Session V_b: **Work-in-Progress 2**

Chair: Joe Sventek, *Hewlett-Packard*

Dynamic Load Control for Ensuring QoS in IP Networks

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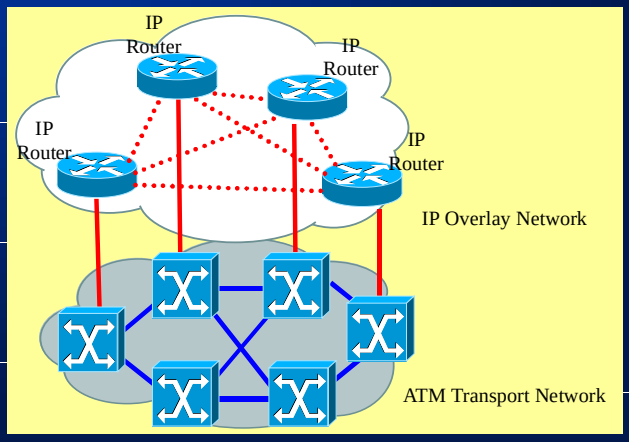
Contents

- Background
- Management Framework
- Proposed Algorithm : ILRM
- Prototype Implementation
- Concluding Remarks

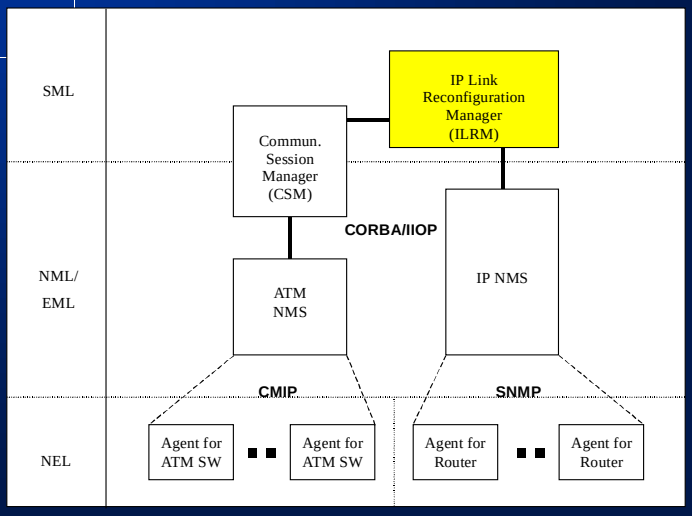
Background

- Emerging time-sensitive and mission-critical applications
  - VOIP, e-commerce, etc.
- ISP backbone test[2] : discouraging results
- Delivering QoS is one of the key requirements
- Two Approaches
  - differentiated QoS for each session : ultimate goal but difficult
  - guaranteeing most stringent QoS requirements : inefficient but easy
- Motivated by the observation that most applications work wel l on unloaded network
- Underlying ATM transport network enables dynamic capacit y reconfiguration

Layered Multi-Service Networ k



Management Framework for Layered Network



Proposed Algorithm(ILRM)

- IP Link Reconfiguration Manager(ILRM)
- Consists of 3 phases
  - **Initialization** : allocating initial link capacity and pre-calculate the route
  - **Monitoring** : periodically measuring the traffic load of each link and traffic volume between any two routers
  - **Reconfiguration** : reconfiguring backbone links triggered by link status change and threshold crossing

Initialization Phase

- Directed graph $G(V, E)$
  - V : set of IP routers v
  - E : set of IP links e
- Pre-allocated link capacity $C(e)$
  - as a result of traffic engineering
- Pre-calculated route $r_{i,j}$
  - set of IP links through which a packet, destined from node i to j, shoul d pass
- Pre-set the design parameters
  - ρ_{ub}, ρ_{lb} : upper and lower bound for traffic load
  - W_{meas} : measurement interval

Monitoring Phase

- Measure the traffic load of each link

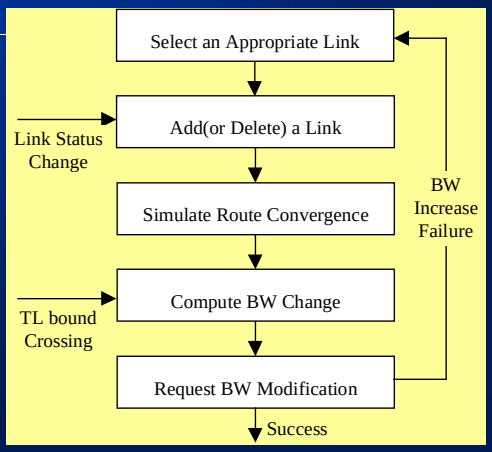
  $\rho(e) = T(t)/(C(e) \cdot W_{meas})$, for all $e \in E$

  where $T(t)$ is the total transmitted bits during $[t\text{-}W_{meas}, t)$
- Compare with ρ_{ub} and ρ_{lb}
- Measure the aggregate traffic volume

  $f(s)$ for all $s \in S$

  where S is the set of all source-destination pairs

Reconfiguration Phase(1)



Reconfiguration Phase(2)

[STEP 1] Drop the link from the topological graph, or

$G' = G(E', V)$, where $E' = E - \{e_{u,v}\}$.

[STEP 2] Simulate the routing algorithm

[STEP 3] Compute the bandwidth for all links by

$$C(e_{i,j}) = \{ \sum_{s \in S(i,j)} f(s)/W_{meas} \} \cdot \alpha, \text{ for all } e_{i,j} \in E',$$

where $\alpha (1 < \alpha < 2)$ is the bandwidth allocation margin.

[STEP 4] Request the bandwidth modification to the CSM

[STEP 5] If receiving an ACK from the CSM, notify the IP NMS of the change and then go to the monitoring phase.

Reconfiguration Phase(3)

[STEP 6] If the CSM replies that it cannot increase the requested bandwidth for a certain link $e_{i,j}$, select an appropriate source-destination pair $s=(k, l) \in S(i, j)$, such that

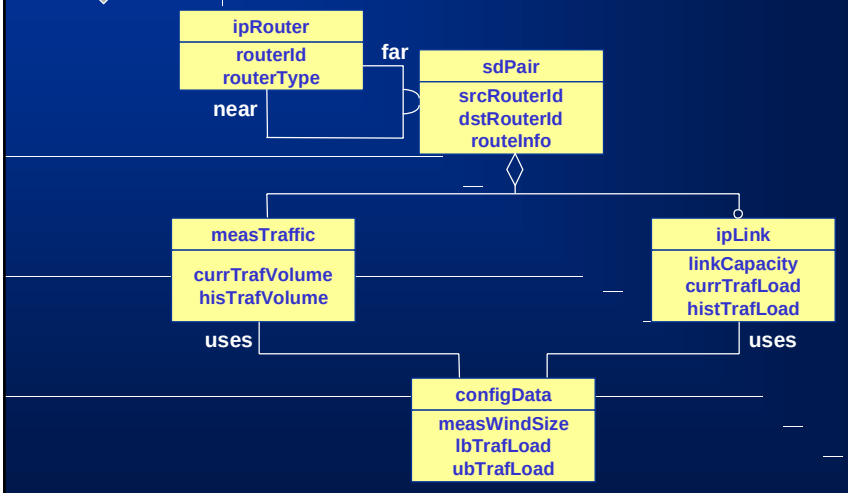
$$f(s) \geq f(t), \quad \forall t \in S(i, j), t \neq s$$

and

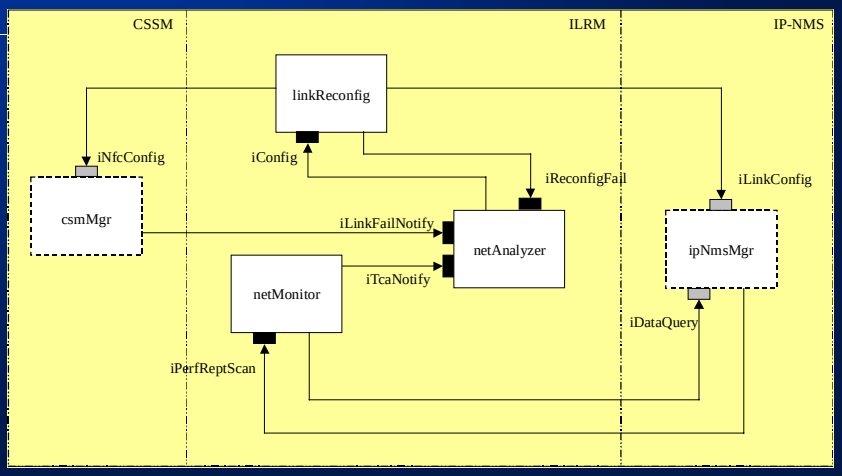
$$|r_{k,l}| > 1$$

[STEP 7] Add the link $e_{k,l}$ to the topological graph or $G'' = (E'', V)$ where $E'' = E' \cup \{ e_{k,l} \}$, and then go to STEP 2.

Information Model



Computational Model



Concluding Remarks

- ILRM scheme
  - monitoring traffic load of each link and aggregate traffic volume
  - dynamically adjusting the IP link capacity
  - ensuring a certain level of QoS in IP backbone networks
  - enhanced adaptability to expected and unexpected traffic variation
- Information and computational model
- Future works
  - verification of effectiveness and stability
  - tuning the design parameters

TINA Business Model for UMTS: Benefits and Possible Enhancements

Chelo Abarca, Alcatel
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Introduction

- **UMTS aims to the provision of personal, terminal and service mobility within the system concept called Virtual Home Environment (VHE)**

  VHE = a system concept for personalised service portability across network boundaries and between terminals

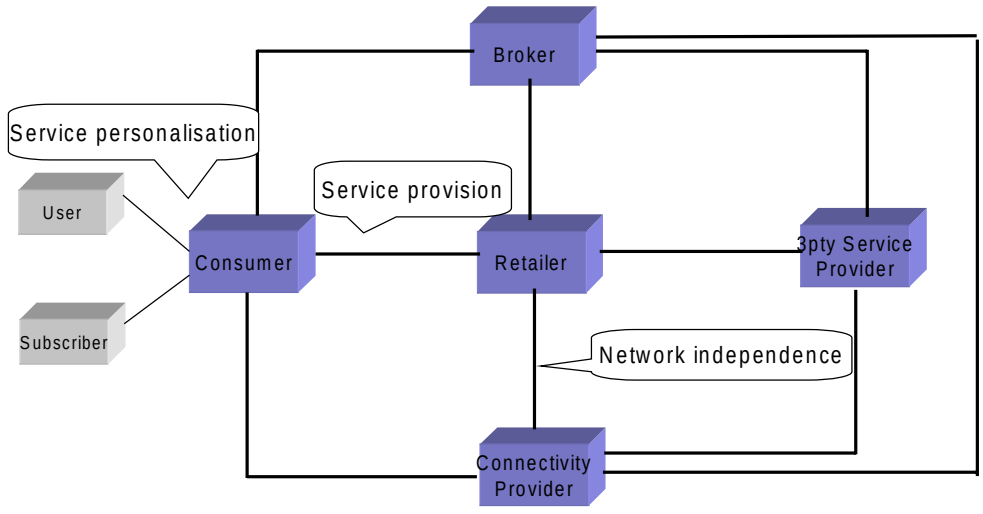
  (not only UMTS: all 3G mobile systems)

- **This is a big step away from legacy, second generation mobile systems… and towards TINA**

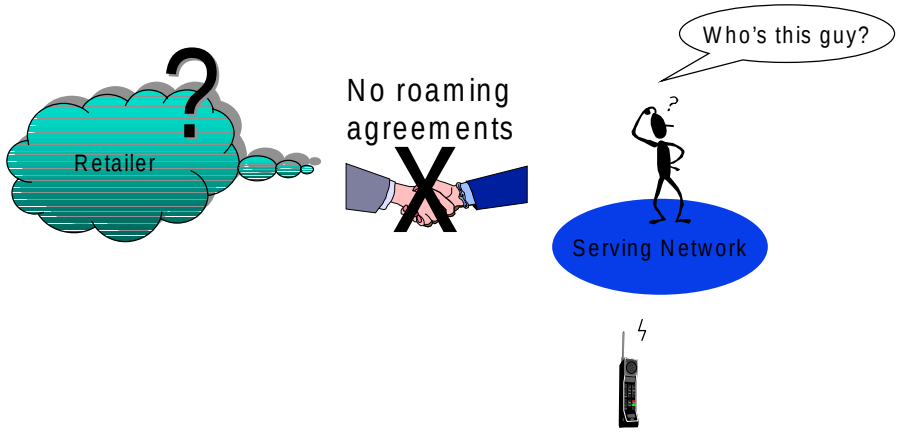
What's new in UMTS?

- **Service provision vs mobility provision**
  - Users attracted by services
  - Mobility taken for granted
  - One-stop shop
- **Single network technology vs network independence**
  - Services "any one, any time, any place"
  - Re-use of legacy networks
  - Fixed-mobile integration
  - New regulatory environment
- **Service personalisation**
  - User as an entity different from subscribers
  - Virtual Home Environment

TINA Business Model Applied to UMTS



The Problem Of a Roaming User



TINA Business Model Enhancement

TINA Broker

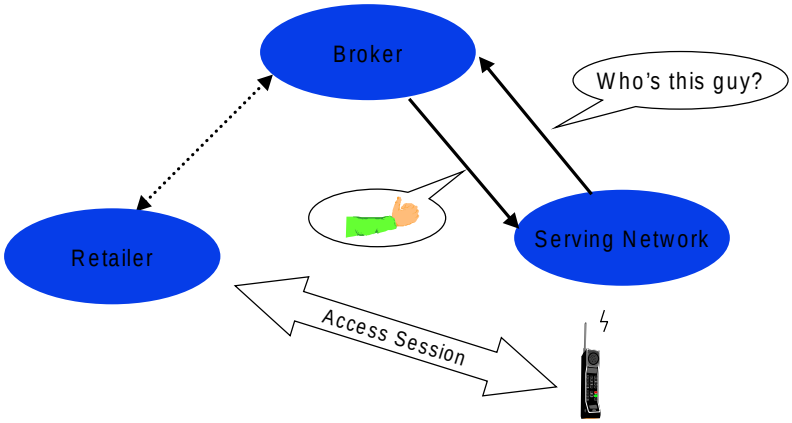
"yellow pages" functionality

+

"credit card" functionality

- resolution of universal numbers
- payment guarantee

The TINA/UMTS Roaming Model



Conclusions

- **TINA provides the right focus for the evolution towards 3G mobile systems**
- **TINA can be easily enhanced to support the needs of 3G roaming users**
- **Further work is starting in TINA to study a TINA solution for full VHE capabilities**

Interested? Contact Chelo Abarca (Chelo.Abarca@alcatel.fr)

The Development Of Multimedia Telecommunication Systems That Integrate ITU IN CS 2/4 And Implement TINA Interfaces

Dr Thomas Adeoye

JilTel Communications

Introduction

This paper describes the JilTel multimedia telecommunication systems architecture , that integrates the ITU IN Capability Set(CS) and implements TINA Interfaces

Dr Thomas K Adeoye

JilTel Communications

Topics

- Introduction
- System Functionality
- Architecture
- Technology
- Using The System
- Conclusions

Increasing competition in the market place and need for better communication effectiveness requires:

- The integration of the telephone network, computer telephony(CTI),video conferencing and internet/intranet network technologies
- A system architecture that leverages on the rapid advances that are being made in the internet/intranet , telephone networks , video networks and distributed computing

The JilTel System can be used to implement this new generation of networks- providing:

- Voice, high quality video and data conferencing that can be integrated with applications such as electronic commerce , distance learning and computer telephony integration.
- Users can access services via an internet browser compatible interface. Integration with web servers

The Architecture Is Scaleable

Applicable to the needs of :

- Single Business Organization,
- The Enterprise
- Telecommunications Service Provider.

A Three Layer Architecture

- Application Layer
- Service Layer
- Connectivity layer

Application Layer

- The application services domain can access services through the CORBA ITU-IN/TINA interface.
- Third parties can develop application services to suit their own requirements. Example applications in E Commerce ,distance learning and CTI are provided .
- Object oriented analysis and design (OOAD) tools are provided to help the development of these extensions.

Service layer

- The service layer provides for
- Call control for voice , video and data.
- Service extensions are possible using Java server-lets or C++ libraries.
- Service extensions are fully integrated with core services such as call control. Thus an extension service e.g a E commerce service can invoke the call control service.

Connectivity Domain Layer

- Connectivity domain layer can consist of a combination of selected network connectivity types:
  - 1)PBX's
  - 2)Voice Over IP Network Gateways
  - 3)PSTN gateways
  - 4)Studio Quality Video Networks.
  - 5)IP Telephones
  - 6)Cable modems
  - 7)ATM Networks

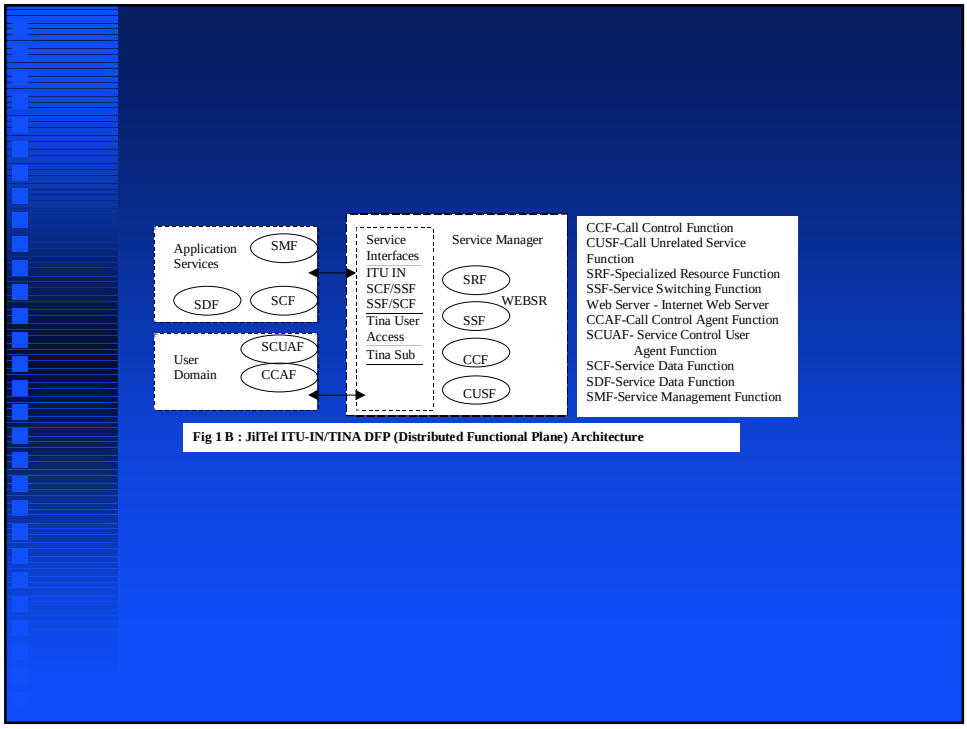


Fig 1 B : JilTel ITU-IN/TINA DFP (Distributed Functional Plane) Architecture

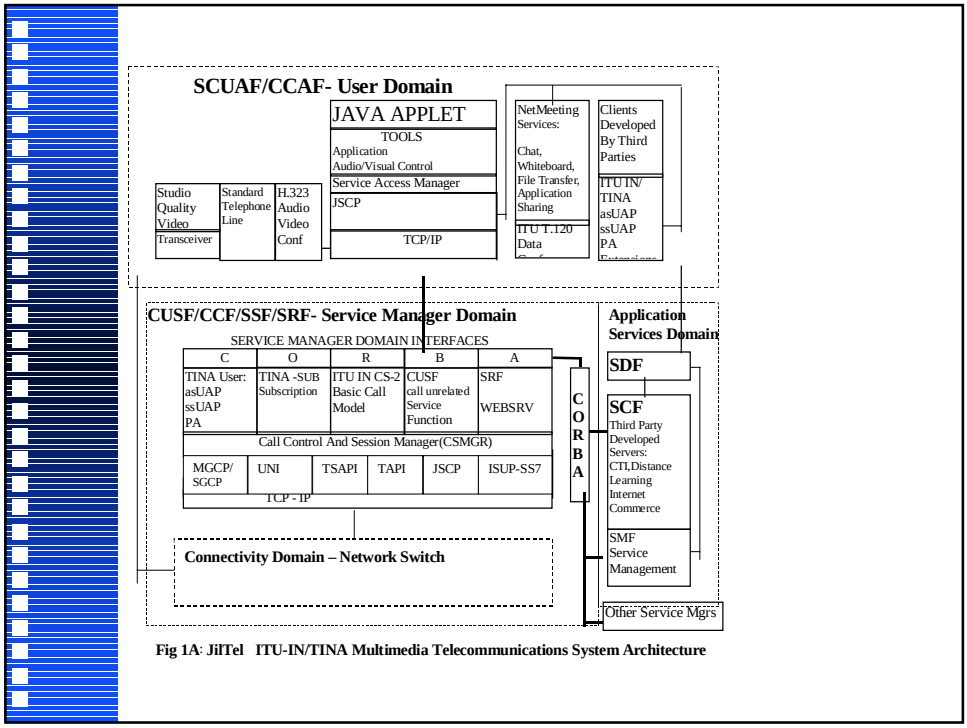


Fig 1A: JilTel ITU-IN/TINA Multimedia Telecommunications System Architecture

Intelligent Network -ITU IN

- The intelligent network has been successful within the telephone network in integrating various components from many vendors.
- It has provided standard open interfaces that have encouraged vendor interoperability

Integrates ITU-IN,Internet,TINA

- The work described in this paper has extended the standard open interfaces and vendor interoperability of the intelligent network to include other computer networks such as the internet .
- TINA interfaces have been incorporated in order to standardize the new interfaces that are required

IN Call Model + TINA User Domain Interface

- Fundamental to this integration is a call model that is applicable to all components of the integrated system.
- Integration of the ITU CS-2 IN basic call model with the TINA user domain interface model . The TINA user domain interfaces used are the : asUAP- access session user application, PA- provider agent , ssUAP - service session user application interfaces)

The ITU-IN DFP Was Modified So As To Be Able To Incorporate Internet/Java Technology

- In ITU IN model, the service control function (SCF) requests the specialized resource function(SRF) to select and activate a user interaction script . This user interaction script controls interactions with the user
- The SRF model used in the JilTel system can request the internet browser to execute Java applets, display HTML hyperlink documents and other media files such as audio and video. Java forms are used to capture the user's response

The TINA User Domain Interface Model Was Used To Enhance The ITU IN CS

- Uses TINA call party handling rather than the ITU IN call party handling features such as add a leg.
- This is because the treatment of call party handling is much more detailed in the TINA model.
- The TINA interface functions allows for the creating and destroying of call sessions ,the adding and removing of users from sessions. TINA also has the advantage of the concept of media streams and there are functions to manipulate users streams

The ITU IN CS-2 Basic Call Model Was Used To Enhance The TINA User Interface Model

- TINA user domain model allows users to be added to a service session (this corresponds to making a call in the ITU IN CS-2 model).
- Adding a user to a service session, is not as straightforward as it seems,in a telecommunications network. This could involve dependencies on many factors in the telecommunications infrastructure
- At specific points in a call , other network service components are required to interact with call processing
- Adding/Removing users from sessions is best implemented through TINA user domain functions, which then invoke the ITU IN basic call service processing model triggers

Using The JilTel System-Architecture solutions

- Different architecture solutions are possible by selecting and integrating two or more network types in the connectivity domain.
- These networks types are controlled by the service manager.
- Connectivity domains can be seen as plug in's into the architecture. Example architecture solutions are described next

Solution 1- PBXs with video conferencing , data collaboration and internet/intranet application servers

- Implement the connectivity domain with two network types:1-Standard PBX and 2-Studio quality Video PBX /Network .
- The JilTel system provides a high quality video network which can be used as part of a connectivity domain. In the distributed video network, users are connected via a central video hub (switch) in a video star network topology

Solution 2-IP Telephone Networks & Cable Television Networks that provide telephony, internet and video services

- The network elements in the connectivity domain, include: 1)Trunking gateway 2)SS7 module and 3) Cable modem or set top box.
- These devices can be controlled from the service manager using SGCP. The Simple Gateway Control Protocol (SGCP) is a standard from Bellcore that describes a master/slave protocol for establishing voice over IP (VoIP) calls
- SGCP has been adopted by the Cable Modem industry as part of the DOCSIS(Data Over Cable Service Interface Specifications) standard

Solution 3: Telecommunication Provider Networks With Multimedia Internet Application Servers

- Allow integration with customer's computer networks, the internet and intranet technologies.
- Allow customers to be able to modify services, create and install new services
- These services have to go beyond the current basic services(e.g. call routing) provided by Service Control Point(SCP) databases.
- Customers should be able to create or modify vertical market application services e.g. distance learning and Internet E Commerce.

Conclusions

ITU IN has been integrated with TINA interfaces to provide solutions that integrate telecommunication and application services which utilize internet/intranet technologies

- The JilTel ITU IN/TINA architecture has been prototyped. Some multimedia telecommunication solutions are being offered as commercial products while others are being offered as customised solutions.
- To help others to conduct future work in this area, an evaluation software development kit based on the JilTel ITU-IN /TINA architecture is being made available at http://www.videoteleconf.com.

Secure Access Control in a TINA environment containing Mobile Agents

Patrick Gleeson - KPN Research
Oliver Weissmann - University of Siegen

SCARAB Smartcard and Agent enabled Reliable Access

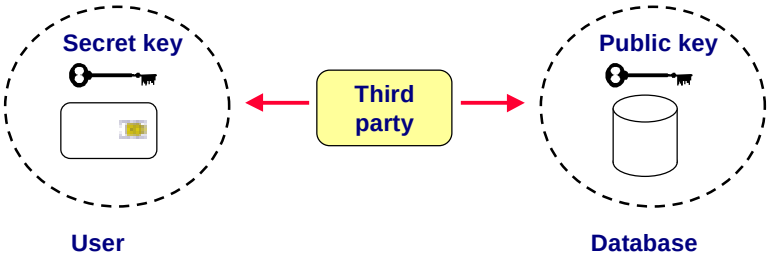
- European Union ACTS project
- Investigation of synergy between Java, Smartcards and Mobile Agents for provisioning of telecommunications services
- Security also covered in depth

Our goal: Users can access the services of their retailer via the use of their smartcard, independent of network and terminal, and in multiple domains.

Nice in theory, but…

- *Terminals and access networks in foreign domains don't have secure association with all retailers*
- *Difficult to have service code available in all locations*
- *Not all terminals have code for every service*
- *Code sent to terminals/foreign domains must be verifiable as safe*

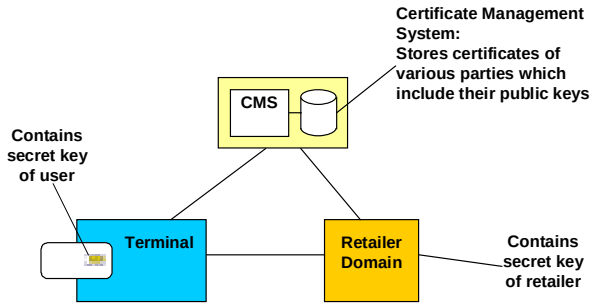
Public Key Cryptography



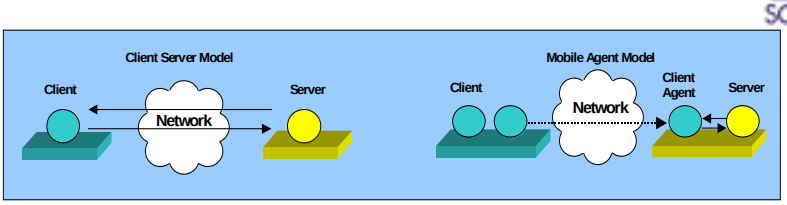
- Everything encrypted using the public key can only be decrypted by the use of the secret key.
- Everything encrypted using the secret key can only be decrypted by the use of the public key.

Access Control Mechanism

- Interaction between Terminal, Retailer and Certificate Management System



Mobile Agents



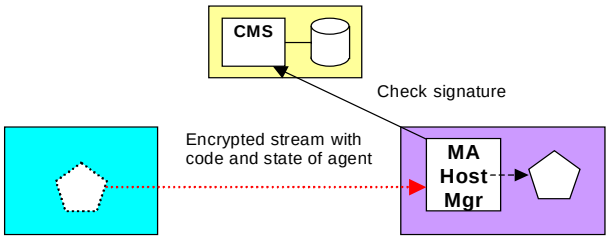
Properties:
- Mobile
- Autonomous
- Communicative
- Reactive
- Pro-active

Advantages:
- Bandwidth reduction
- Disconnected processing
- Local interaction

Disadvantages:
- Security Risks

Secure Mobile Agent Movement

- Define Instantiation Entity & Mobile Agent Host
- Use encryption of data stream

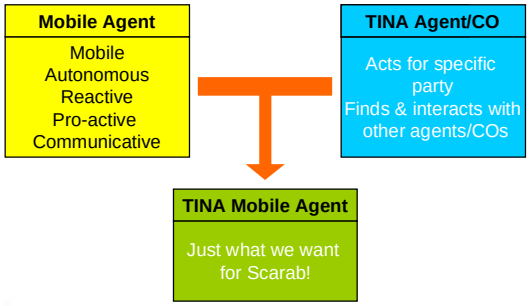


Instantiation Entity
- Only place Mobile Agents are created

Mobile Agent Host
- Only place Mobile Agents carry out their tasks

Turning a TINA Agent into a Mobile Agent

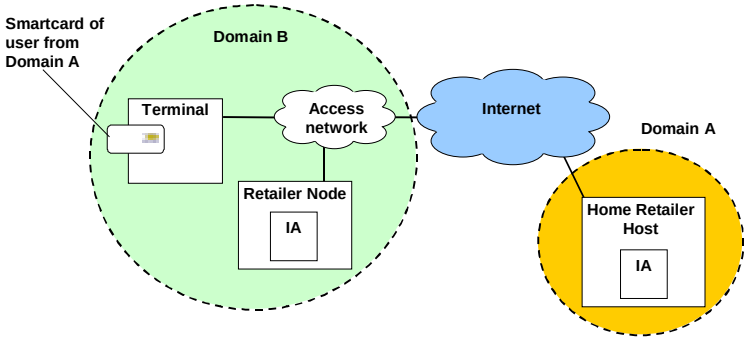
- Big difference between Mobile Agent and TINA Agent/COs (e.g. User Agent, Provider Agent)
- We'll take useful aspects from MA to create TINA Mobile Agent



Application to TINA - Scenario

SCARAB

- Under what circumstances would these technologies be needed?



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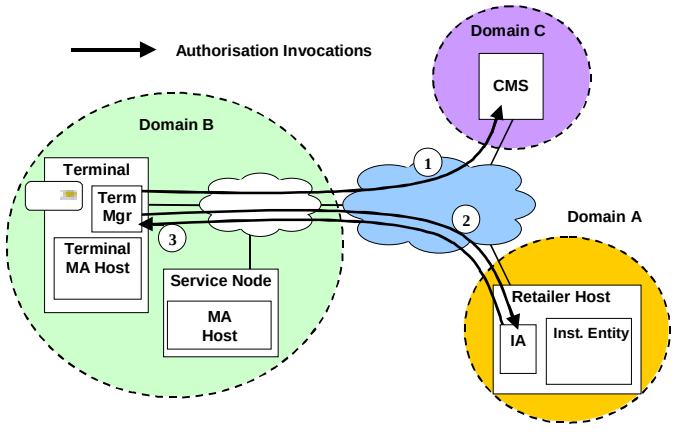
Application to TINA - Our Solution (1)

SCARAB



1 Get retailer certificate 2 Challenge retailer 3 Challenge user

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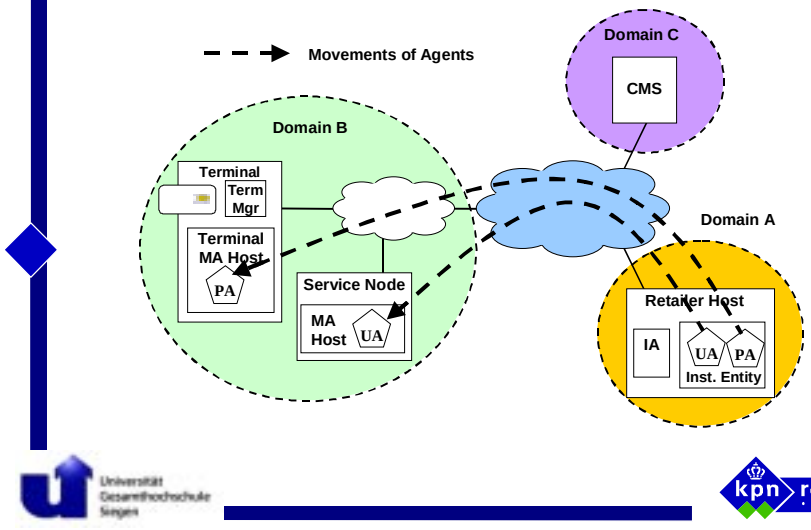
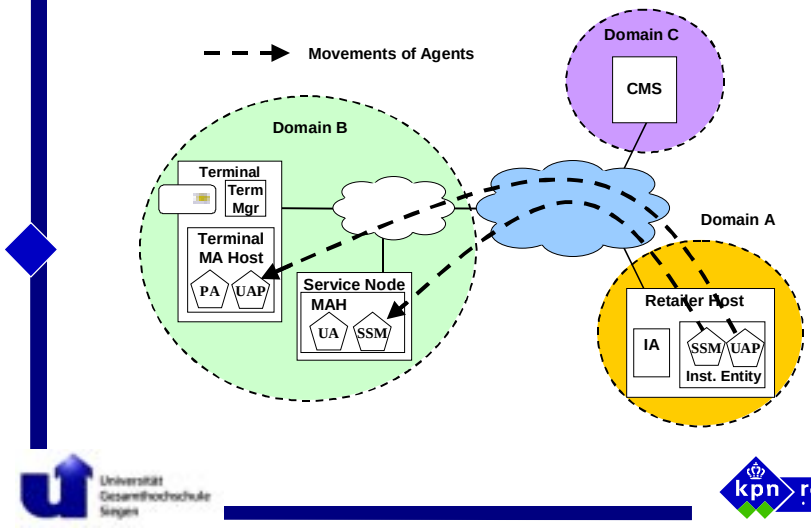
Application to TINA - Our Solution (2)



Application to TINA - Service Session



Conclusions and Future Work

- Use of Public Key Cryptography and Mobile Agents leads to:
  - Better security
  - Easier service provisioning in foreign domains
  - Less of a reliance on TINA IDL specifications → move to lower level compliance
- The future for Scarab...
  - Demo of system at end of 1999 in Turin/Madrid

Service Composition in a TINA Environment

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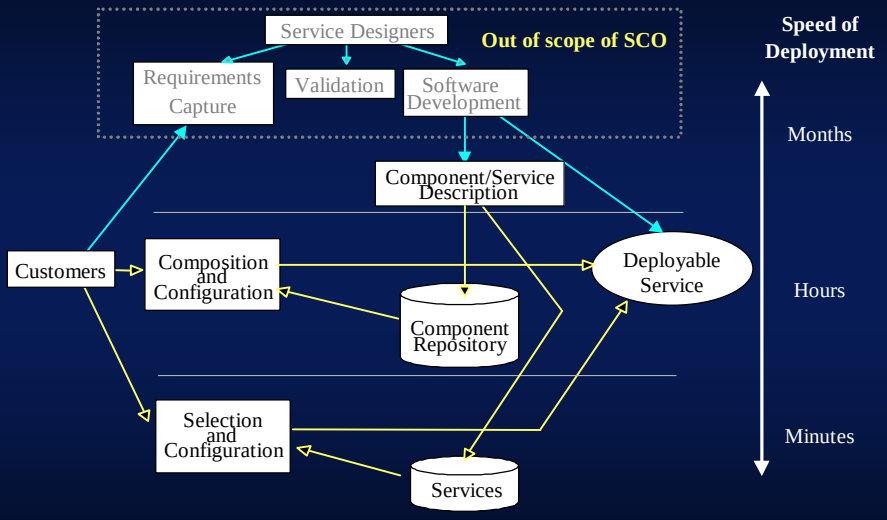
Motivation

- General requirments for telcommunication service provisioning:
  - Time to market
  - Cost reduction
  - Customization
- One possible answer:
  - component oriented working
  - maximum re-use
- Project goals:
  - Process model for service composition
  - Tool architecture and implementation
  - Component description model

Motivation

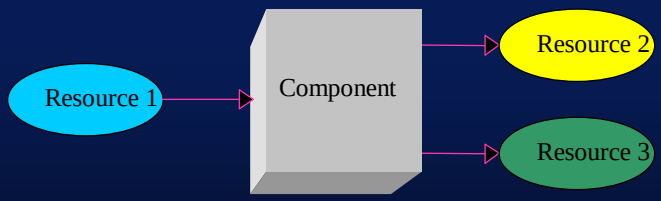
- Specific problems with real components in a TINA implementation:
  - **Simple dependency**
    (Java based PA implementation requires a Java Virtual Machine)
  - **Version dependencies**
    (The PA requires JDK 1.1.2, it will not work with 1.1.3. But with 1.2.x)
  - **Interoperability conflict**
    (Two specific ORB implementations are not interoparable or they are only interoperable if some features are not used (for example CORBA::any))
  - **Resource limitation**
    (disk space, IP ports etc. restrict the number of components on machines)

The Process Model



Component description model

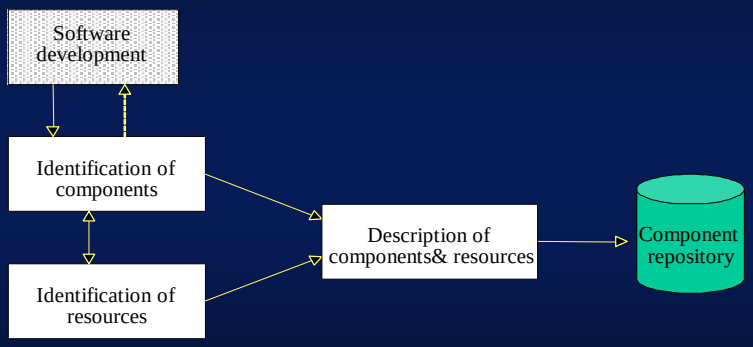
- Relation between components are expressed by means of consumed and provided resources
- Example: PC provides a set of card slots
- Component is a piece of software or hardware
- Resource is property of components



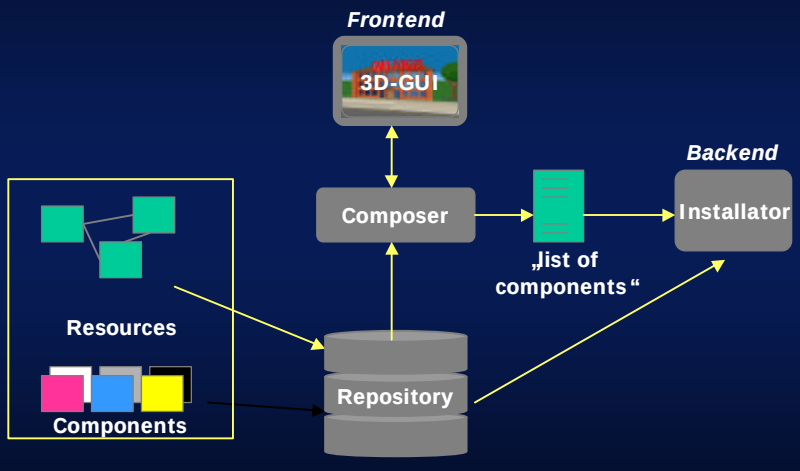
Advantages of the component model

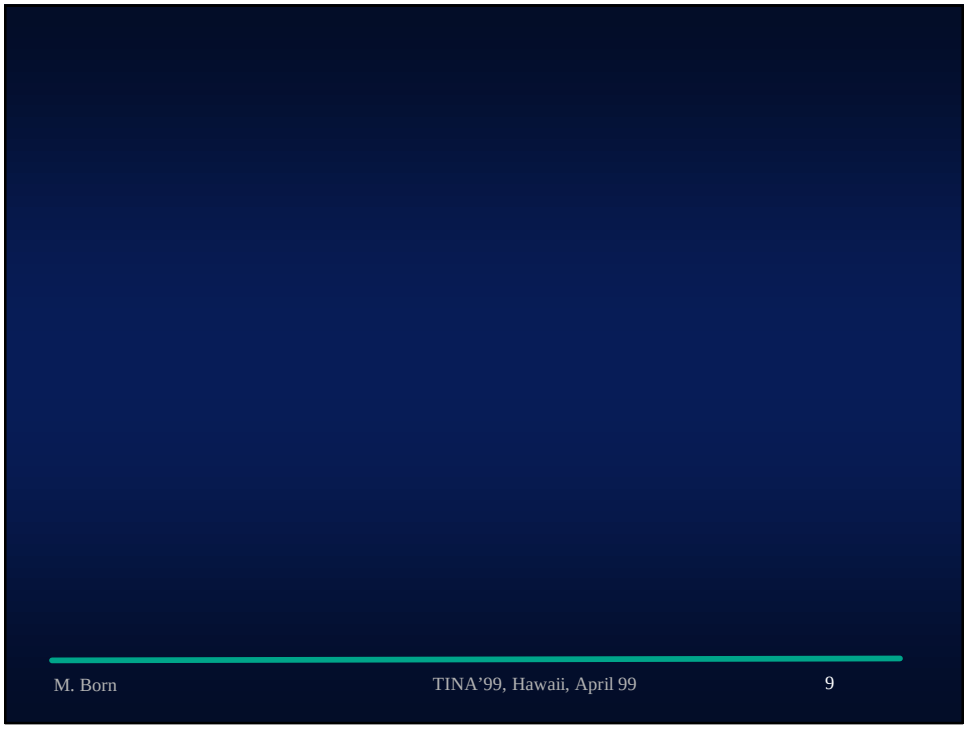
- Component development process and component technology is separated from the component description.
- Composition environment open for a wide range of components including hardware components such as video-cameras or graphic adapters. Independent from a specific software component model (like ActiveX, or CORBA Components)
- Computation of valid compositions, i.e. balanced compositions where each consumed resource is also provided by some component possible

Component description steps



Tool architecture




M. Born
TINA'99, Hawaii, April 99
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Service Lifecycle in a Distributed Computing Environment

http://www.windwardsolutions.com

Windward Solutions

The Internet Age Arrives

- Internet use exploding
- Globalization creating intense competition
- eBusiness solutions generating new income and driving down costs
- Early leaders hard to catch
- Solutions becoming more sophisticated

Deployment often an afterthought

Windward Solutions

eSolution Deployment Challenges

- Organize & package value added services
- Manage a complex distributed environment
- Ensure reliability and availability
- Support ongoing application evolution
- Scale to meet demand

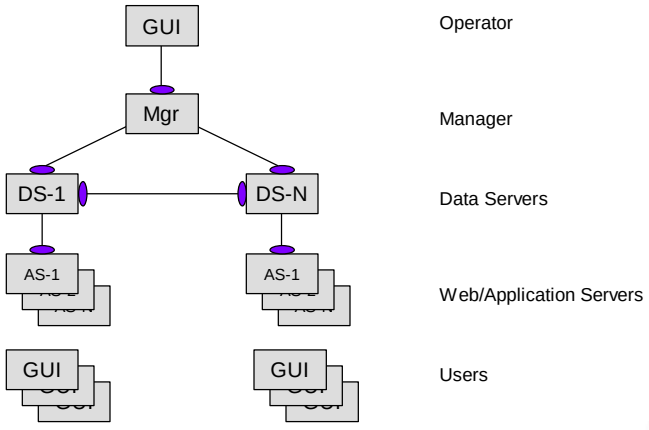
Introducing Aero

- A deployment environment for complex distributed solutions (i.e. eSolutions)
  - Centralized management environment
  - Decentralized deployment architecture
  - Application monitoring & control
  - Managed application evolution
  - CORBA & Java standards

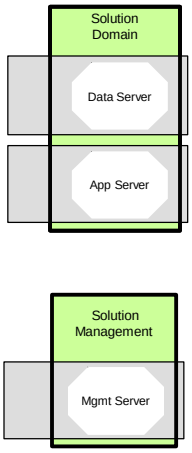
Aero End User Benefits

- Increased application scalability
- Increased application availability
- Reduced development costs
- Reduced deployment costs
- Reduced maintenance costs
- Reduced risk

A Typical Solution

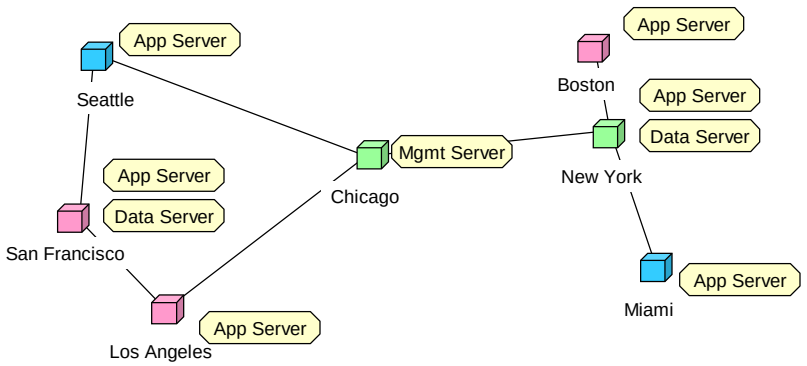


Solution Services and Deployment Packages

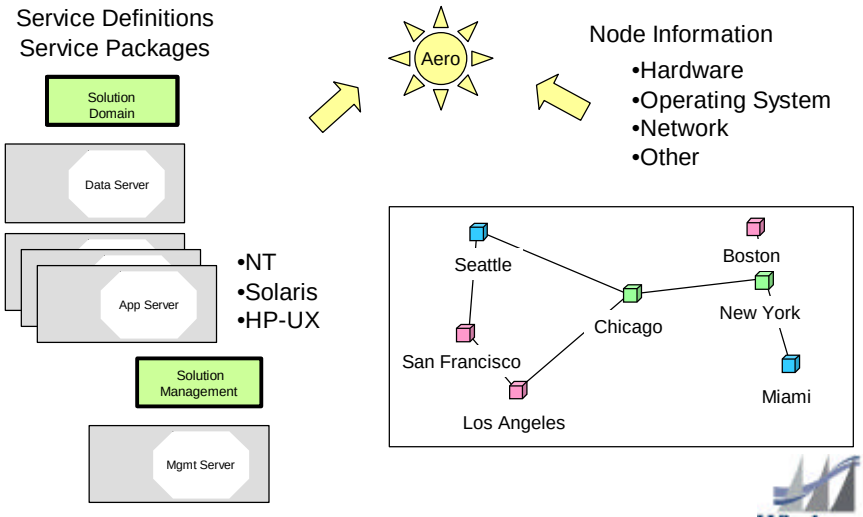


- One Solution Domain service includes a Data Server package and multiple Application Server packages
- There may be multiple instances of Solution Domain services
- Application Servers must run on a variety of platforms
- The Solution Management service has one Management Server package
- The Solution Management service requires at least one Solution Domain to operate

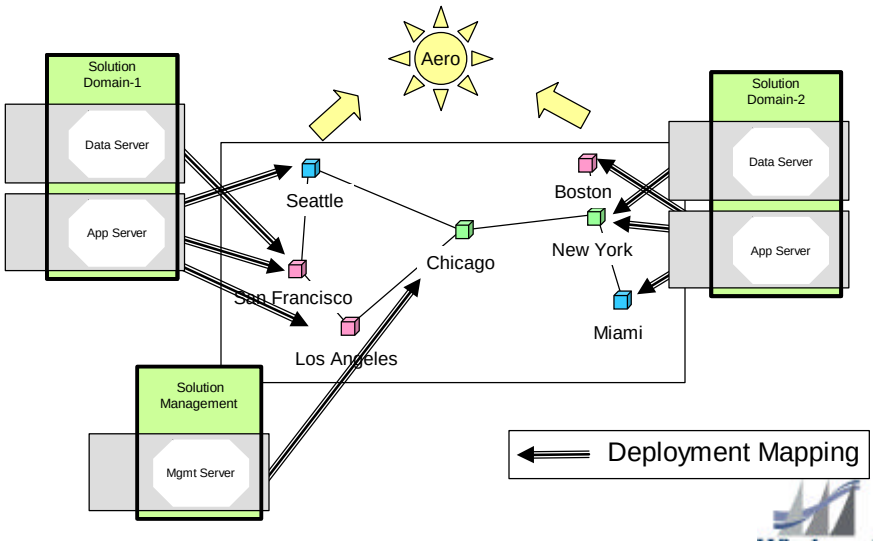
Desired Solution Deployment



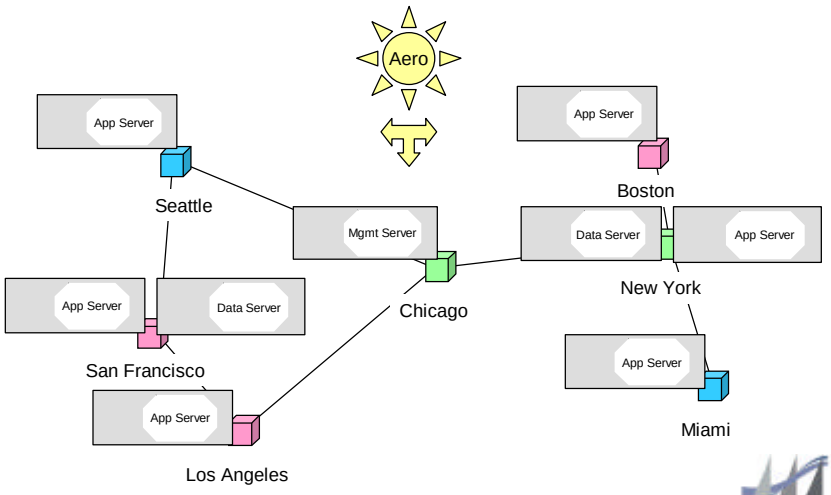
Service & Node Management



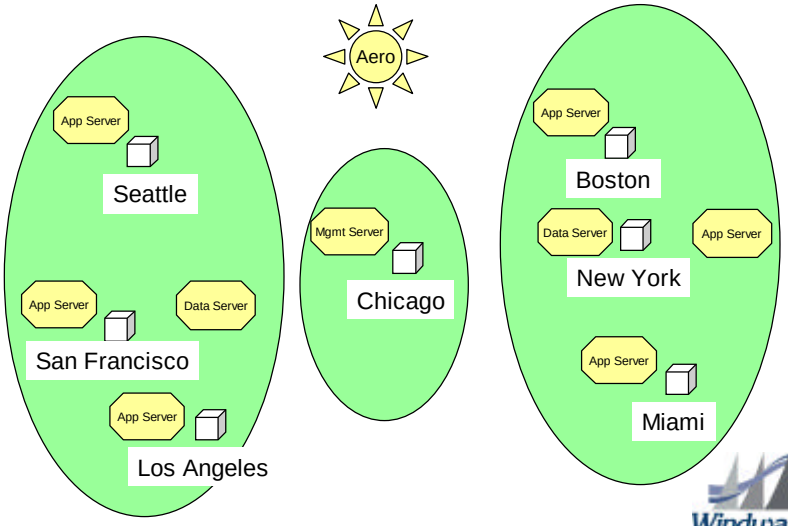
Deployment Mappings



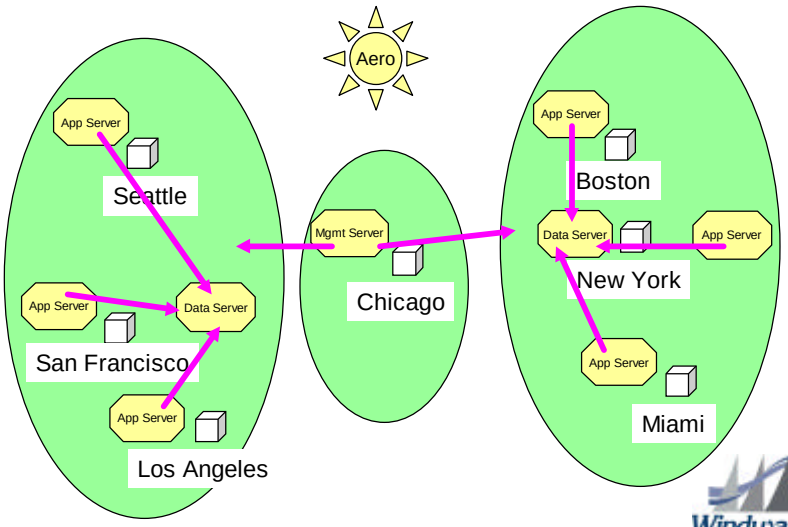
Automated Installation



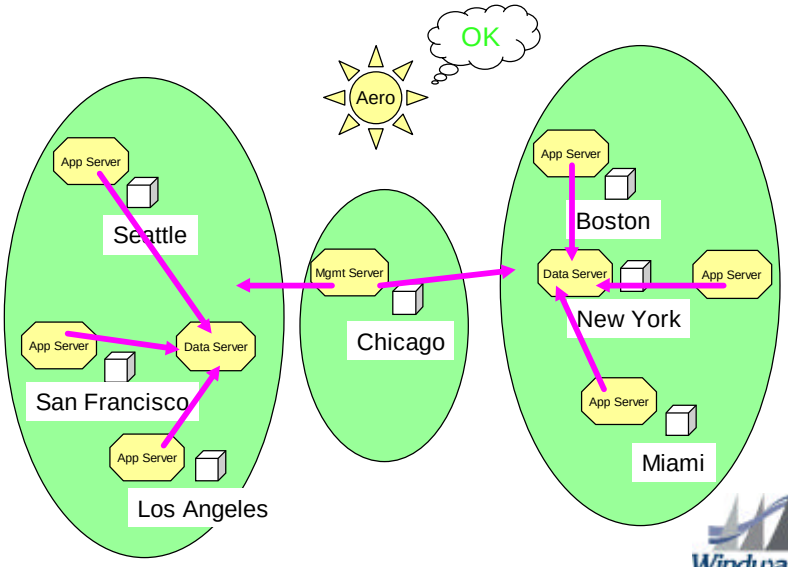
Automated Service Activation



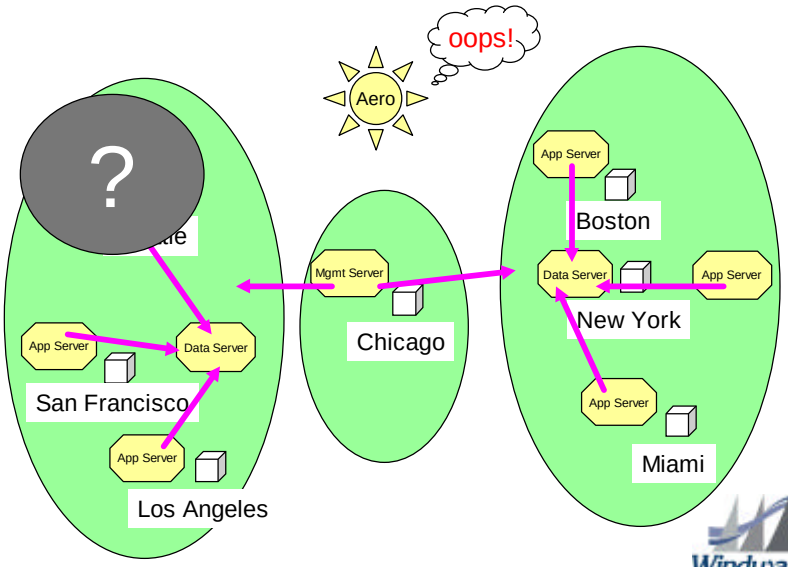
Component Introduction



Component Monitoring



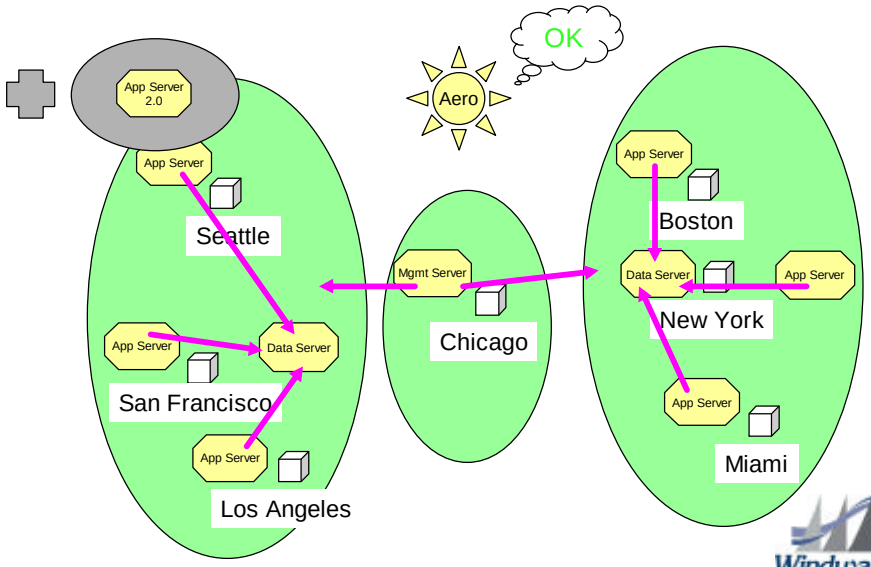
Failures Happen



Aero Recovers from Them

- Monitor the status of active components
- Insulate clients from component failures
- Utilize redundant components automatically
- Initiate restart of failed components
- Utilize application knowledge to re-introduce restarted components to the rest of the system

Change Happens



Aero Helps Evolve Gracefully

- Maintain versions of services, packages, components and interfaces
- Determine extent of necessary changes
  - method changes have least impact
  - class changes impact existing state
  - interface changes affect clients
  - organization changes affect everybody
- Replace impacted running components with new versions & reintroduce with minimal impact to system operation

Aero Services

- represent groups, objects and interfaces in TINA ODL
- generate implementation skeletons and customized distribution frameworks
- model platform and network organization
- define and manage services and packages
- install, activate and introduce components
- monitor component status
- recover from component failures
- support graceful system evolution

eSolution Deployment Challenges

- Build & deploy value added services
- Manage a complex distributed environment
- Ensure reliability and availability
- Support ongoing application evolution
- Scale to meet demand

Aero Meets the Challenges

- ✓ Manage a complex distributed environment
  - platforms, languages, hardware configurations
- ✓ Build & deploy value added services
  - component development & packaging
  - installation, activation, introduction
- ✓ Ensure reliability and availability
  - monitoring & restarting failed components
- ✓ Support ongoing application evolution
  - graceful evolution without complete shutdown
  - scale to meet demand