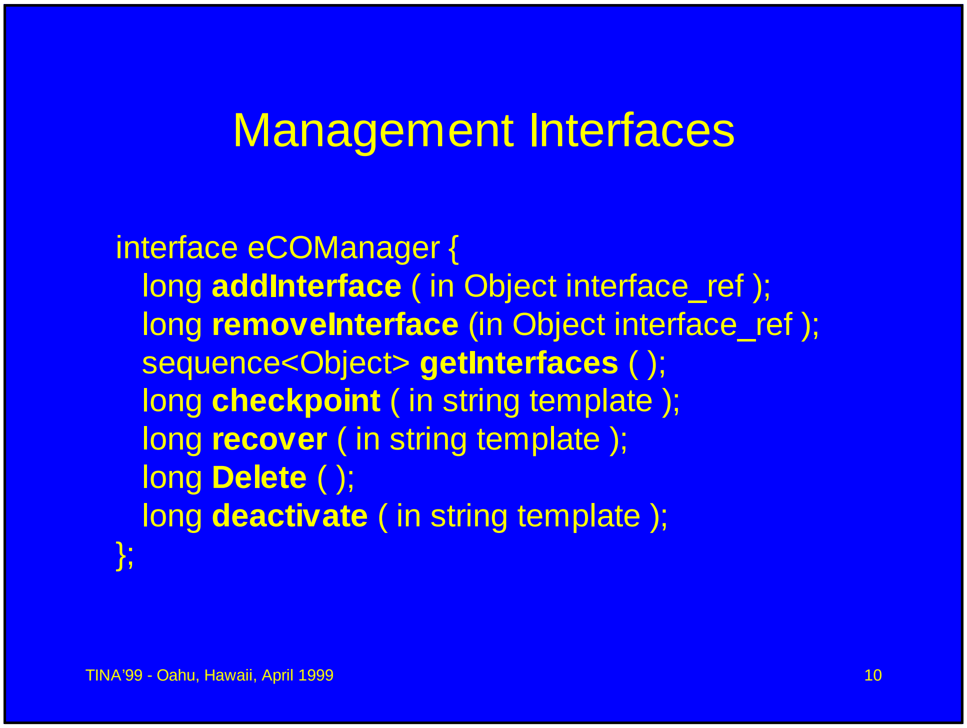
Nodes

Capsule

Capsule

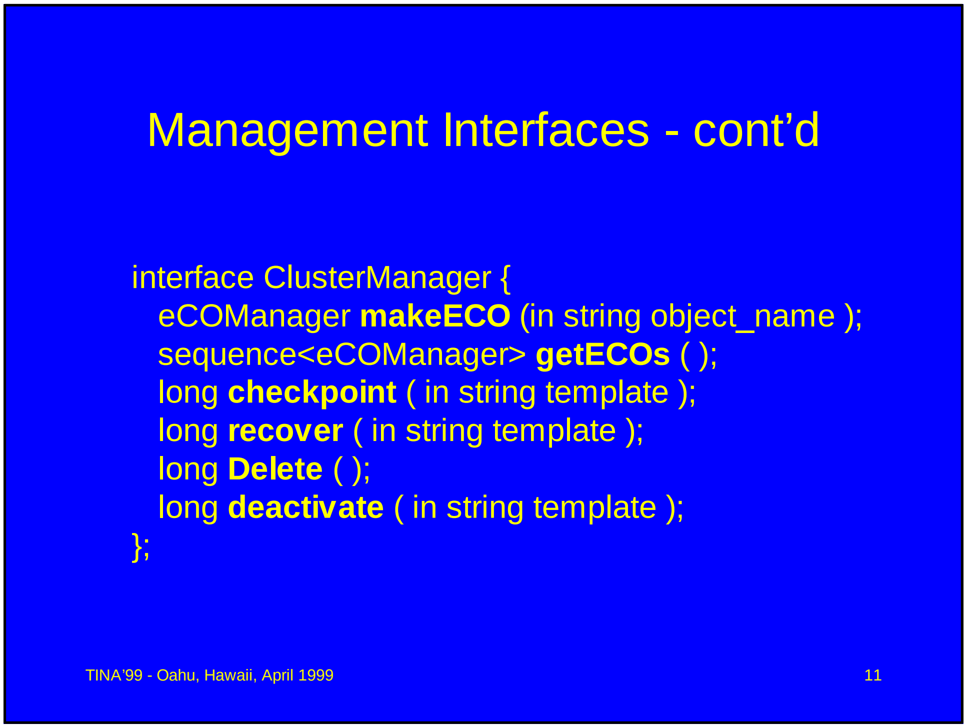
Node Manager

Capsule



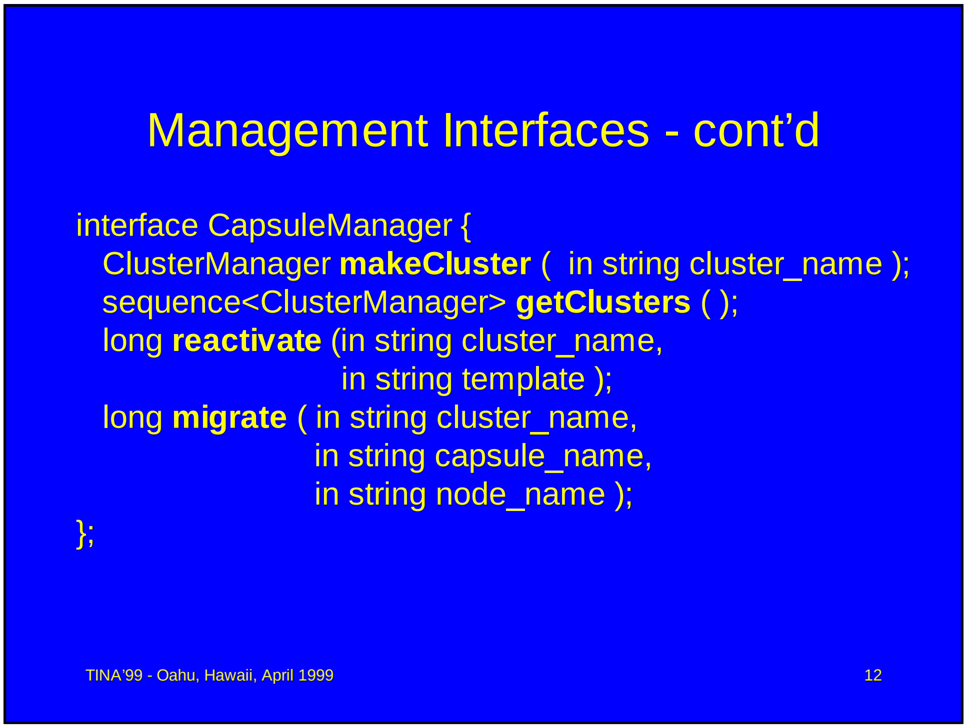
Management Interfaces

```
interface eCOManager {
   long addInterface ( in Object interface_ref );
   long removeInterface (in Object interface_ref );
   sequence<Object> getInterfaces ( );
   long checkpoint ( in string template );
   long recover ( in string template );
   long Delete ( );
   long deactivate ( in string template );
};
```



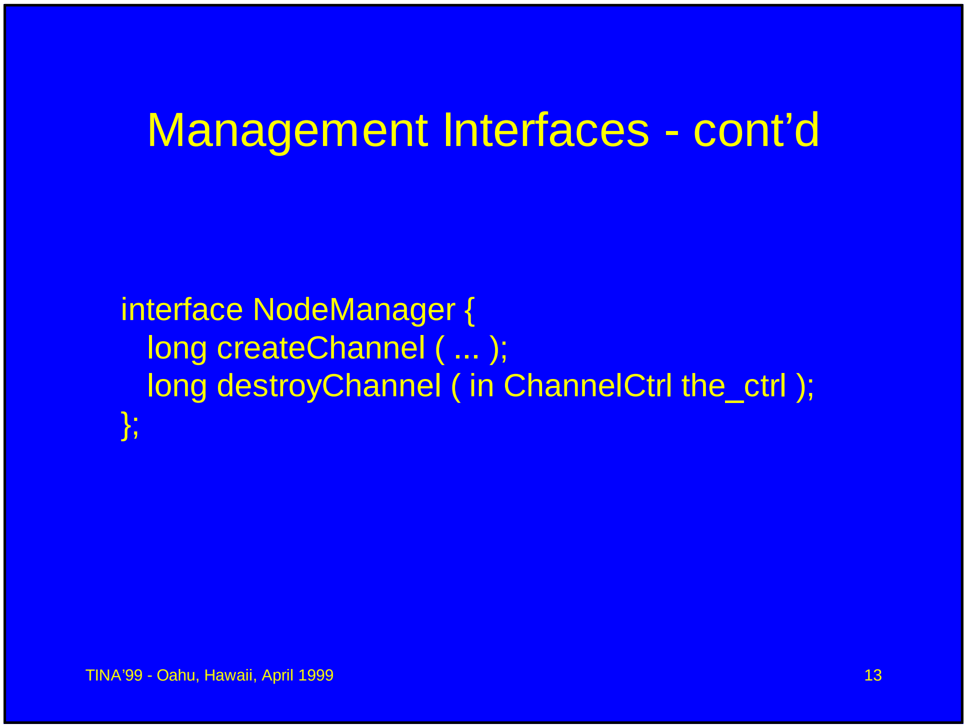
Management Interfaces - cont’d

```
interface ClusterManager {
  eCOManager makeECO (in string object_name );
  sequence<eCOManager> getECOs ( );
  long checkpoint ( in string template );
  long recover ( in string template );
  long Delete ( );
  long deactivate ( in string template );
};
```



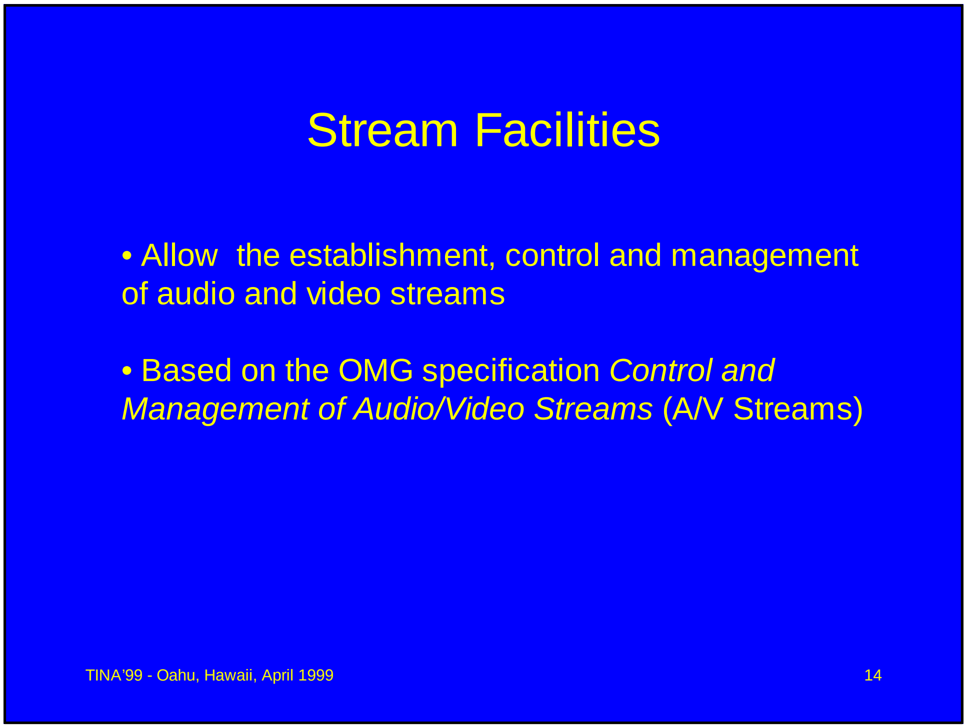
Management Interfaces - cont’d

```
interface CapsuleManager {
  ClusterManager makeCluster (  in string cluster_name );
  sequence<ClusterManager> getClusters ( );
  long reactivate (in string cluster_name,
                     in string template );
  long migrate ( in string cluster_name,
                   in string capsule_name,
                   in string node_name );
};
```



Management Interfaces - cont’d

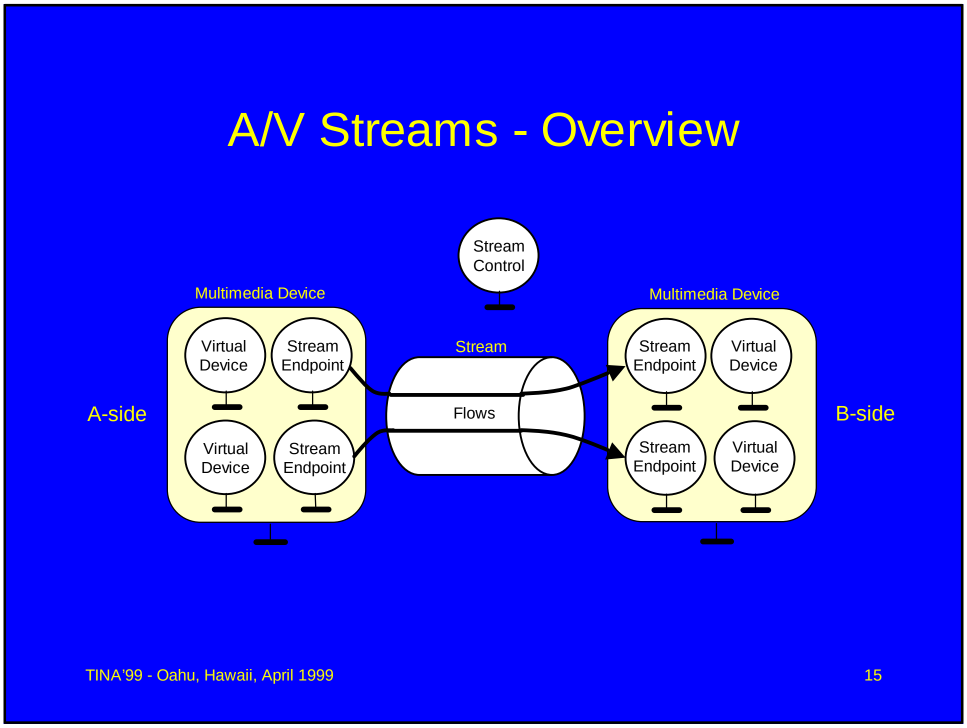
```
interface NodeManager {
   long createChannel ( ... );
   long destroyChannel ( in ChannelCtrl the_ctrl );
};
```



Stream Facilities

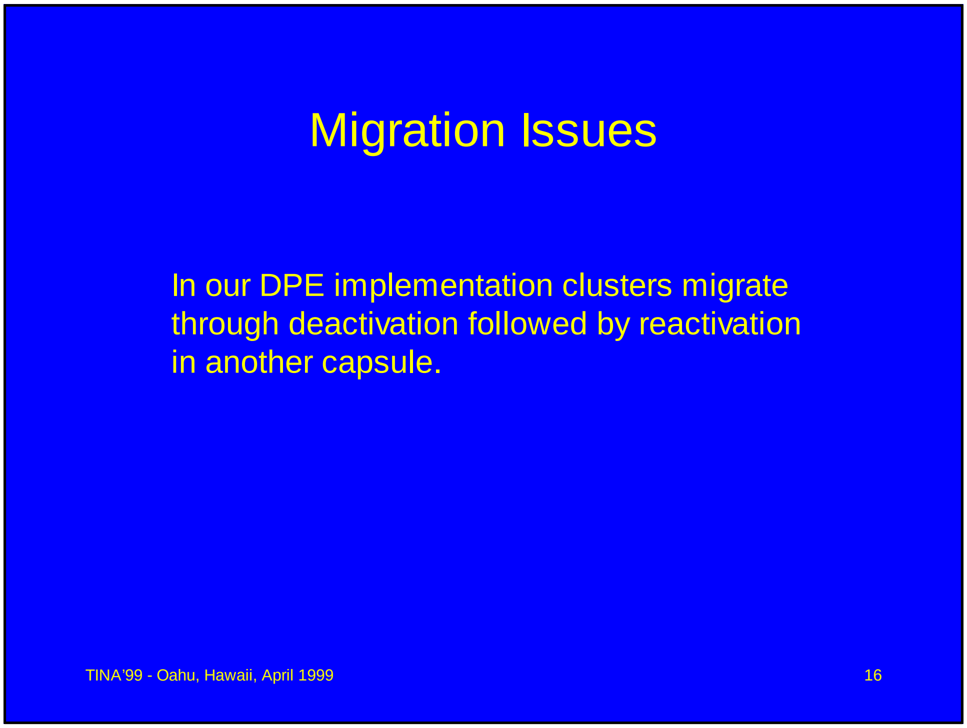
- Allow the establishment, control and management of audio and video streams

- Based on the OMG specification *Control and Management of Audio/Video Streams* (A/V Streams)



A/V Streams - Overview

TINA'99 - Oahu, Hawaii, April 1999 15

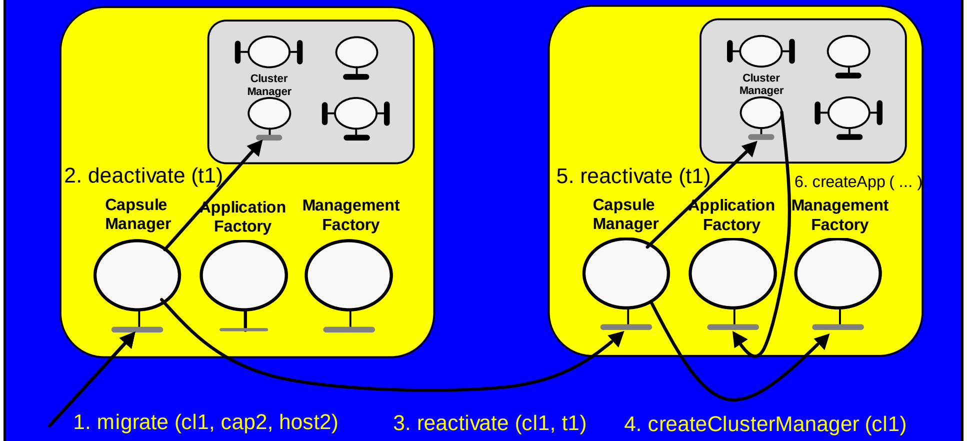


Migration Issues

In our DPE implementation clusters migrate through deactivation followed by reactivation in another capsule.

TINA'99 - Oahu, Hawaii, April 1999 16

Migration Issues - cont’d



Cluster Manager

2. deactivate (t1)

Capsule Manager

Application Factory

Management Factory

Cluster Manager

5. reactivate (t1)

6. createApp (...)

Capsule Manager

Application Factory

Management Factory

1. migrate (cl1, cap2, host2)

3. reactivate (cl1, t1)

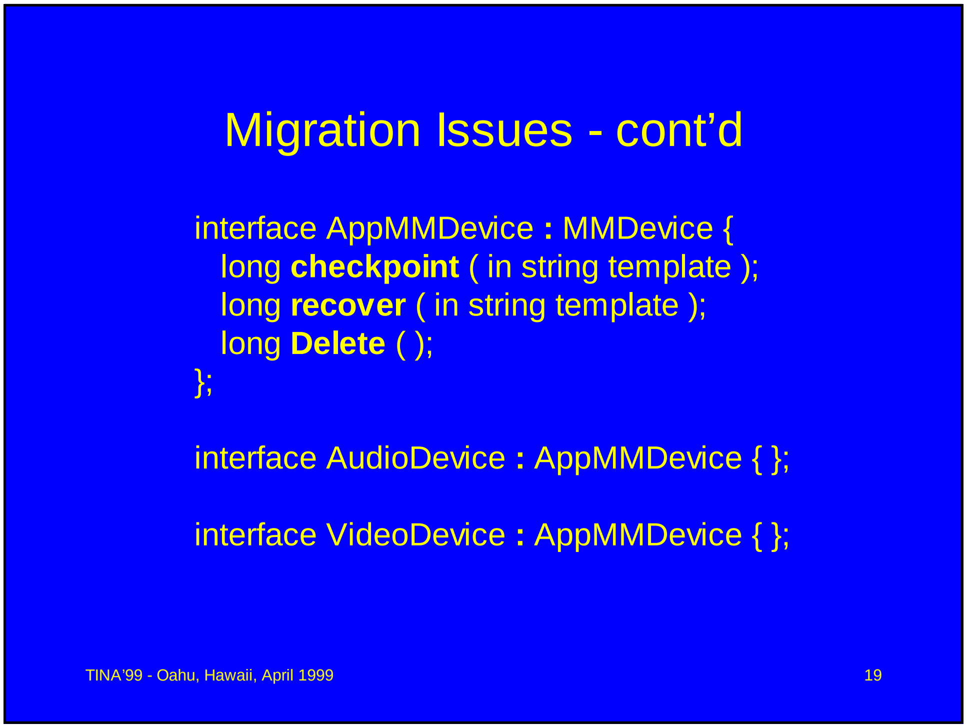
4. createClusterManager (cl1)

Migration Issues - cont’d

How to migrate stream endpoints with the cluster’s objects ?

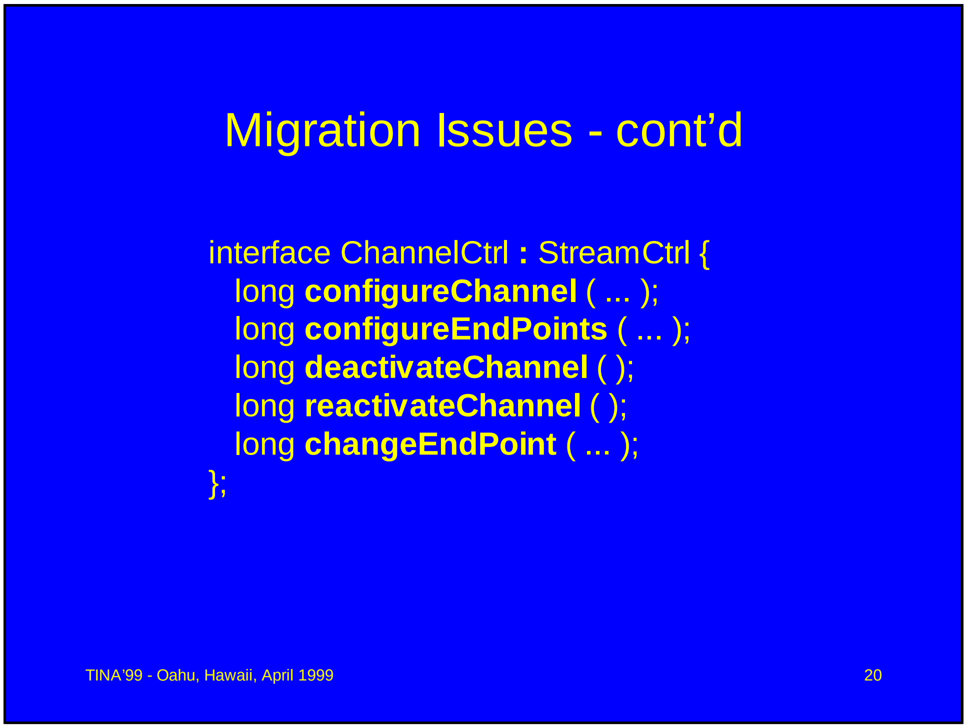
1. by migrating multimedia devices with the cluster

2. by extending the stream control operations in order to facilitate stream reconfiguration



Migration Issues - cont’d

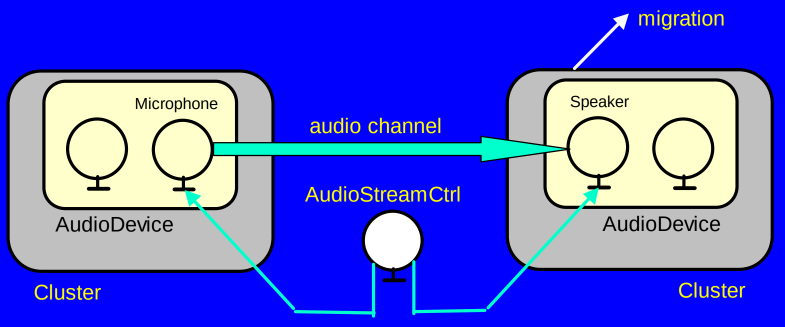
```
interface AppMMDevice : MMDevice {
  long checkpoint ( in string template );
  long recover ( in string template );
  long Delete ( );
};

interface AudioDevice : AppMMDevice { };

interface VideoDevice : AppMMDevice { };
```



Migration Issues - cont’d

```
interface ChannelCtrl : StreamCtrl {
  long configureChannel ( ... );
  long configureEndPoints ( ... );
  long deactivateChannel ( );
  long reactivateChannel ( );
  long changeEndPoint ( ... );
};
```

Migration Issues - Example



migration

Microphone

Speaker

audio channel

AudioStreamCtrl

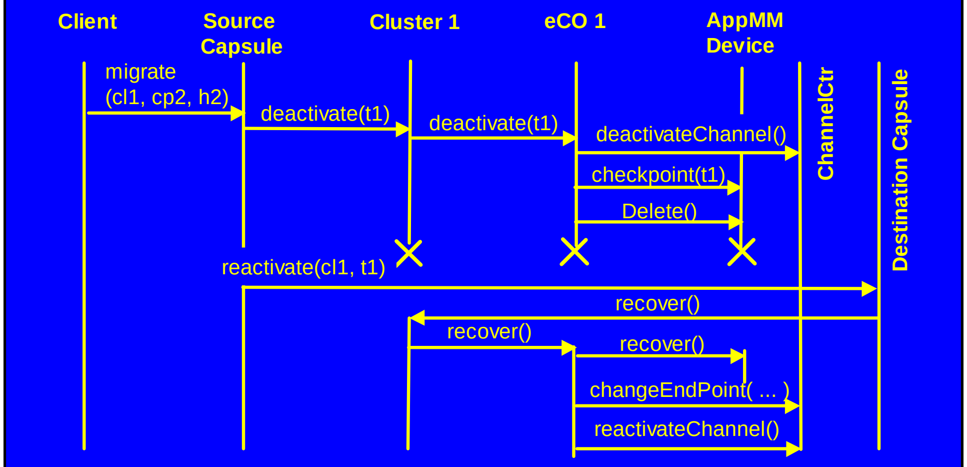
AudioDevice

AudioDevice

Cluster

Cluster

Migration Issues - Example



Client

Source Capsule

Cluster 1

eCO 1

AppMM Device

ChannelCtr

Destination Capsule

migrate (cl1, cp2, h2)

deactivate(t1)

deactivate(t1)

deactivateChannel()

checkpoint(t1)

Delete()

reactivate(cl1, t1)

recover()

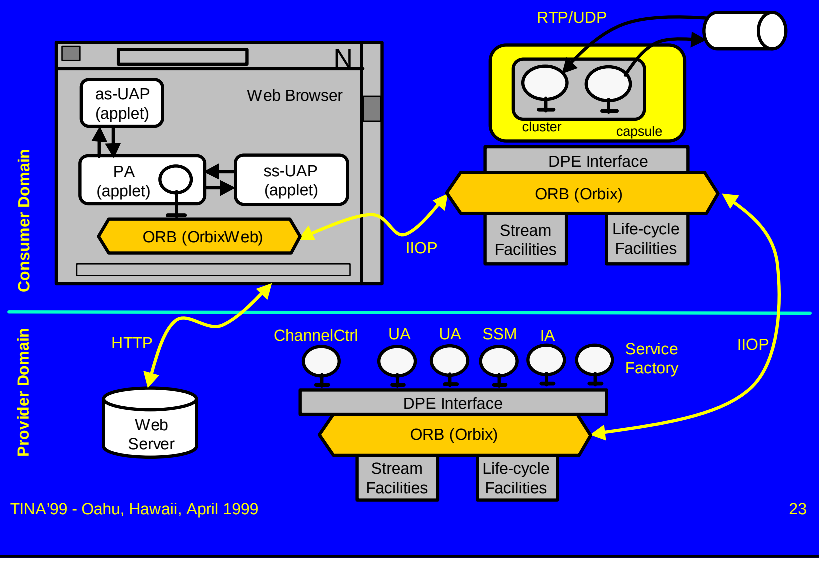
recover()

recover()

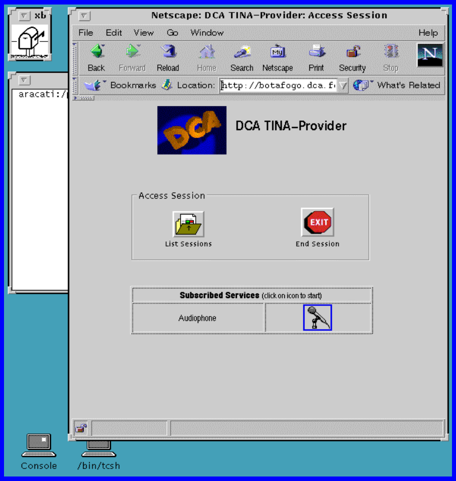
changeEndPoint(...)

reactivateChannel()

Mobile Application



Mobile Application - cont'd


Netscape: DCA TINA–Provider: Access Session

Location: http://botafogo.dca.f

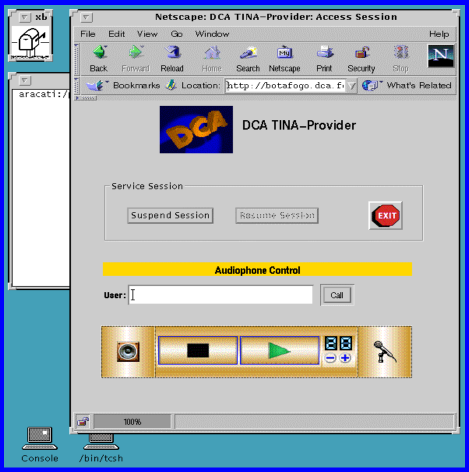
DCA TINA–Provider

Access Session

Subscribed Services (click on icon to start)

Audiophone

Mobile Application - cont’d



Netscape: DCA TINA–Provider: Access Session

Location: http://botafogo.dca.f

DCA TINA–Provider

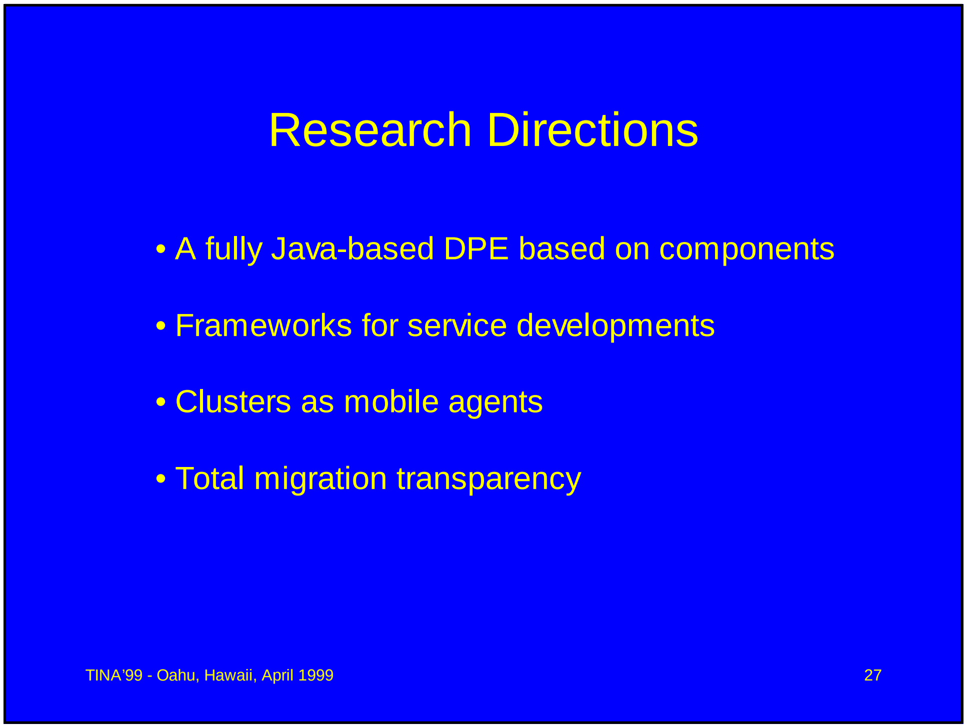
Service Session

Audiophone Control

User:

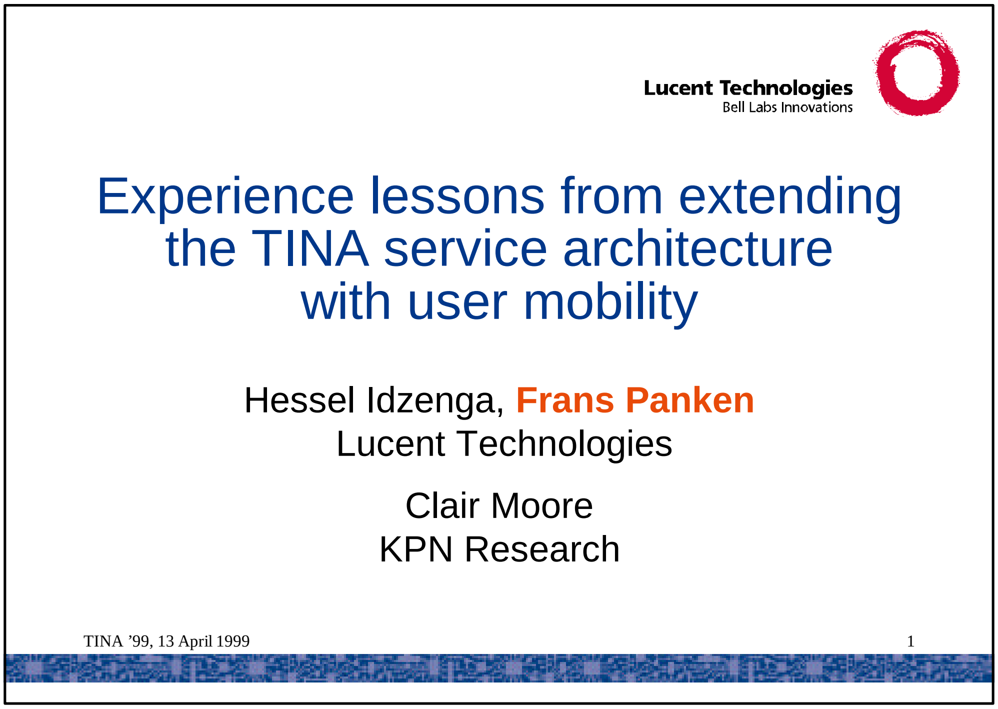
Concluding Remarks

- A DPE must address migration in a comprehensive manner
- TINA Service Architecture can turn Internet applications into Internet services
- CORBA, Web and TINA fit well !



Research Directions

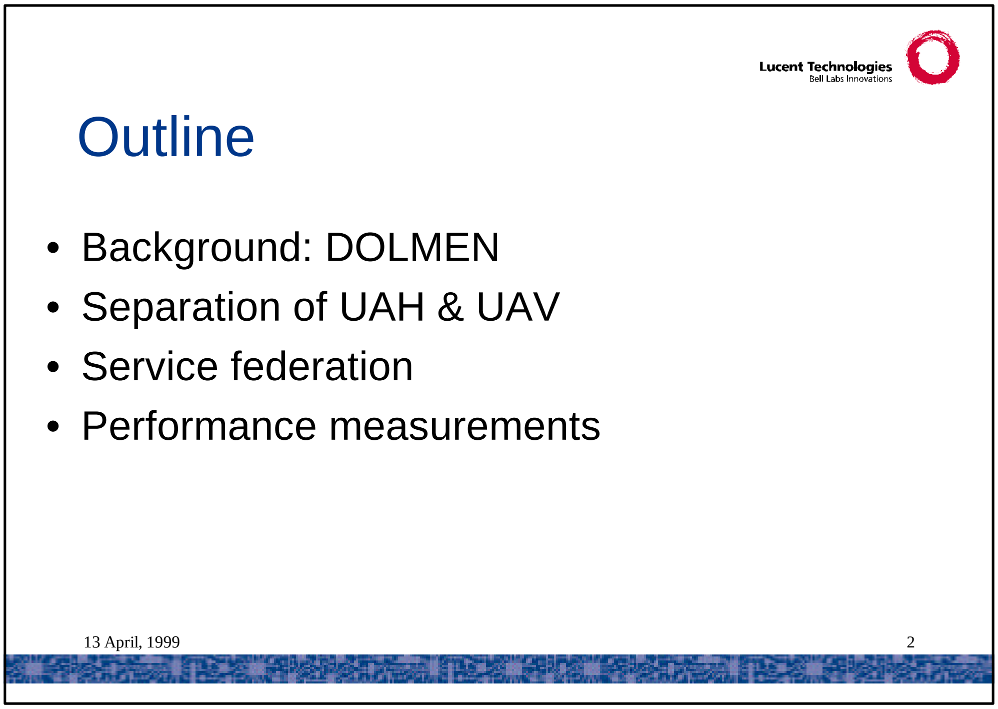
- A fully Java-based DPE based on components
- Frameworks for service developments
- Clusters as mobile agents
- Total migration transparency



Experience lessons from extending the TINA service architecture with user mobility

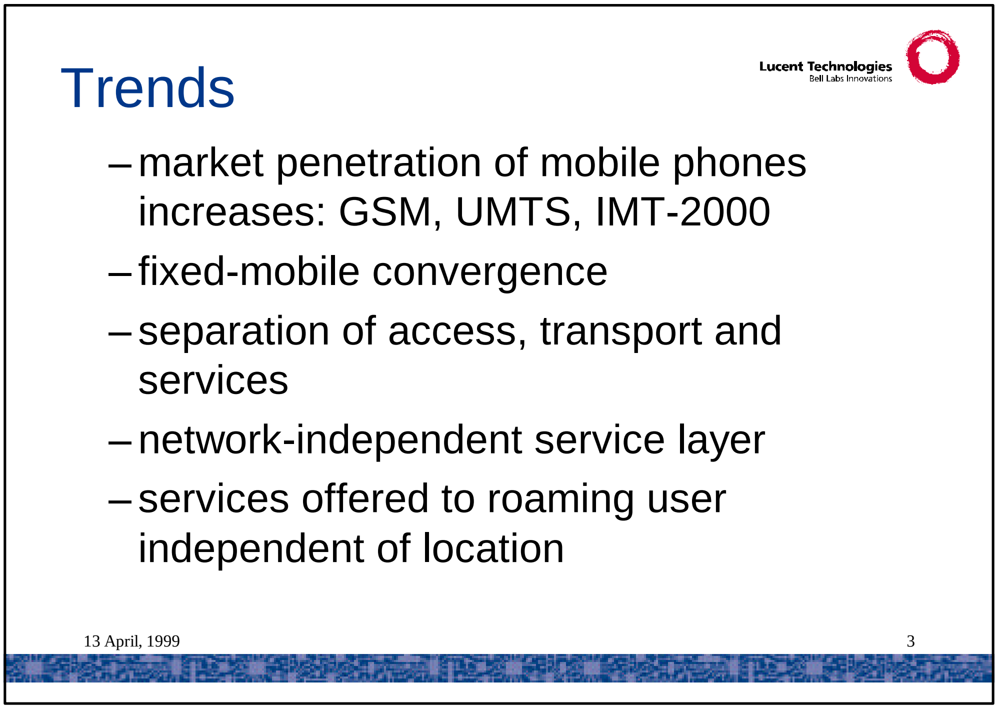
Hessel Idzenga, **Frans Panken**
Lucent Technologies

Clair Moore
KPN Research



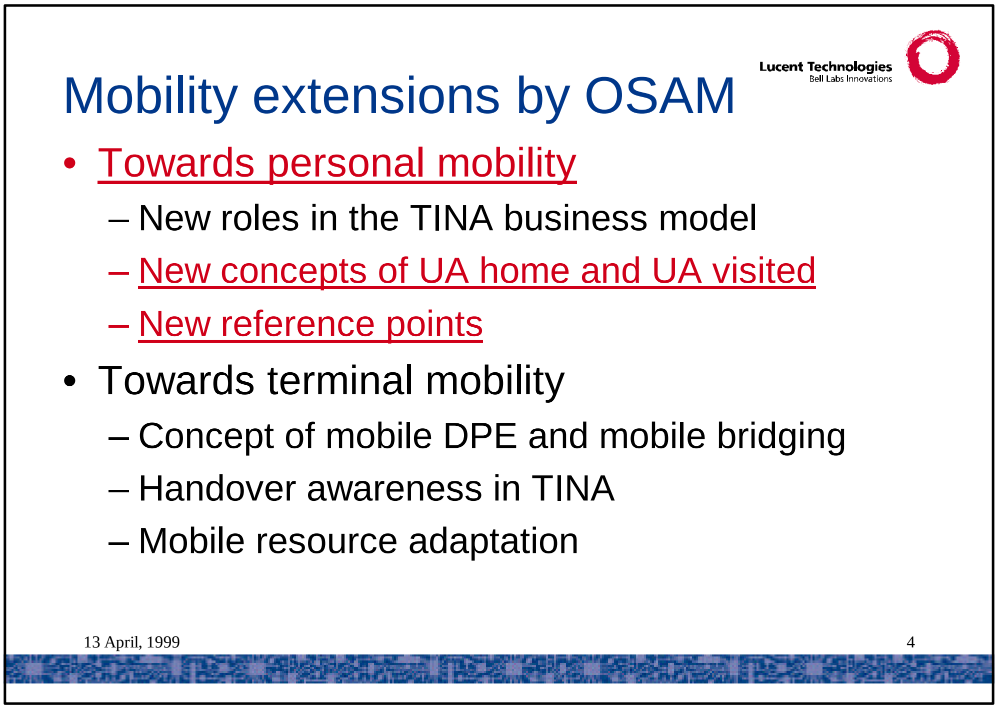
Outline

- Background: DOLMEN
- Separation of UAH & UAV
- Service federation
- Performance measurements



Trends

- market penetration of mobile phones increases: GSM, UMTS, IMT-2000
- fixed-mobile convergence
- separation of access, transport and services
- network-independent service layer
- services offered to roaming user independent of location



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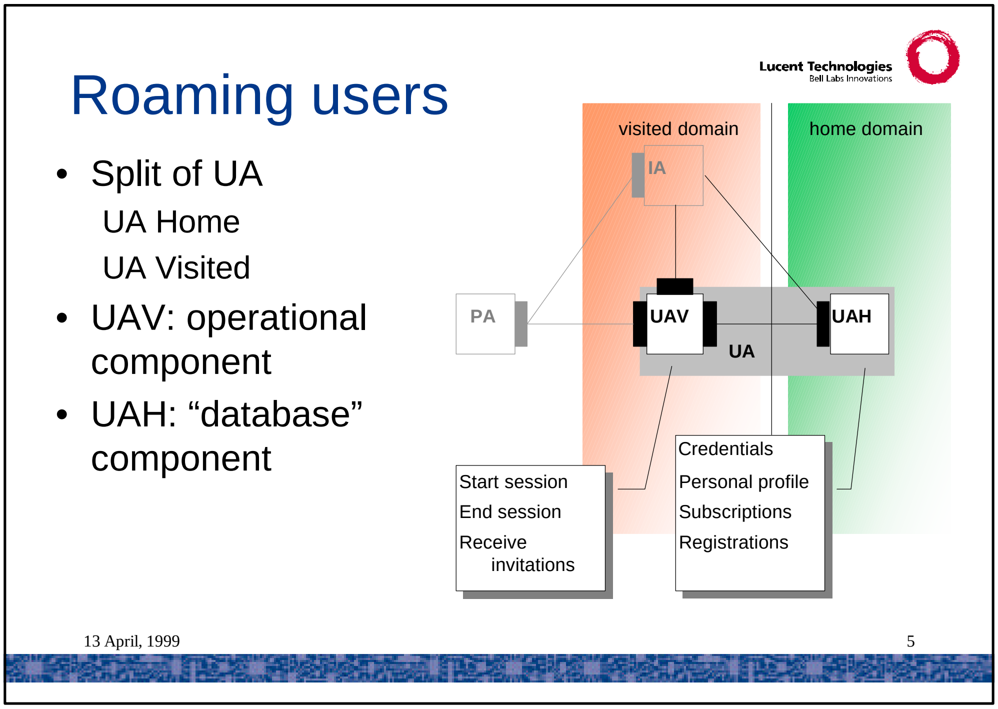
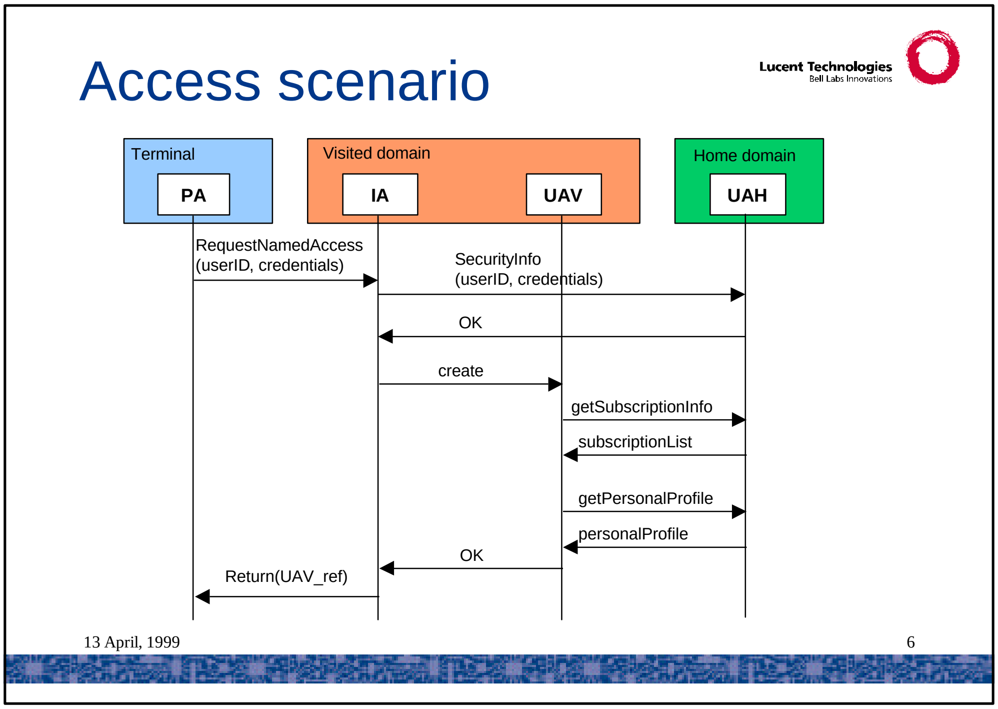
  - Handover awareness in TINA
  - Mobile resource adaptation



Roaming users

- Split of UA
  - UA Home
  - UA Visited
- UAV: operational component
- UAH: "database" component

13 April, 1999



Access scenario

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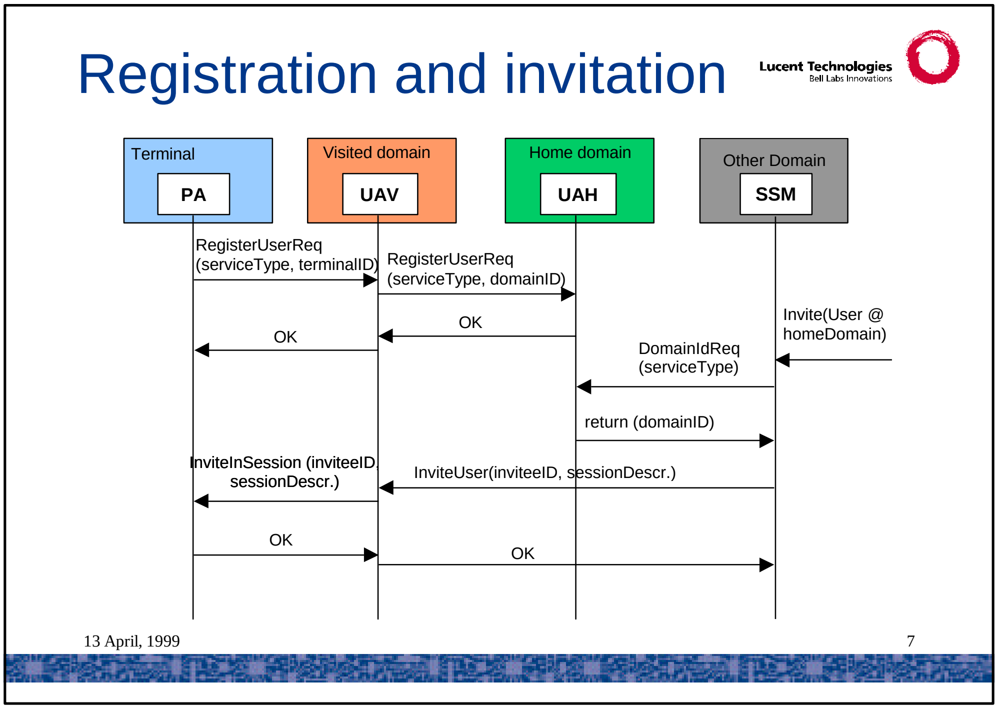

Registration and invitation

Lucent Technologies
Bell Labs Innovations
Terminal
PA
Visited domain
UAV
Home domain
UAH
Other Domain
SSM
RegisterUserReq (serviceType, terminalID)
RegisterUserReq (serviceType, domainID)
OK
OK
Invite(User @ homeDomain)
DomainIdReq (serviceType)
return (domainID)
InviteInSession (inviteeID, sessionDescr.)
InviteUser(inviteeID, sessionDescr.)
OK
OK

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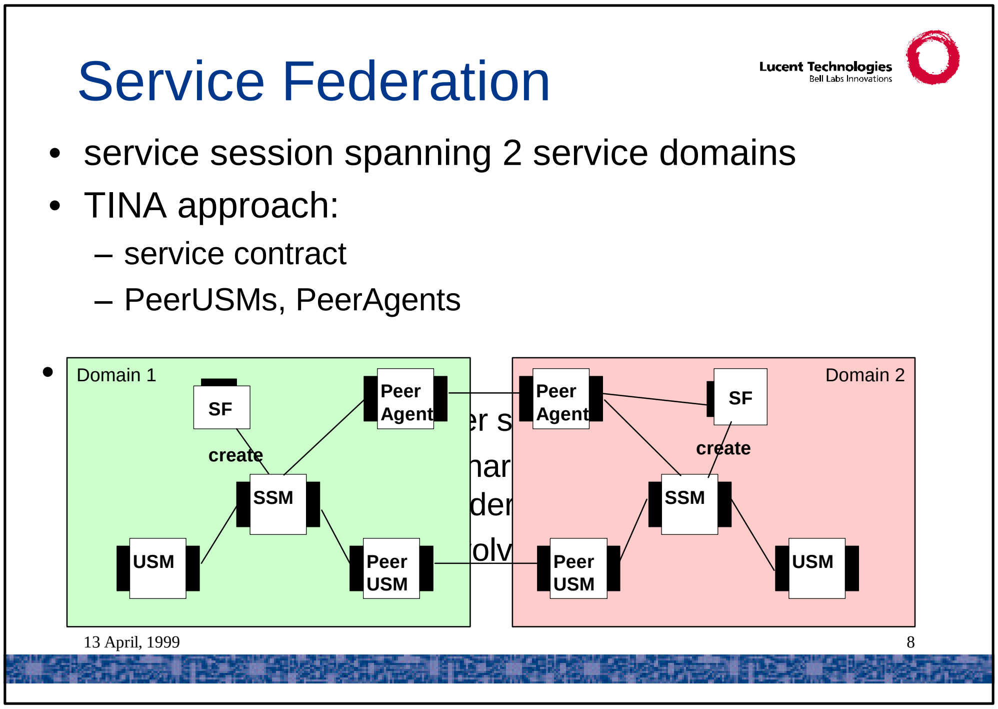

Service Federation

- service session spanning 2 service domains
- TINA approach:
  - service contract
  - PeerUSMs, PeerAgents
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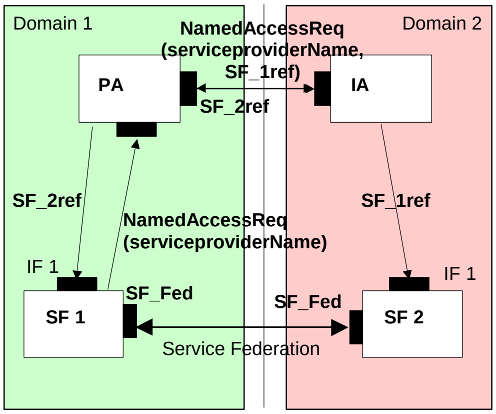
Service Federation, access

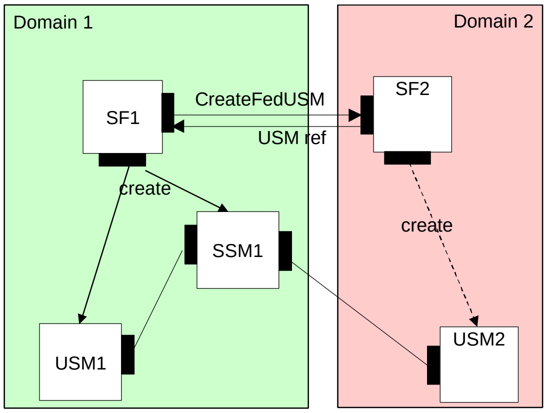
DOLMEN approach

- service contract
- access session between domains
- Service Federation at SF level



Service Federation, usage

DOLMEN approach



Advantages

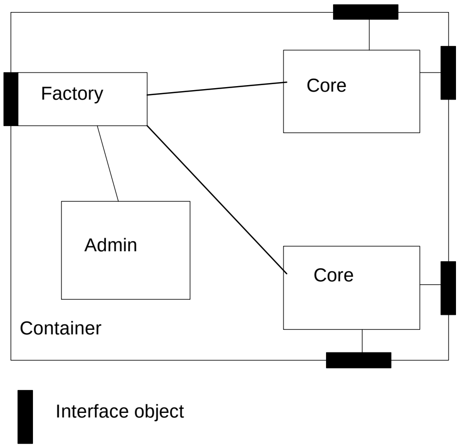
Simplicity:

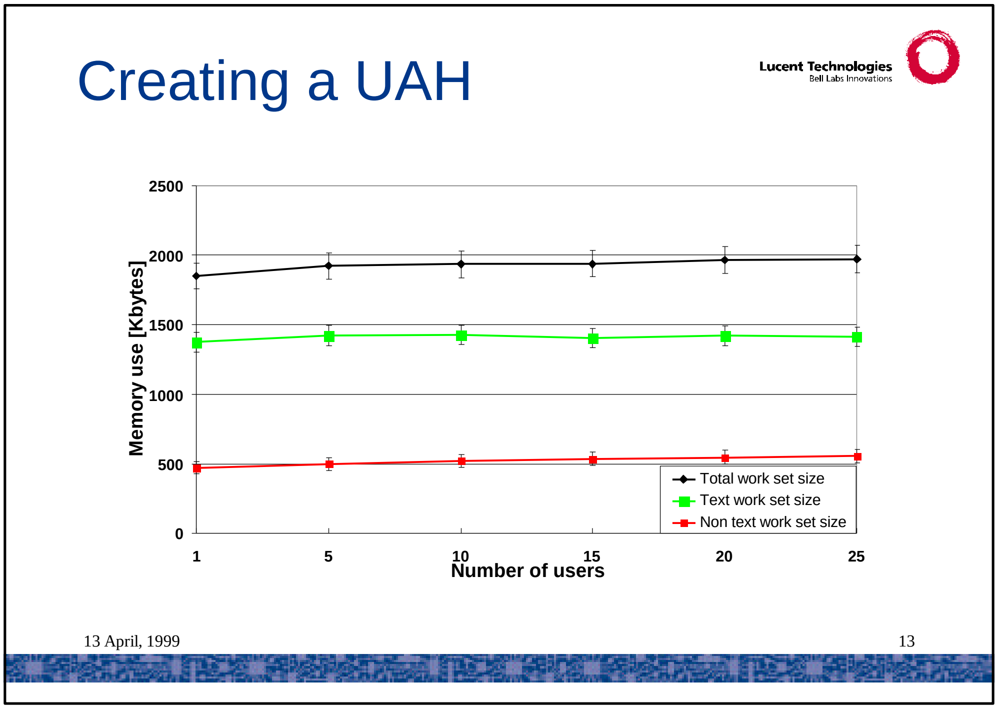
- Re-use of the access session components,
- Avoids involvement of Peer Agents in usage,
- Avoids peerUSMs that obscure the control of the session with regard to master or slave role,

while maintaining service contract and control over access

Implementation

- Using standard component template
  - provide IDL and component configuration, framework code is generated
  - delegation of interface invocations to Core object
- Demonstrated in NHs of UK and Finland





Creating a UAH

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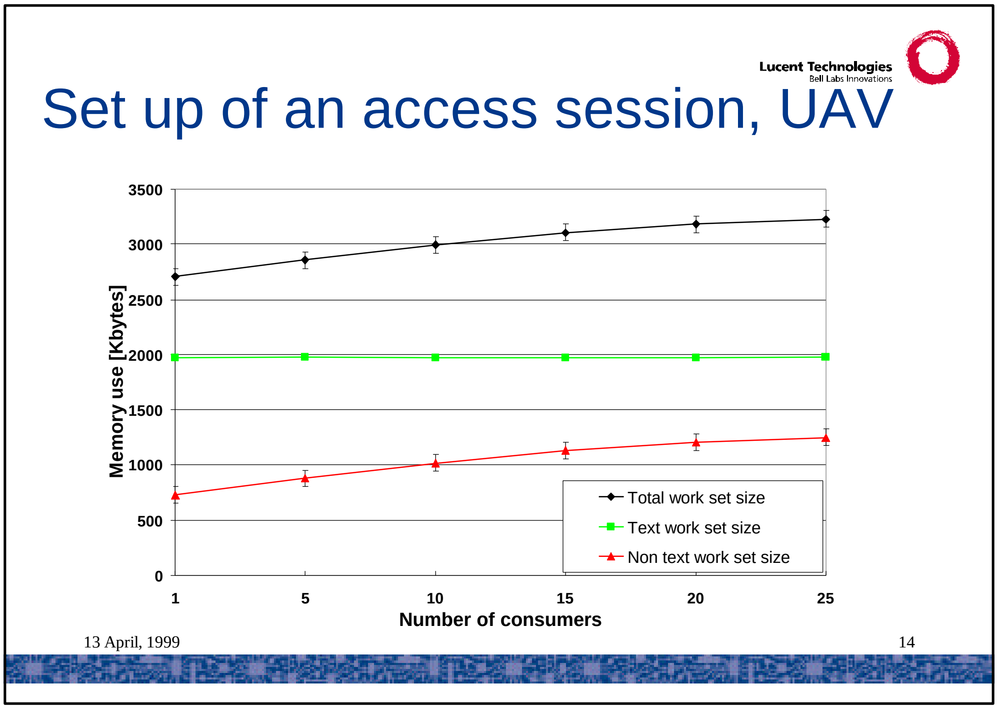

Set up of an access session, UAV

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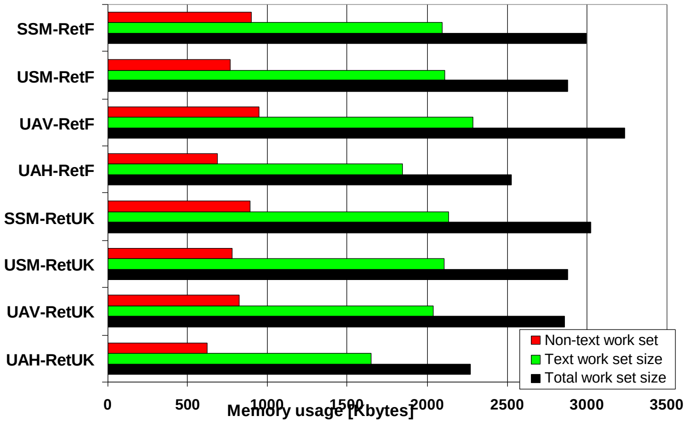
Set up of audio session



Conclusions

- Ret RP syntax OK; semantics poorly defined: properties, name-value pairs, any’s
- Service Federation made straight-forward with SF-federation
- Component template useful for uniform coding style and for re-use of components
- Performance evaluation:
  – no excessive memory when # consumers increases
  – UAV more demanding than UAH
  – uniform memory usage among components in audio session