Session VI_b: **Connection Services**

Chair: Hiroshi Ishii, *NTT*

"Providing Scaleable QoS-based Connectivity Services"

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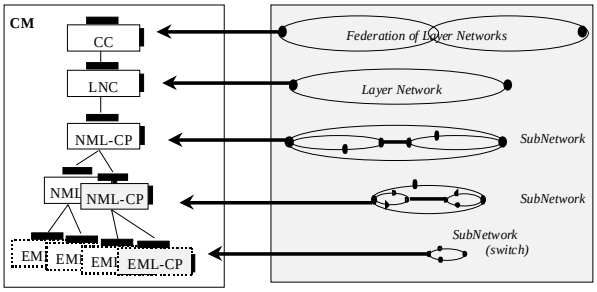
TINA Conference, Hawaii, 15th April 1999

The ReTINA Project

- ReTINA is a European Union funded ACTS project
- Goal: To develop a distributed real-time multimedia environment over emerging broadband networks
- Lancaster University, Alcatel, & Siemens contribute to a work package on development of a network management platform based on the ReTINA DPE
- Lancaster University has actively participated in research on provision of guaranteed QoS through participation in OPENSIG and ReTINA projects

TINA-CMA

- Goal: provide management of broadband networks to provide efficient routing, QoS guarantees and maintenance of connections



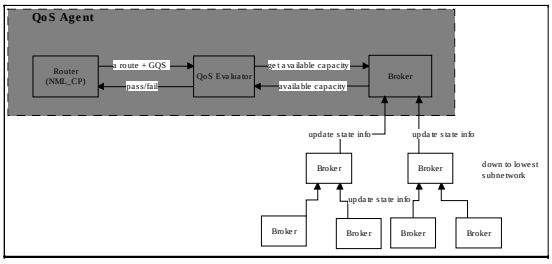
- Developed on ideas of Open Signalling - providing a configurable, programmable network environment
- TINA Connection Management Architecture (TINA-CMA) is based on an hierarchical routing approach but lacks QoS support

QoS Management

- ReTINA-CMA extends TINA-CMA to provide QoS routing and maintenance functionality
- Add QoS information to the state information exchanged between CPs (Connection Performers)
- Concerns of top levels of hierarchy becoming swamped with QoS changes not a problem due to natural filtering and aggregation properties of hierarchical network composition
- Division of *topological routing* from *QoS estimation*
- Keeping both topological and QoS status up-to-date in real time considered unrealistic

ReTINA NML_CP architecture

- NML_CP divided into three computation entities:
- Router: functions as traditional NML_CP selecting routes from its topological information database
- Admission Tester: responsible for testing if a given route can be admitted while maintaining QoS guarantees. Has no state information as is purely an evaluation function
- Broker: maintains QoS capacity information for associated subnetworks. Stores bandwidth, delay, and error rate but is easily extendible

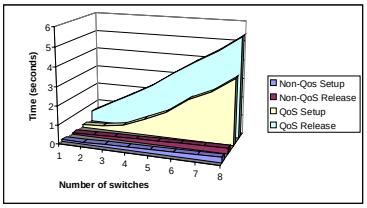


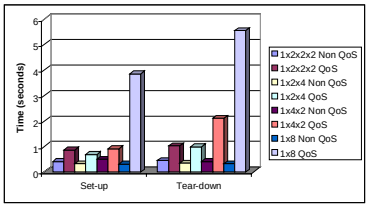
Evaluating the initial QoS approach

- This simplistic approach was presented in the paper "TINA Connectivity Services: Quality and Quantity through QoS Based Routing and DPE Performance" by Huw Oliver at TINA Conference 1997
- Approach has since been validated by implementing, testing and evaluating the architecture.
- Implemented in C++ on Solaris Workstations using Iona's Orbix CORBA v2 compliant DPE
- Evaluation of QoS management aspects on Lancaster University ATM test bed

Evaluating the initial QoS approach

- Performance results were unsatisfactory. Connection establishment/release latency scaled poorly.
- However, when QoS functionality was disabled, performance improved drastically
- Further investigation shows performance was a factor of type of hierarchical composition
- Narrow hierarchies yield much lower connection latencies than equivalent broad compositions





Refined ReTINA-CMA

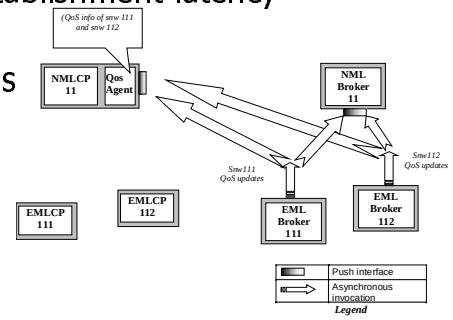
- Refinement of CMA with more mature QoS provision model adopting results from simplistic approach
- Three areas of refinement
  - reduce latency of connection establishment/release
  - improve scalability of Connection Management
  - improve QoS model with support for more parameters

CP Replication

- The hierarchical CMA approach inevitably leads to criticisms of the "hot spots"
- All operations go through the root and higher level nodes leading to the following problems
  - Scalability - number of concurrent users limited by computational resources available on the node running the high level CPs
  - Reliability - root CP represents a single point of failure in system
- Obvious solution to replicate the high level CP objects, but how do you maintain consistency between replicas?
- Our approach uses a DPE Notification Service developed by Alcatel within the ReTINA project

Division of QoS and Routing functionality

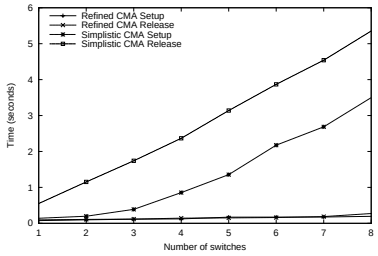
- Results showed NML_CP swamped with QoS updates & impacting on connection establishment latency
- In Refined-CMA total separation, NML_CP contains Router function and a QoS Agent (contains last up-to-date QoS estimate)
- Broker calculating estimate may be located elsewhere



- Communication is through Notification Service: allowing
  - replication of NML_CPs and QoS Brokers
  - dynamic switching between broker implementations

Evaluating Refined ReTINA-CMA

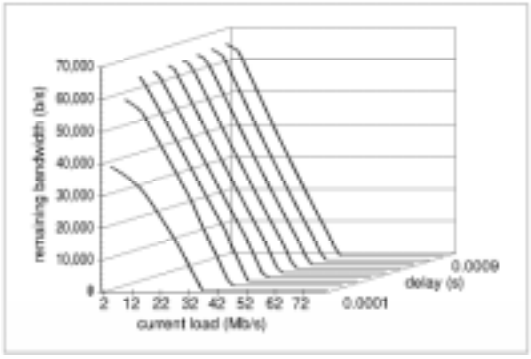
- Refined-CMA evaluated through implementation and testing on same platform as simplistic approach
- Results show model is scalable, QoS estimation making no impact on performance
- Set-up time (excluding switch interaction) is negligible (bellow 200 milliseconds)



- Compares well with IEFT's RSVP QoS signalling protocol which at best (assuming message is not lost) takes the total round trip time of the route

Evaluation of QoS Guarantee

- Available bandwidth on a link is dependant on the QoS guarantee already reserved
- The figure shows the results obtained for a link of 80,000b/s
- For a given current load on the link, it can be observed that the available bandwidth is dependant upon the level of delay required



Switch Control

- The ReTINA platform has been shown to effectively manage QoS reservations, but switch control remains an open issue
- Some switch manufactures see switch control as an integral part of the switch package and are not keen on opening up their switches to third party control software
- ReTINA has developed EML_CP using SNMP to provide control for the Fore ASX100 and ASX200 ATM switches
- But SNMP was designed as a generic device management protocol and not optimal for high performance connection control

Goal of Switch Control

- When designing switch control mechanisms the following must be considered:
- **Sharing**: simplest models allow a single controller to control a single switch. Advanced schemes allow for multiple controllers
- **QoS model**: three approaches, local QoS profiles, service specific, abstract switch model
- **Update Model**: traditional management protocols (eg SNMP) allow a client to pull information off the switch. However a switch push model may be appropriate for QoS update information (like SNMP traps)

Switch Control

- Open switch control has long been demanded by the open signalling community
- However, at last there are a number of promising up-and-coming approaches including
  - GSMP v1 (General Switch Management Protocol) - master/slave protocol for managing ATM switches but lacking QoS support
  - qGSMP and GSMP v2 - refine GSMP to provide QoS functionality
  - VSI (Virtual Switch Interface) protocol- developed by Multiservice Switching Forum to allow multiple clients to manage a switch
- IETF have recently established GSMP Working Group

Conclusion

- Distributed hierarchical QoS management has been shown to be a scalable approach to providing QoS guarantees in wide area networks
- Operation latency times (200 milliseconds) are extremely low, appearing from the user point of view as instantaneous
- Switch control has in the past been a barrier to take-up of open signalling approaches
- New protocols with backing of IETF and switch vendors
- Role for connection management has changed with the emergence of the Internet. Challenge is to adapt network management to new demands

OMG A/V Streams and TINA NRA: An Integrative Approach

Olaf Kath
Humboldt Universität zu Berlin
Wataru Takita
Nippon Telegraph and Telephone

Questions

- How can one build an environment for continuous media exchange, that supports different data streaming standards and different networking technologies?
- How fits TINA Connection Management and OMG Control and Management of A/V Streams in that framework?

Answers (?!)

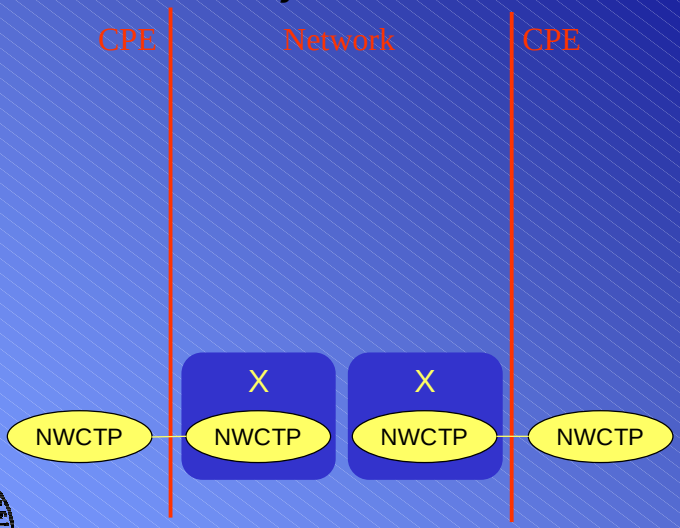
- Application of OMG A/V Streams as *ONE* standard for multimedia devices and nodal bindings
- Application of TINA Connection Management concepts for the management of connections within the transport network

How looks the connectivity consumer - connectivity provider interaction point (i.e. TCon) then?

Outline

- Information objects and their relationships
- Computational representation of information entities
- Computational model and integration of A/V Streams
- Engineering model
- Conclusions

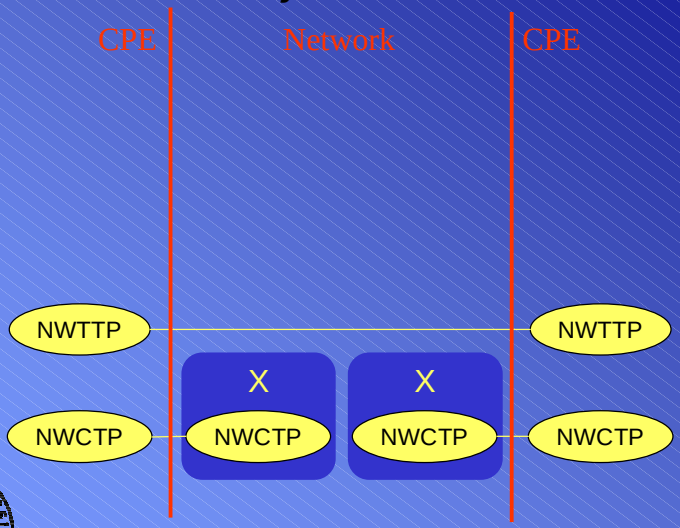
Information Objects



Information Objects

- NWCTP
  - VCI, VPI, MTU, AAL, traffic type, network qos
  - corelated to NWCTP SN
  - colocated to NWTTP

Information Objects



Information Objects

- NWCTP
- NWTTP
  - role, end-to-end user data protocol (e.g. TCP, UDP, native ATM, ...)
  - corelated to NWTTP
  - colocated to NWCTP, NFEP

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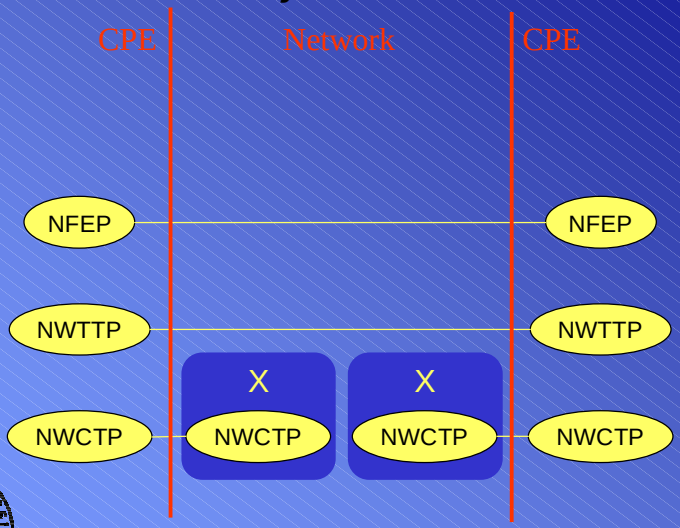
Information Objects



Information Objects

- NWCTP
- NWTTP
- NFEP
  - file descriptor, fragment size
  - corelated to NFEP
  - colocated to NWTTP, SFEP Bridge

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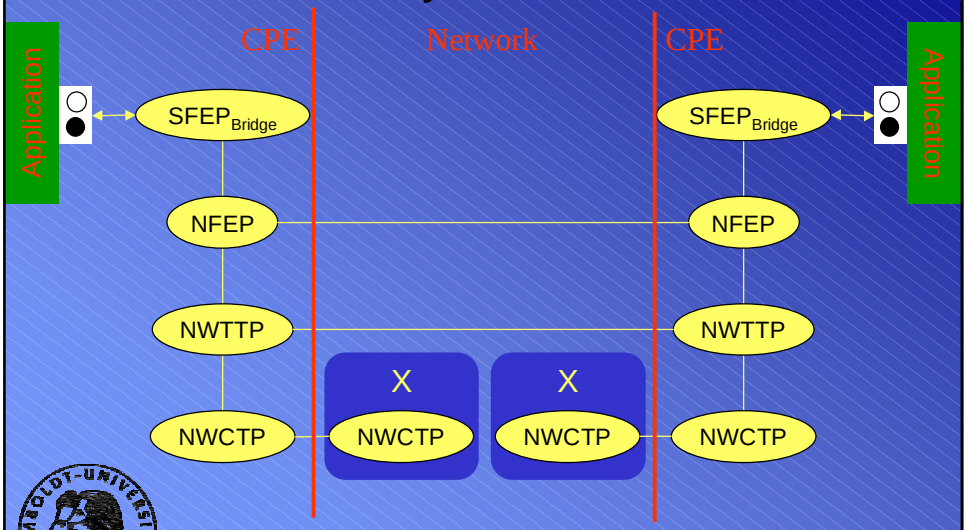
Information Objects

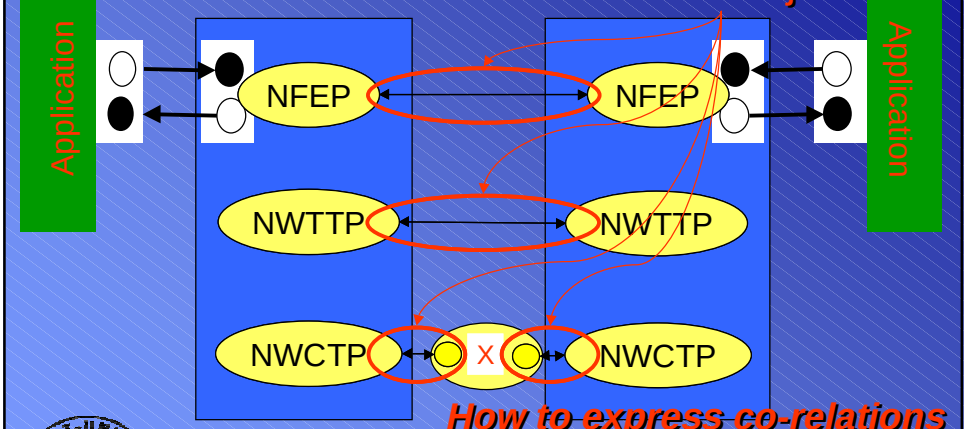


Information Objects

- NWCTP
- NWTTP
- NFEP
- SFEP Bridge
  - Product Standard, user data format, Application Layer Binding mechanism
  - corelated to NFEP
  - colocated to SFEP Bridge

Information Model

Co-Relation between information objects



How to express co-relations of information objects?

Information Object Representation

- Notification channels express co-relations between information objects
  - decoupled communication
  - efficient information exchange
  - application of filters, time-outs for notifications, multi-cast of notifications etc.

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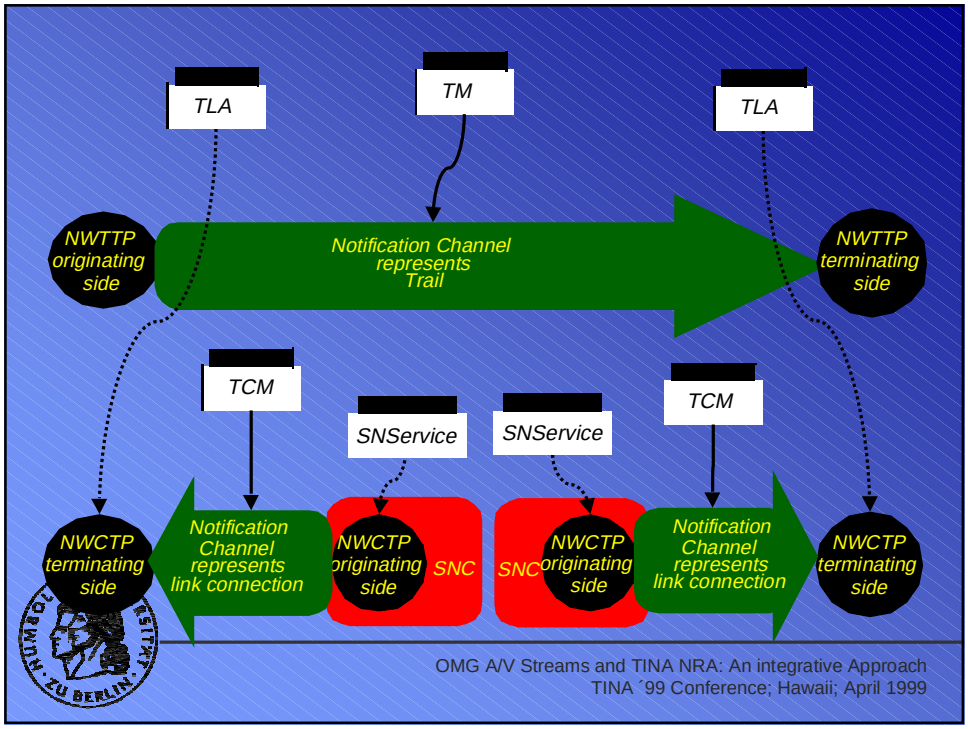

Information Object Representation

- Notification channels express co-relations between information objects
- Application of *Objects by Value* standard for light-weight information objects

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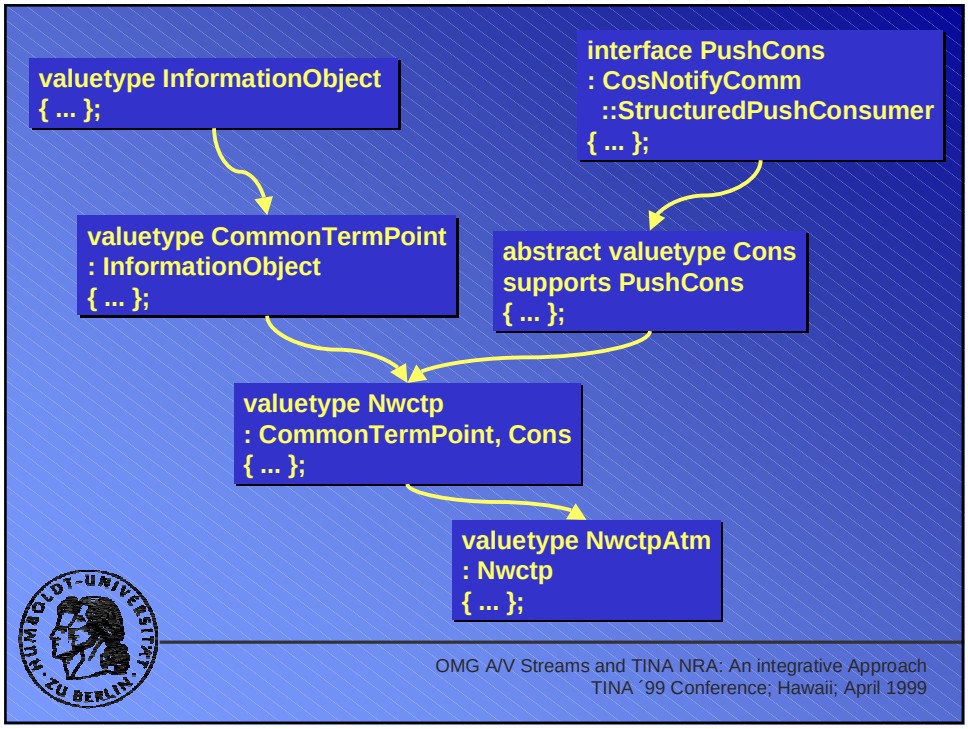

Information Object Representation

- Notification channels express co-relations between information objects
- Application of *Objects by Value* standard for light-weight information objects
  - local operation implementations hold domain dependent semantics, dynamically downloadable

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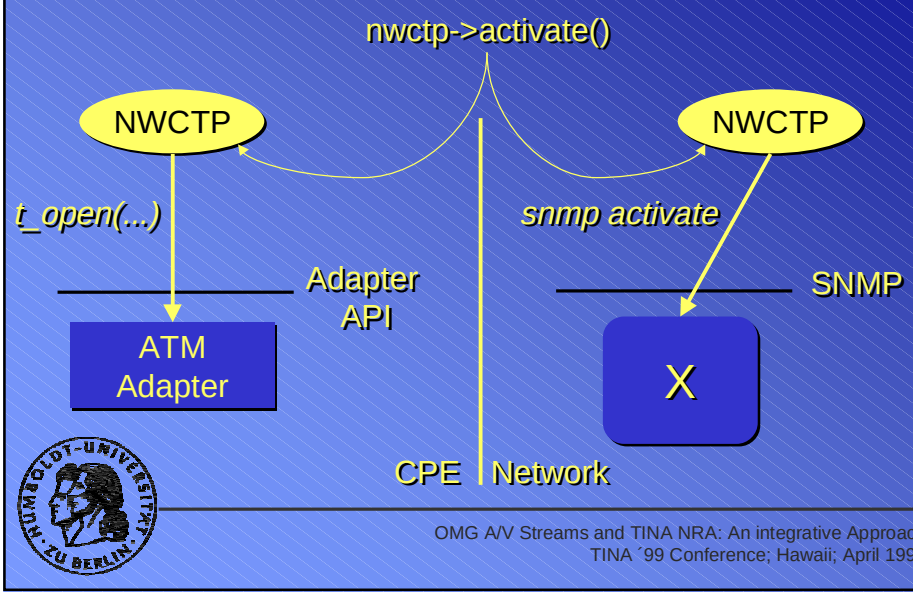
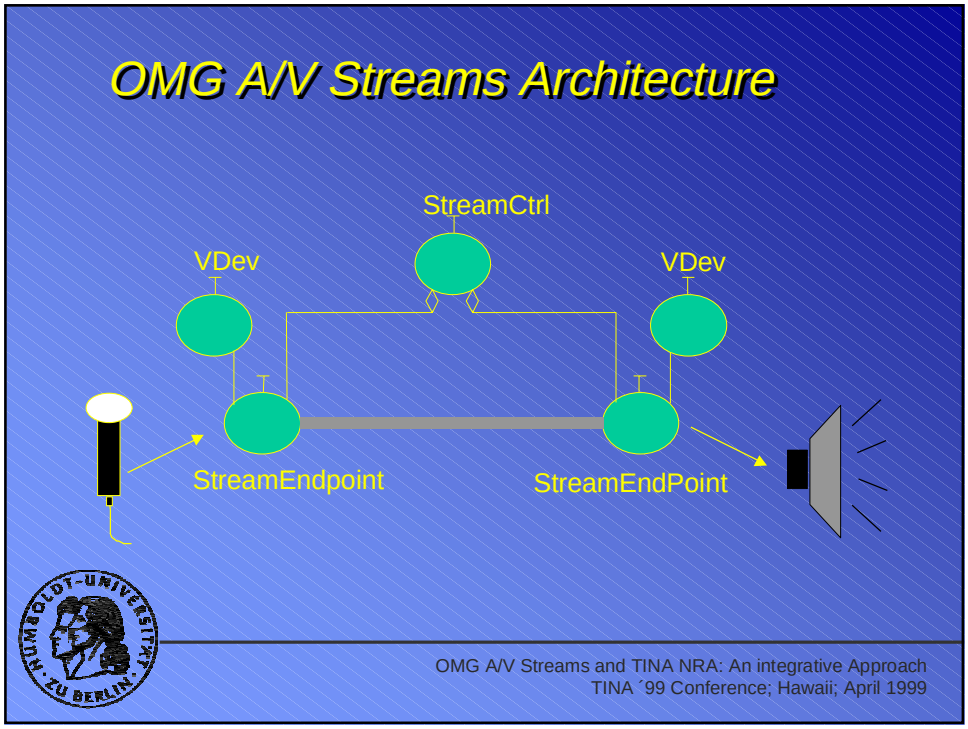
NWCTP Activation



Information Object Representation

- Notification channels express co-relations between information objects
- Application of *Objects by Value* standard for information objects
  - local operation implementations hold domain dependent semantics, dynamically downloadable
  - can be transmitted as notifications directly (soon?!)
  - dependencies between information objects expressed through inheritance


OMG A/V Streams Architecture
StreamCtrl
VDev
VDev
StreamEndpoint
StreamEndPoint
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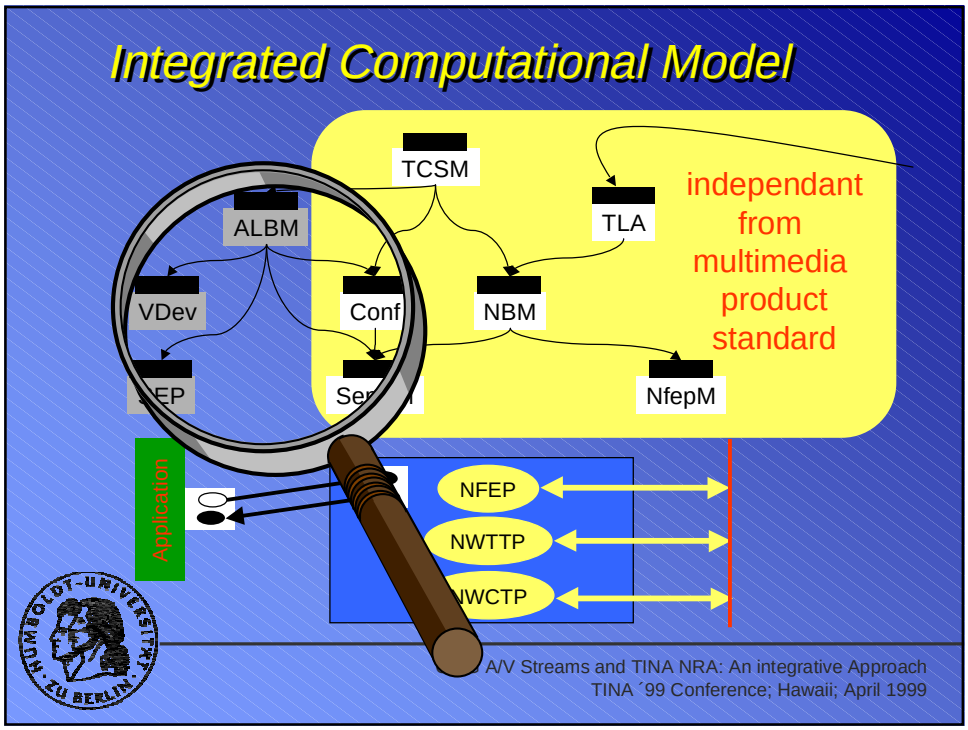
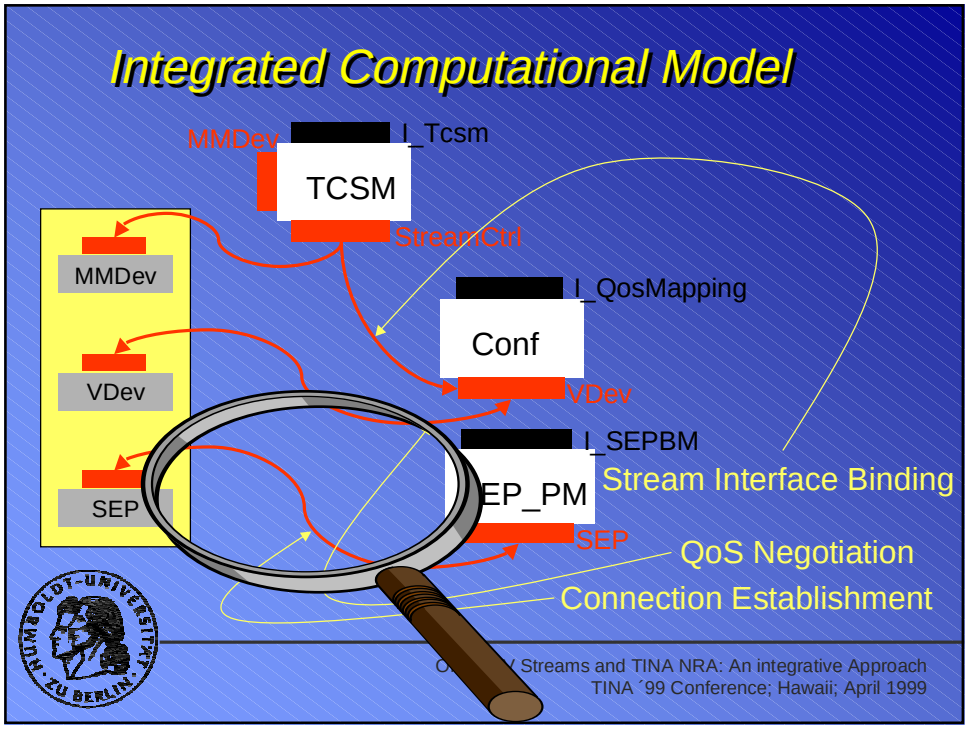

Integrated Computational Model
TCSM
TLA
ALBM
VDev
Conf
NBM
NfepM
independant
from
multimedia
product
standard
Application
NFEP
NWTTP
A/V Streams and TINA NRA: An integrative Approach
TINA ´99 Conference; Hawaii; April 1999


Integrated Computational Model
MMDev
I_Tcsm
TCSM
StreamCtrl
MMDev
I_QosMapping
Conf
VDev
VDev
I_SEPBM
SEP_PM
Stream Interface Binding
SEP
SEP
QoS Negotiation
Connection Establishment
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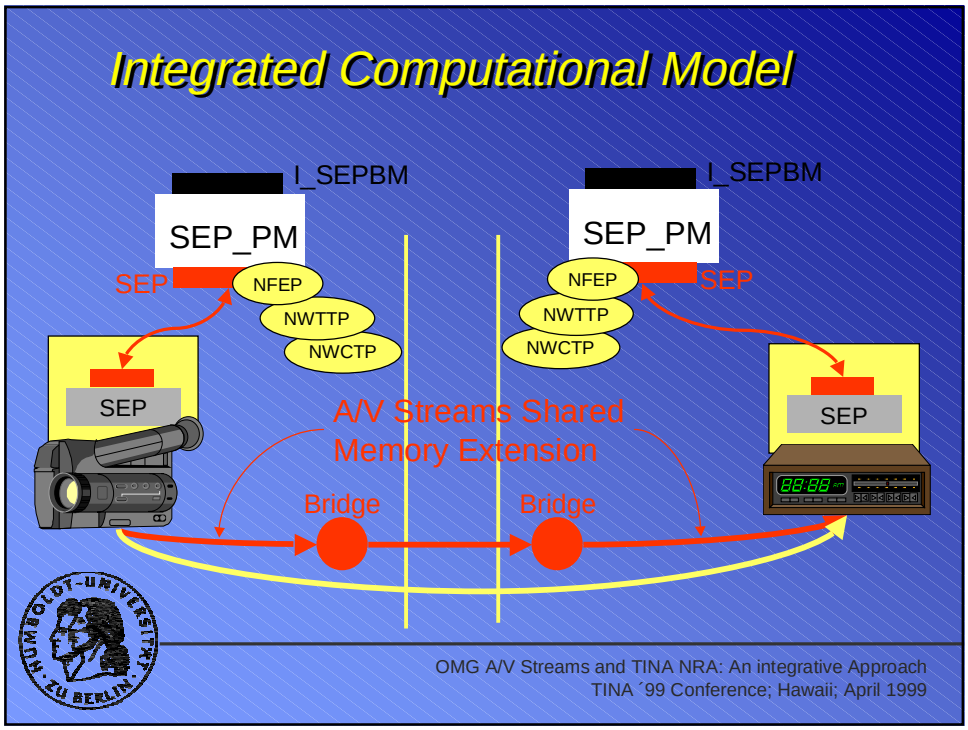
Integrated Computational Model
I_SEPBM
SEP_PM
SEP
NFEP
NWTTP
NWCTP
I_SEPBM
SEP_PM
NFEP
NWTTP
NWCTP
SEP
SEP
SEP
A/V Streams Shared
Memory Extension
Bridge
Bridge
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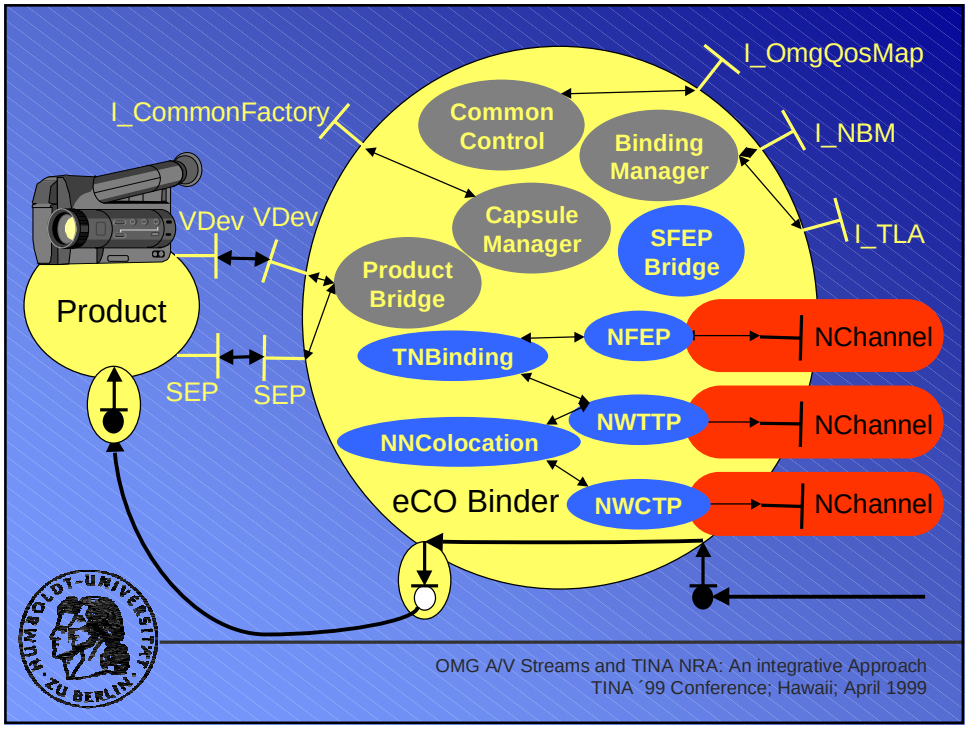

Conclusions

- Framework abstracts from networking technologies
  - efficient and managable framework for customer devices
  - is able to support several networking approaches
  - at different layers (signalling vs. connection management, Internet Protocols vs. native)
  - demonstrator in an ATM environment

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Conclusions

- Framework abstracts from networking technologies
- Simple integration of multimedia products
  - OMG standard „Control and Management of A/V Streams“ as example
  - as much indepandance from multimedia products and standards as possible
  - simple to integrate new standards

Conclusions

- Framework abstracts from networking technologies
- Simple integration of multimedia products
- ObV, POA and Notification Service improved elegance and efficiency of the framework
  - don‘t overuse objects by value !!!

An Implementation of TINA Connection Management System for ATM Networks

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† NTT Information Sharing Laboratories Group
† † NTT Software Corporation

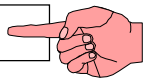
TINA'99 Oahu, Hawaii, April12-15, 1999

Outline

- ***Introduction for TTT (The TINA Trial)***
- ***Scope of TTT-CM (Connection Mgmt) Component***
- ***Object model / basic design***
  - *Engineering mapping,*
  - *Component deployment scheme*
  - *Usage of Trading Service*
  - *Relationship management*
- ***Evaluation for Implementation***
  - *LNC (Layer Network Coordinator)*
  - *CP (Connection Performer)*
  - *Network Resource Data Builder*
- ***Conclusion***

Outline

- ***Introduction for TTT (The TINA Trial)***



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TTT (The TINA Trial)

History

- *Phase1 1997.4 to 1998.5*
- *Phase2 1998.6 to 1999.4*

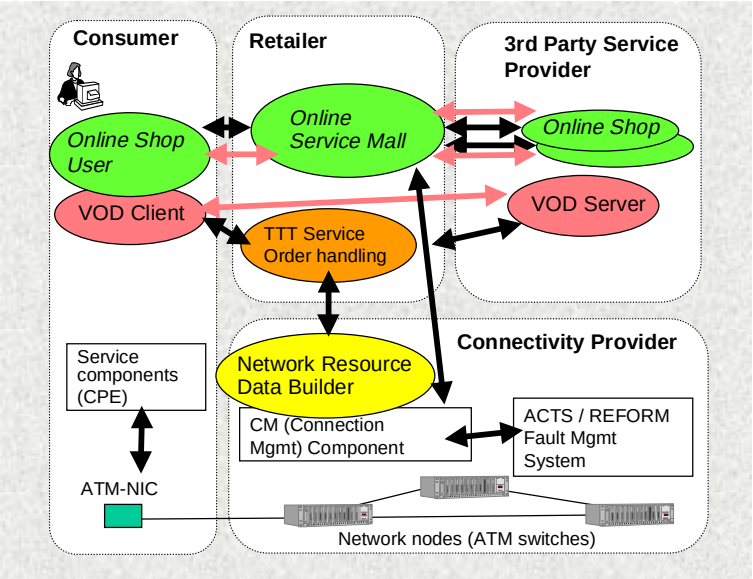
Participants

- *NTT, Fujitsu, Hitachi, NEC, Oki Electric, IBM, IONA Technologies, and CompaQ Computer*

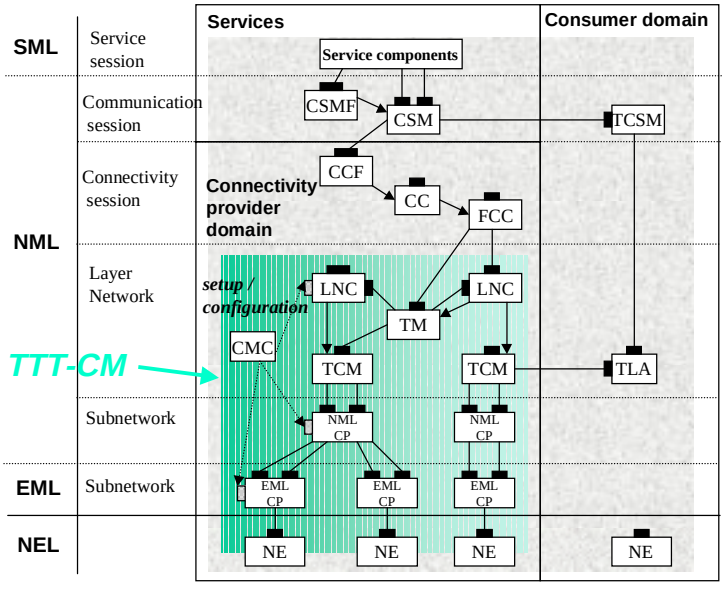
Goal of TTT

- *Providing a full set of product: "from transport to application"*
- *Evaluation and interoperability test for TINA implementations in a multi-developer environment*
- *Feedback for TINA spec in the viewpoint of implementation*

Applications for TTT



Scope of TTT CM (Connection Mgmt) component



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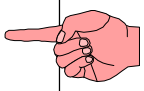


Object model / Basic design

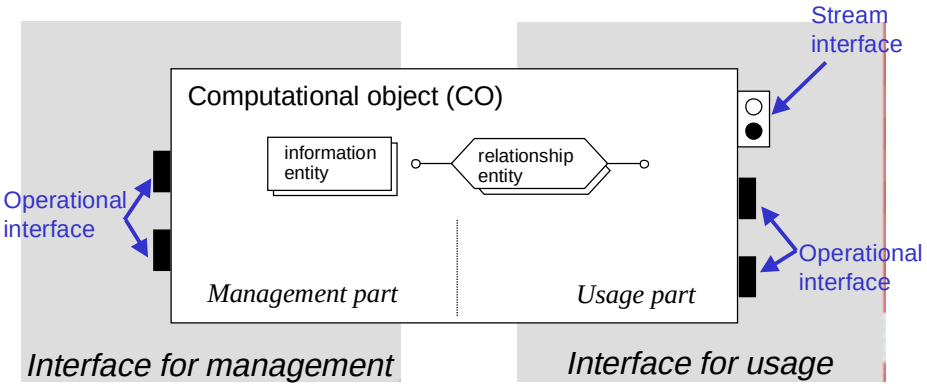
Requirement:

- *Need for flexible object deployment*
- *Need for starting/creating/deleting of objects customized for each system configuration*

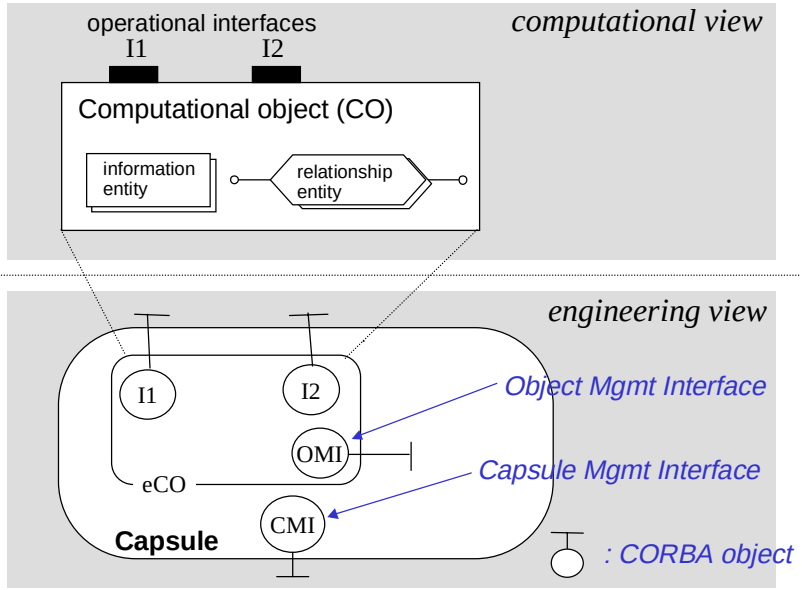
We propose:

- *Mapping scheme of TINA computational object into CORBA objects*
- *Definition of function that manages object creation/deletion*
- *Definition of function that deploys objects into DPE nodes*

TINA computational object



Engineering mapping



Interface definition

CMI (Capsule Mgmt Interface) *is responsible for setup of Capsule, creation/deletion of eCO inside a Capsule.*

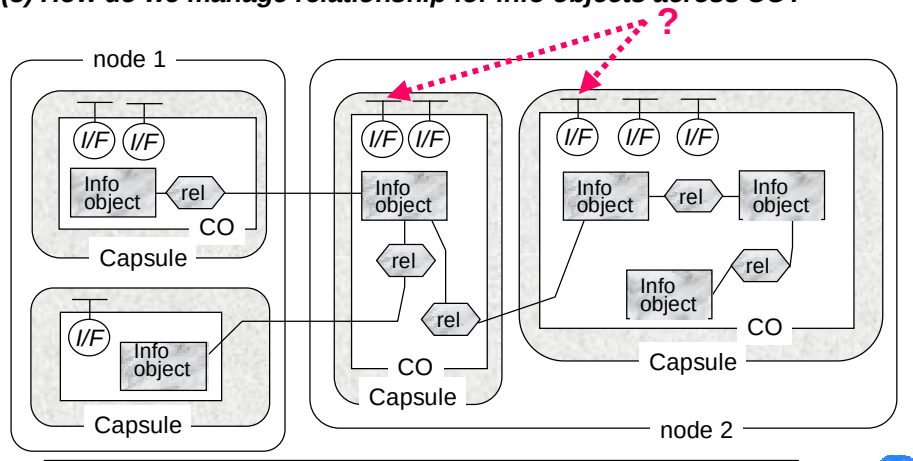
OMI (Object Mgmt Interface) *is responsible for creation /deletion of interface object inside an eCO.*

Mgmt (CpMgmt, LncMgmt,...) *interface handles creation / deletion of information objects inside an eCO.*

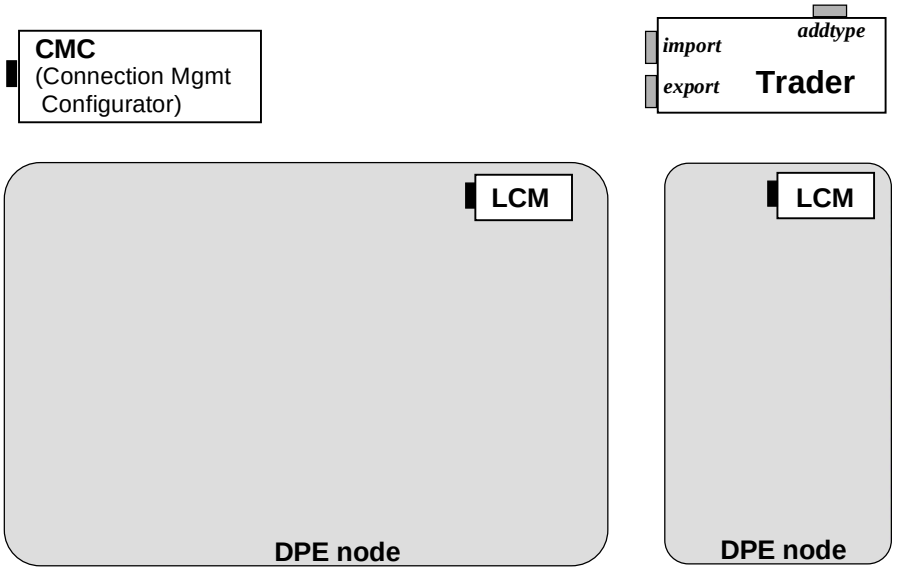
RelationshipIF *handles creating/removing relationship information inside an eCO.*

Usage of Trading Service

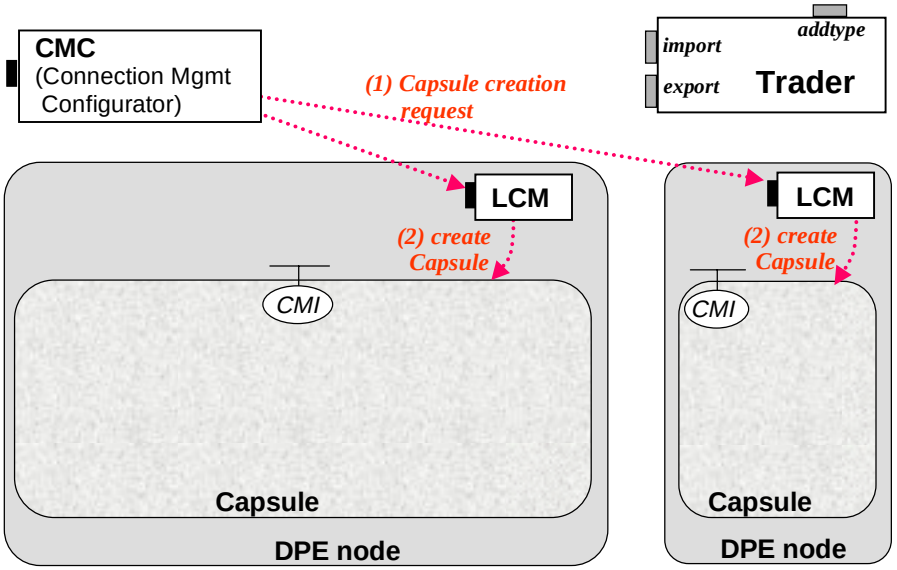
(1) How do we distribute & keep consistency for info objects into distributed CO?
(2) How do we find the right interface object for a particular info object?
(3) How do we manage relationship for info objects across CO?



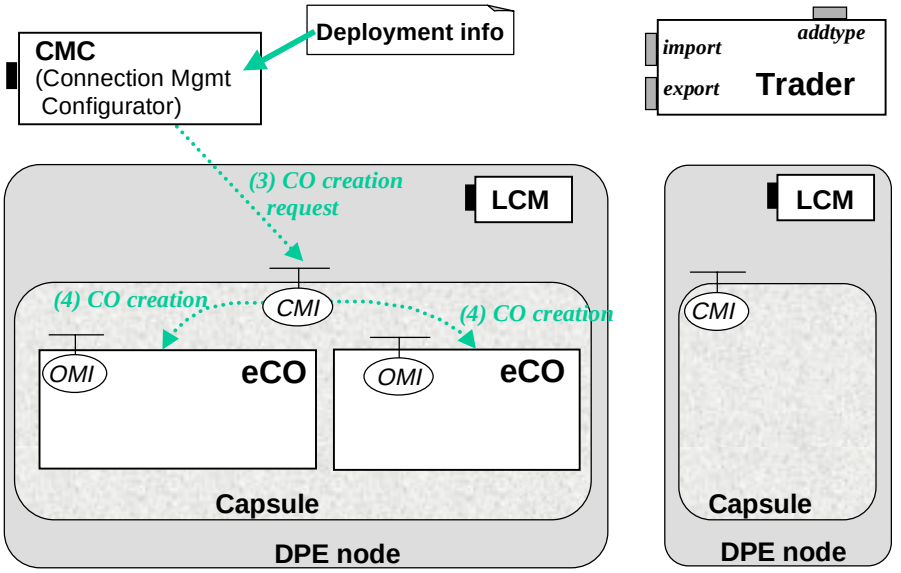
Component deployment-(0)



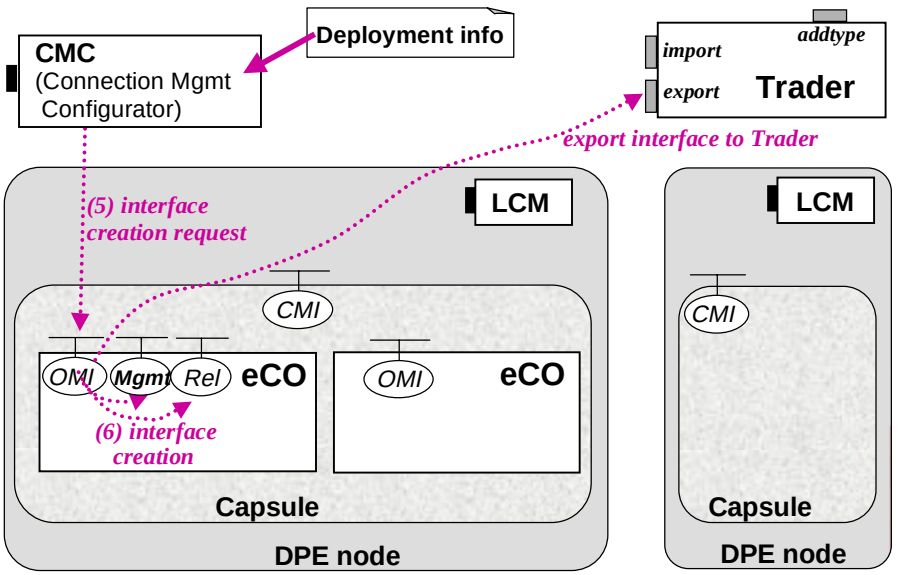
Component deployment-(1)



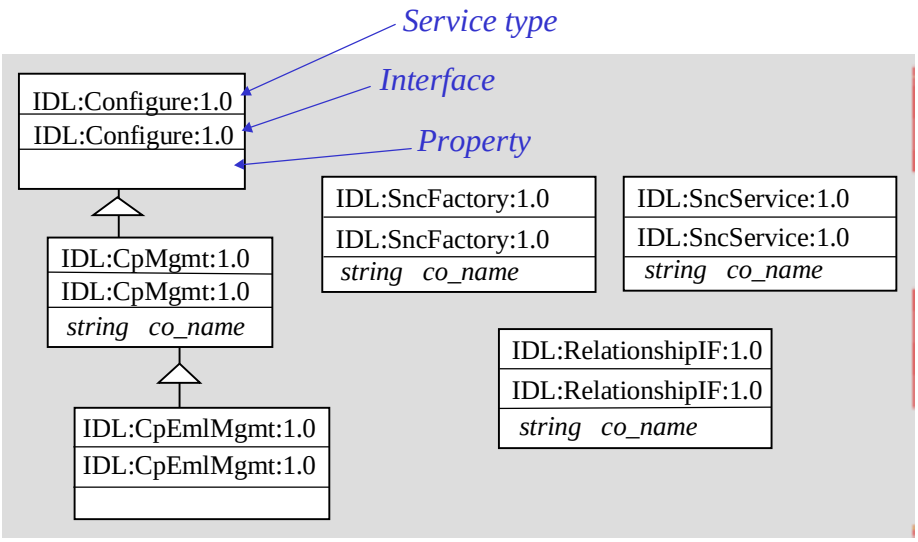
Component deployment-(2)



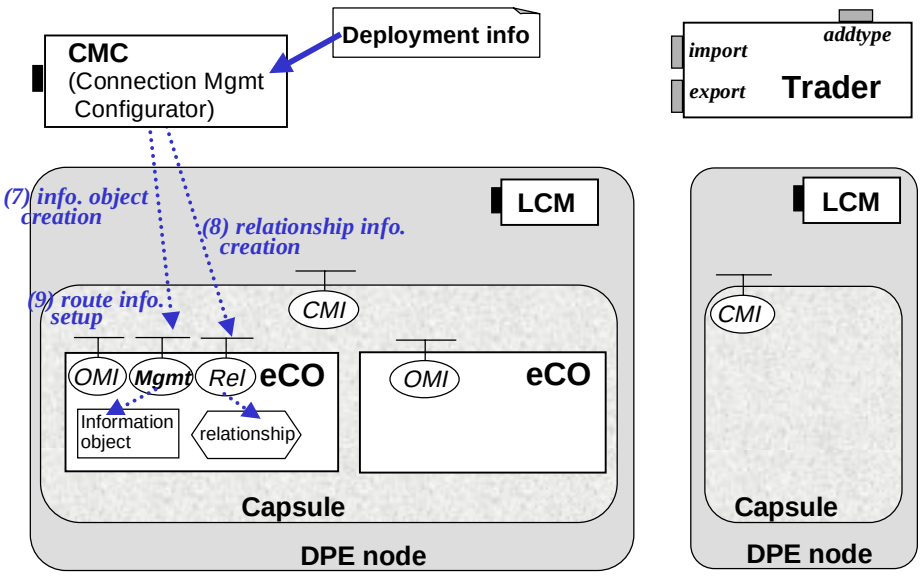
Component deployment-(3)



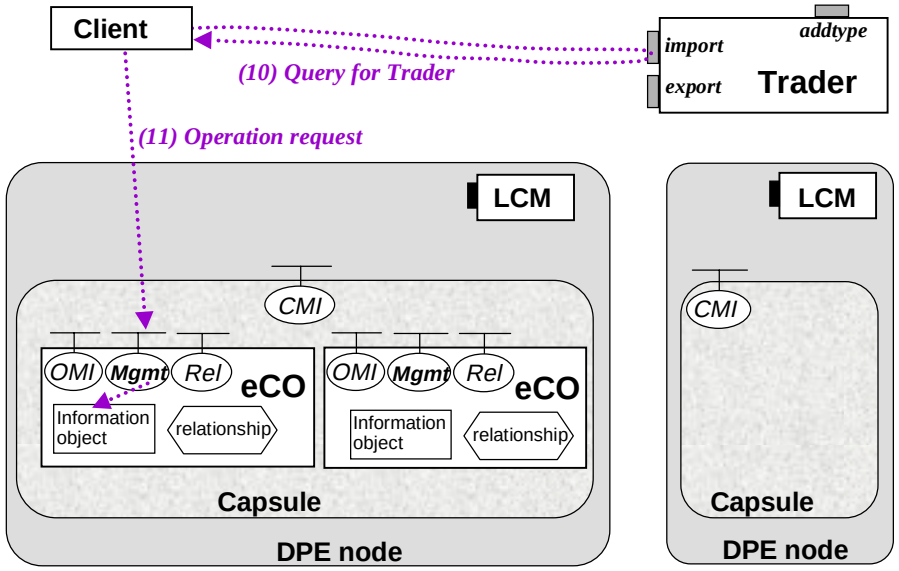
Service type definition (CP example)



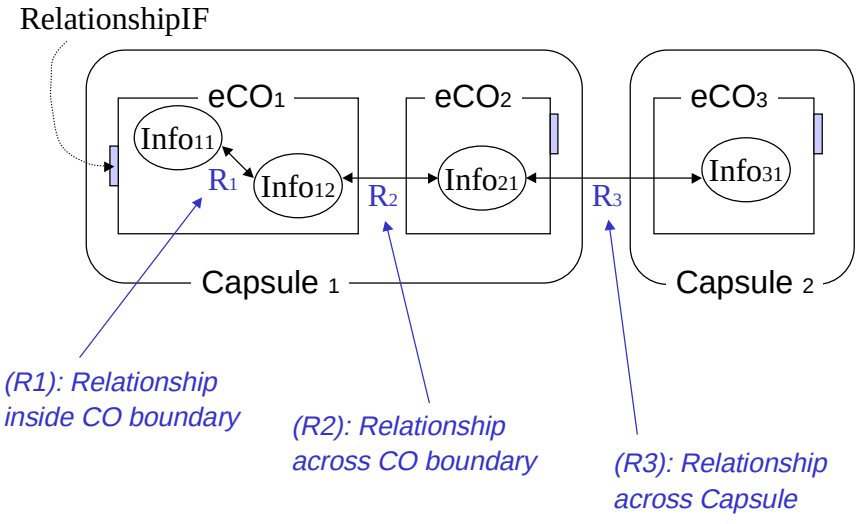
Component deployment-(4)



Management operation



Category for relationship information

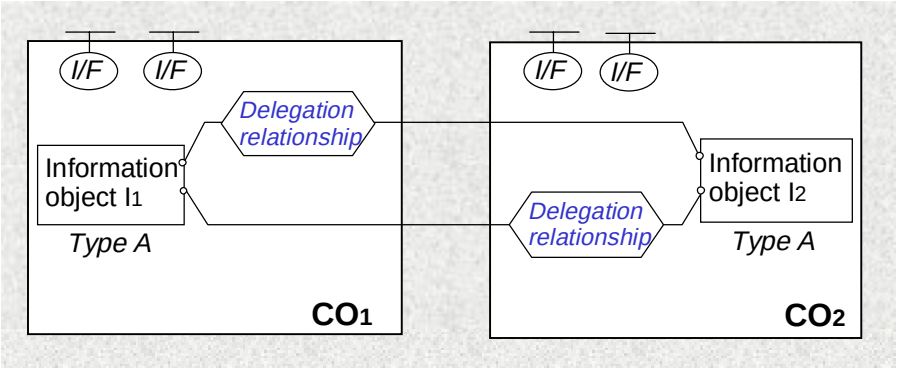


Delegation relationship

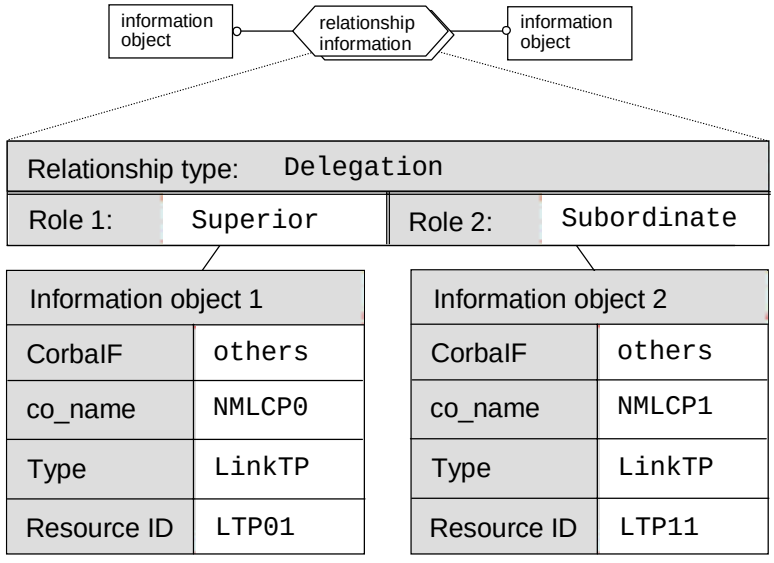
- Delegation relationship relates info objects that are logically coinciding but stored in different COs.

- Example

LinkTP (Network Level --- Element Level)
NWCTP (Network Level --- Element Level)

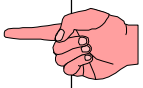


Definition of relationship information

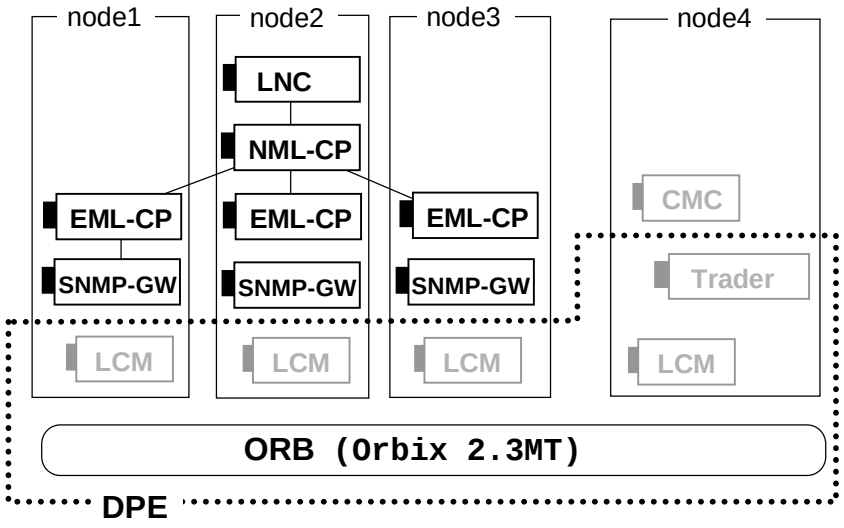


Outline

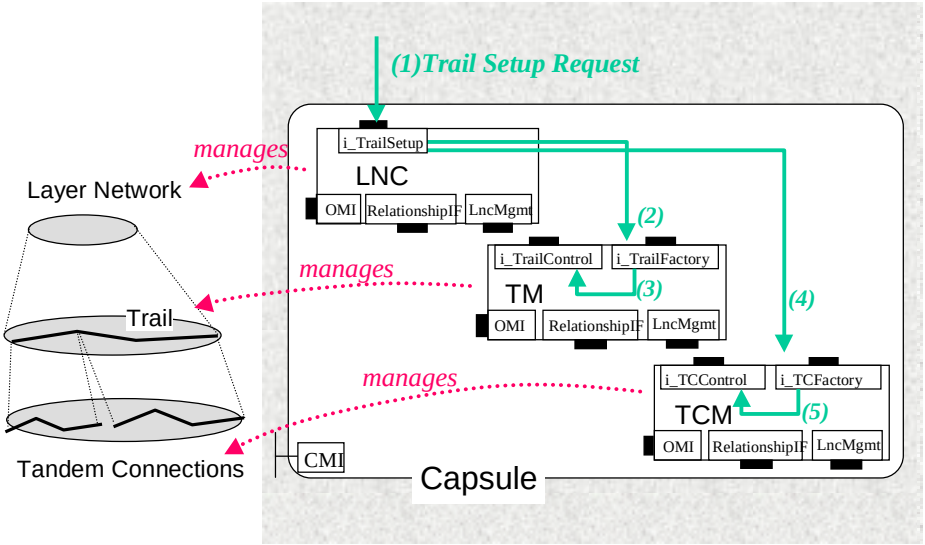
- *Introduction for TTT (The TINA Trial)*
- *Scope of TTT-CM (Connection Mgmt) Component*
- *Object model / basic design*
  - *Engineering mapping,*
  - *Component deployment scheme*
  - *Usage of Trading Service*
  - *Relationship management*
- ***Evaluation for Implementation***
  - *LNC (Layer Network Coordinator)*
  - *CP (Connection Performer)*
  - *Network Resource Data Builder*
- *Conclusion*



Connection management component



LNC (Layer Network Coordinator)



LNC (Layer Network Coordinator)

TTT-CM unique features

- Represents a single layer network domain

- Setup and release point-to-point Trail inside a single Connectivity Provider domain

Evaluation of implementation

- LNC, TM (Trail Manager), and TCM (Tandem Connection Manager) deployed in a single Capsule

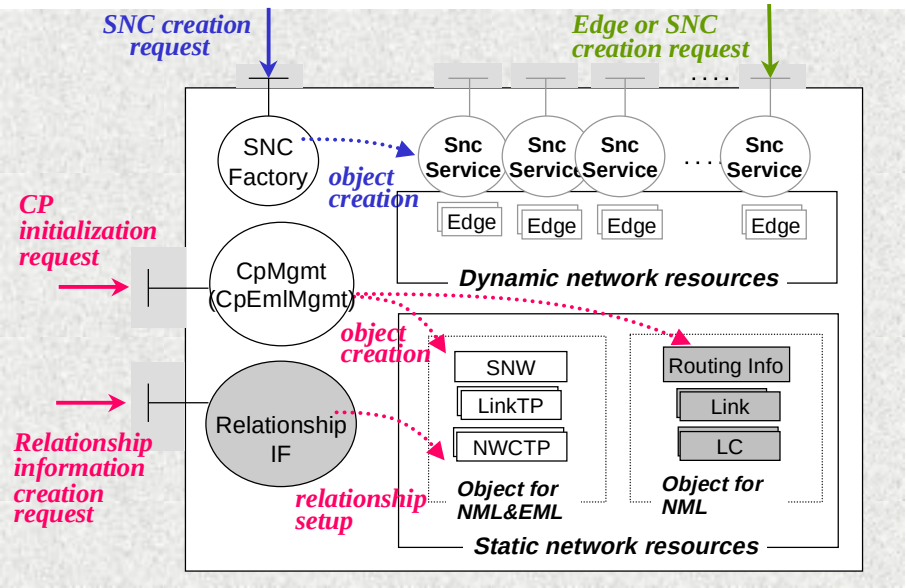
… A customization for concentrating interaction related to Layer Network inside a single process.

- Requires LNC client to handle the Trader usage

… Need for more loosely combined client interface

- Multi-point connection are for further development

CP (Connection Performer)



CP (Connection Performer)

Distinguishes static/dynamic information object

- *Static network resource (SNW, LinkCTP, NWCTP, …) to be set-up initially*
- *Dynamic network resource (Edge, SNC, ...) to be set-up upon request*

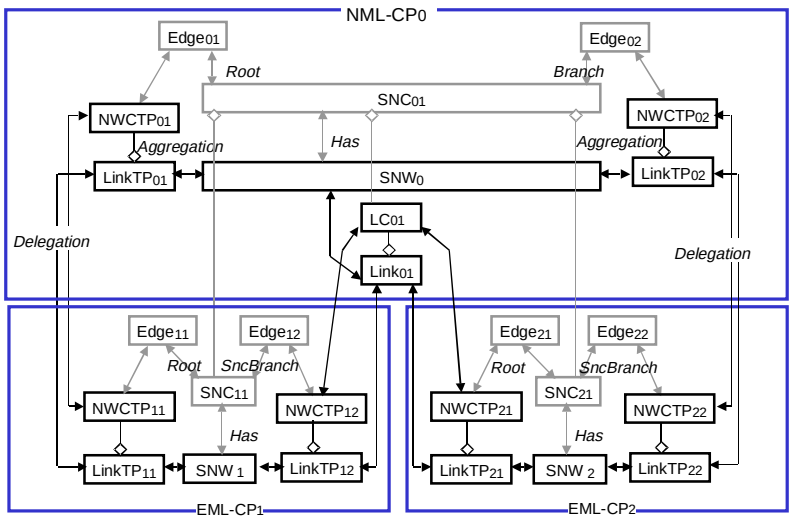
Reuse of common part (NML/EML)

- *Uses common binary code for both NML and EML (Decides behavior of CP by initial parameter)*

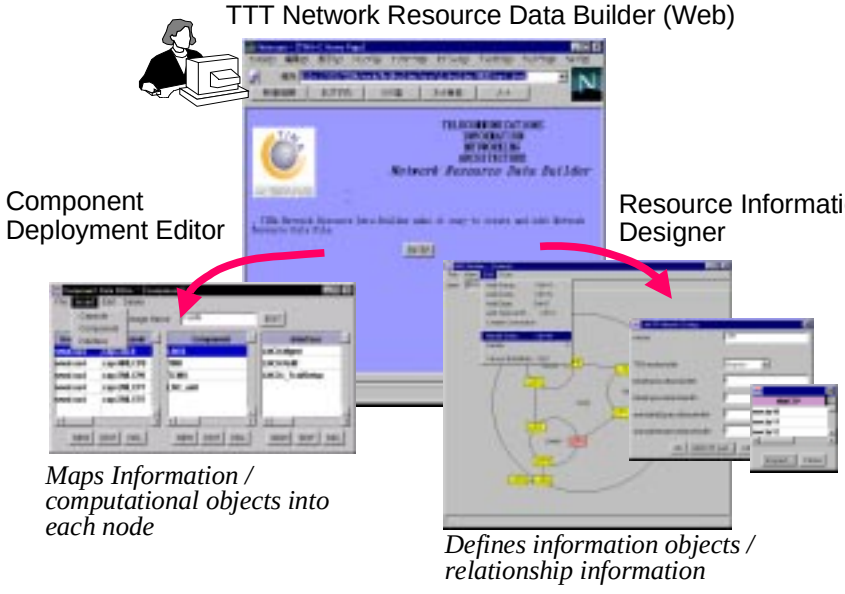
Delegation relationship

- *NWTTP, LinkTp between NML-CP and EML-CP are in delegation relationship*

Managed information of CP



Network Resource Data Builder tool



TINA'99 Conference, Turtle Bay, Oahu, HW, April 1999

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