New inter-domain issues in Research and Education networks

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Objective of this presentation

- R&E community requires more network services than only any-to-any connectivity (Internet commodity)

  - Guaranteed bandwidth on Demand, Multicast, IPv6, VPNs, etc...

- End-users are rarely connected to one single network managed by a unique operator

How can we provide end-to-end services ?

How can we dynamically enable network resource for a

given user and application ?

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Internet is fundamentally Inter-domain. Research & Education Nets even more

- Inter-domain started with BGP, which was designed to support few thousand classful IPv4 routes

- Today the full routing table size is > 170000 routes

- With VPN services, more states must be maintained

- Today a carrier-class system can easily manage 1000000 routes in the forwarding table

  - Apart the number of routes, scalability of a network depends on the number of events to be processed by each node

- BGP introduced many features to extend the limits

  - Confederations, Route Reflectors, Multiple Planes, Outbound Route Advertisements, Route Target Filtering

- Today, inter-domain is <u>and only is</u> BGP

  - (+ MSDP for inter-domain IPv4 PIM SM)

Examples of Recent Inter-domain Initiatives in the IETF (1)

- **Flow Specification Disseminations (or Dynamic firewall filtering)**
  - draft-marques-idr-flow-spec
  - Mailing list:
    - http://www.cqr.org/mailman/listinfo/flow-spec

- **End to end Inter-domain Multicast with AMT**
  - draft-ietf-mboned-auto-multicast
  - BSD-based gateway and relay available today
    - Open source project funded by Juniper
    - http://www.mountain2sea.com/amt/

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Examples of Recent Inter-domain Initiatives in the IETF (2)

- **Inter-domain MPLS VPNs and Multicast VPN**

  - **draft-raggarwa-l3vpn-2547-mvpn**

- **Inter-domain GMPLS Traffic Engineering**

  - **draft-ietf-ccamp-inter-domain-rsvp-te**

  - **draft-vasseur-ccamp-inter-domain-pd-path-comp**

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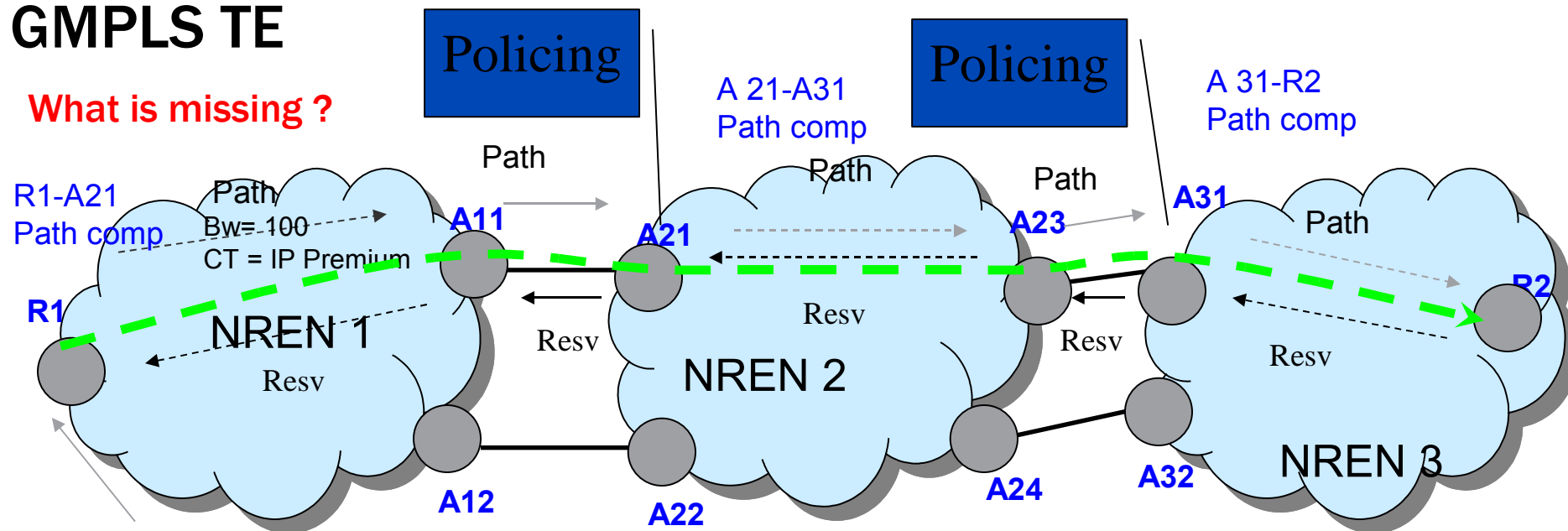# The Actual Limit of Current Internet

- Internet is reaching a limit
  - Actually not on scalability
- Internet proved its any-to-any connectivity capability
  - But it is just a connectivity service...
- Today Public Network requires
  - Any-to-any Multi-services capability
  - Which means:
    - Inter-domain QoS, Security and Reliability
    - And Dynamic Service activation
  - Requires new peering capabilities and techniques
    - It is not anymore just a question of exchanging route information

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Example: Schedulable Deterministic End to End Pipes

- **For GRID projects, eVLBI, DEISA, MUPBED, HEC Facilities, CERN etc...**

- **Potentially based on Layer 1, 2 or 3 technologies**

- **Need for a Capacity Management Middleware**

  - **Already several initiatives in R&E**

    - However some challenges: Licences, network technologies required, standard used, multi-domain support, features/flexibility, security mechanisms, integration with other tools, vendor dependency

- **Question: How can we converge to a common tool supported both by the global R&E community and the industries?**

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Potential implementation with IETF inter-domain GMPLS TE

What is missing ?

Policing

Policing

R1-A21
Path comp

A 21-A31
Path comp

A 31-R2
Path comp

Path

Path

Path

Path

Path

Bw= 100
CT = IP Premium

A11

A21

A23

A31

R2

R1

NREN 1

NREN 2

NREN 3

Resv

Resv

Resv

Resv

Resv

Resv

A12

A22

A24

A32

Inter-AS TE-LSP R1-R2 : bw = 100m, CT = IP Premium
ASBR-Path: A21-A31-R2

- **GMPLS TE is originally intra-domain (RSVP-TE with routing IGP TE extensions)**
- **Inter-domain GMPLS TE extends signaling and routing protocols to set-up an LSP across multiple providers**
- **Need for proper policing and filtering of RSVP-TE messages at NREN boundaries**
  - **Filter/modify QoS parameters**
- **Need for scheduling**
- **In this example the Path Computation is performed per domain (route expansion)**
  - **Need for Provider-chain selection based on NRENs business relationship**

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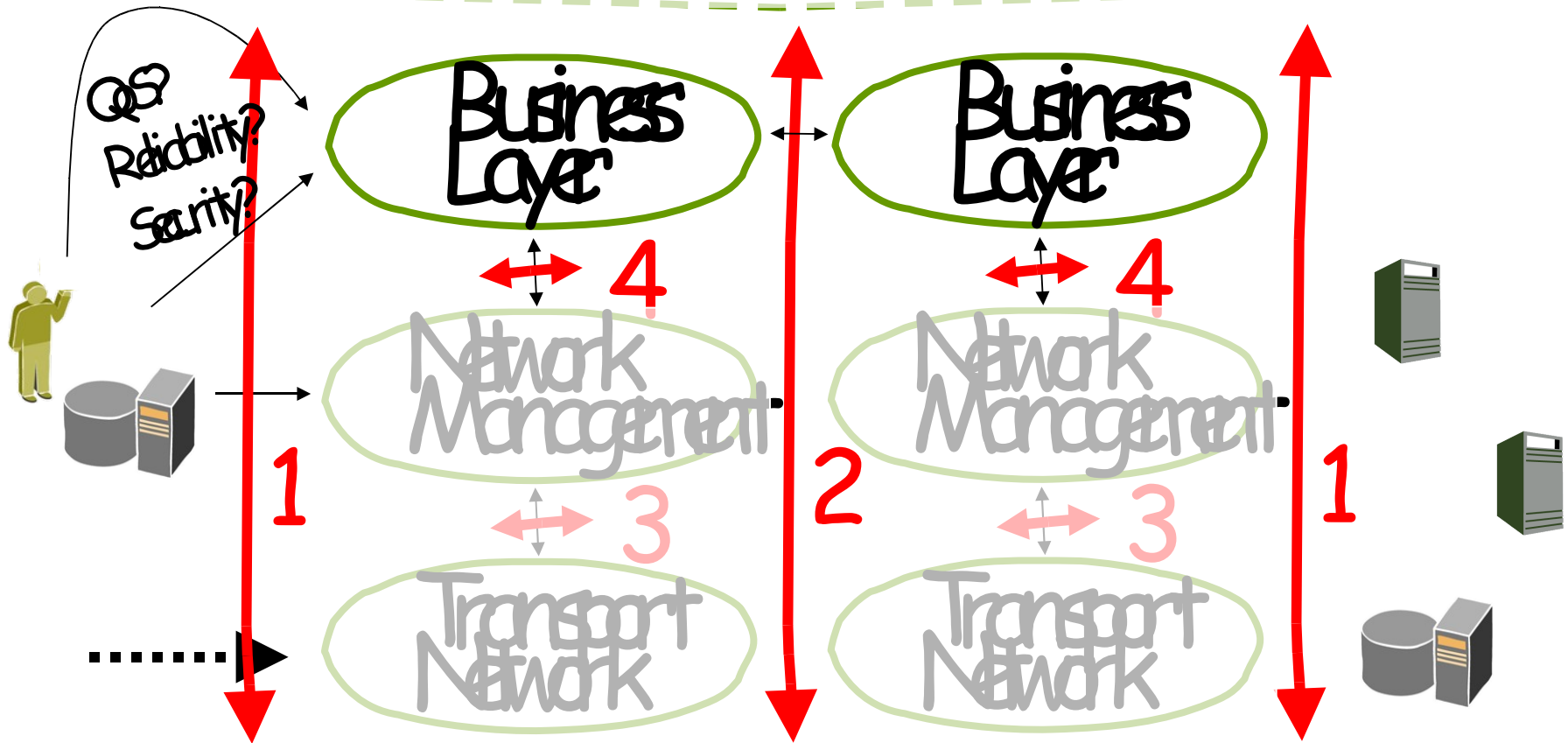# Napkins approach

- **Wish List:**
  - **Ubiquity**
    - Limited users, but can be anywhere so it requires any-to-any capabilities, potentially
    - Technology independent
  - **Platform/Vendor independent**
  - **Domain independent**
  - **Perennial**
  - **Federative**
  - **Why not solving all "on-demand" type of network service at one stroke? Is there a common framework possible?**
  - **(Prefigure future public networks)**

The realistic solution is in a Divide and Conquer approach, again never reinventing the wheel

Potentially a Higher Layer Middleware (eg GRID)

QoS?
Reliability?
Security?

Business Layer

Business Layer

Network Management

Network Management

Transport Network

Transport Network

1 2 3 4

The need for a "Business Layer"

What is an IPsphere ?

IPsphere

A pan-service framework

Defined by the IPsphere Forum

Leveraging Service Oriented Architecture (SOA)

Providing **business structure** for IPservices

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Why SP's need IPsphere

- Enable SP's to move up the value-chain

- Framework that enable new business models

- Help SP's move away selling dumb "bits" and create a framework which enables SP's to sell "services"

- Public Internet isn't good enough to provide next generation services (ie VoD etc)

- Not a replacement for the Internet

# Did they have NRENs and GRIDs use case in mind ?

- … hmmm …
- But IPsphere offers:
  - A common framework for unlimited use cases
  - Based on standard protocols and technologies
  - No overlap with other standardization bodies: very focused on the business layer for a seamless integration
    - Network Technology independent
    - Network Management independent
    - Platform/Vendor independent
    - Service delivery is Domain independent
  - A standardized model, with a strong motivation to be quickly deployed in live networks
    - Involves the whole industry: many SPs, manufacturers, OSS, application vendors

A model for IPspheres

The IPsphere Reference Architecture
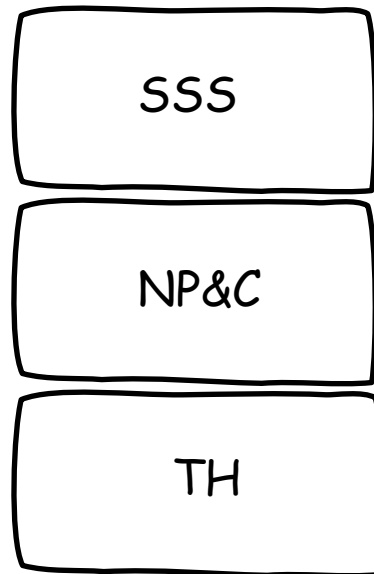
Service Structuring Stratum

Network Policy & Control

Traffic Handling
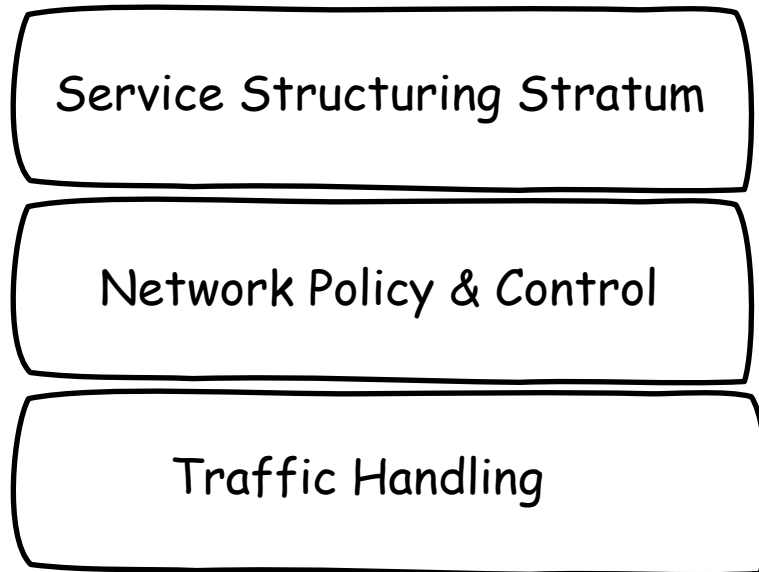
The IPsphere Forum defines an IPsphere as a network comprised of three basic "strata"
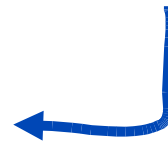
Today's networks

The IPsphere Reference Architecture

```
┌─────────────────────┐
│         SSS         │
└─────────────────────┘
┌─────────────────────┐
│        NP&C         │
└─────────────────────┘
┌─────────────────────┐
│          TH         │
└─────────────────────┘
```
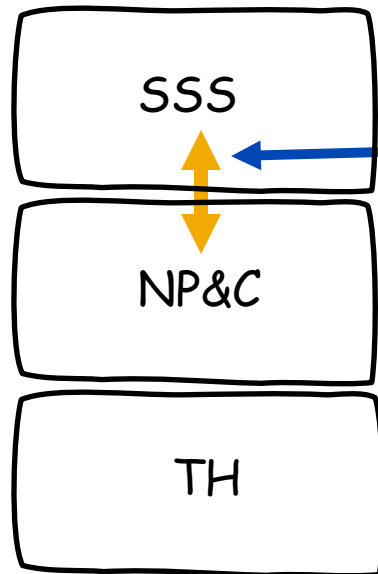
Today's IP networks reside in the lower two strata

e.g. NMS, OSS, policy servers

e.g. SDH, Routers, firewalls, etc.

What's different about an IPsphere?

IPspheres add a Service Structuring Stratum which leverages Service Oriented Architectures (SOA): "no need to reinvent the wheel"

The IPsphere Reference Architecture

SSS

NP&C

TH

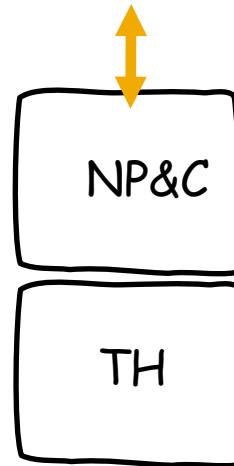The SSS allows networks to "publish" their service capabilities

Why is this so important?

The SOA framework – using mechanisms like SOAP, XML, UDDI – allows IP networks to "publish" their service capabilities into a __structured__ operational framework
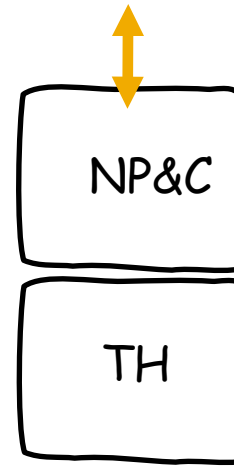
"Hey, I can offer services X, Y, and Z!"
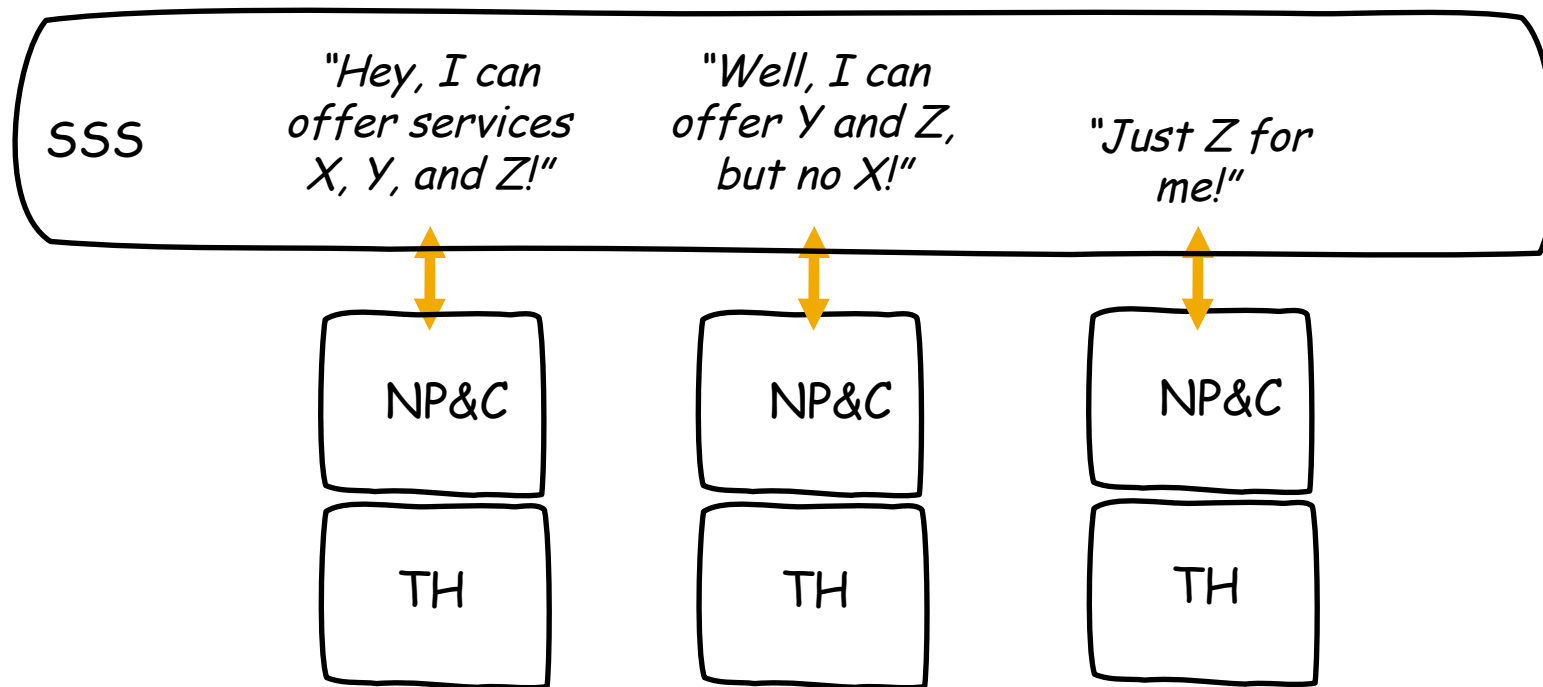
"Well, I can offer Y and Z, but no X!"

"Just Z for me!"

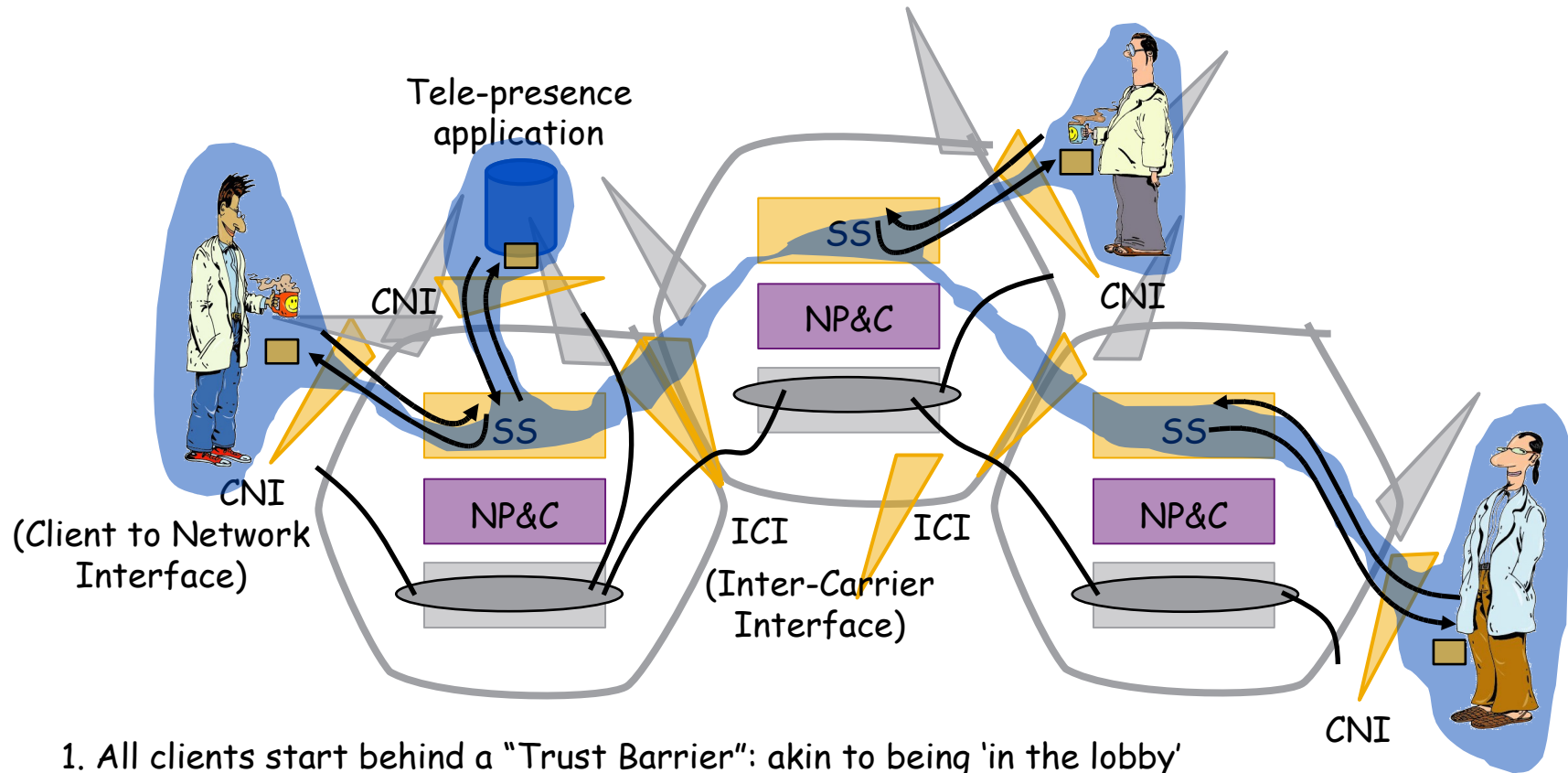| NP&C	NP&C	NP&C
TH	TH	TH

The creation of a true "business layer"

The Service Structuring Stratum provides this framework – allowing service capabilities to be joined together in unprecedented ways

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Notion of Federations

Tele-presence application

CNI

CNI
(Client to Network Interface)

SS

NP&C

ICI   ICI
(Inter-Carrier Interface)

NP&C

SS

NP&C

SS

NP&C

CNI

CNI

1. All clients start behind a "Trust Barrier": akin to being 'in the lobby'

2. To get inside clients present credentials, and receive authorizing "token": akin to a 'badge'

3. "Federate" other clients participating in the activity: akin to populating the 'meeting room'

4. Provide network environment for the exchange – akin to 'projector, whiteboard, audio…

Service Decomposition Model
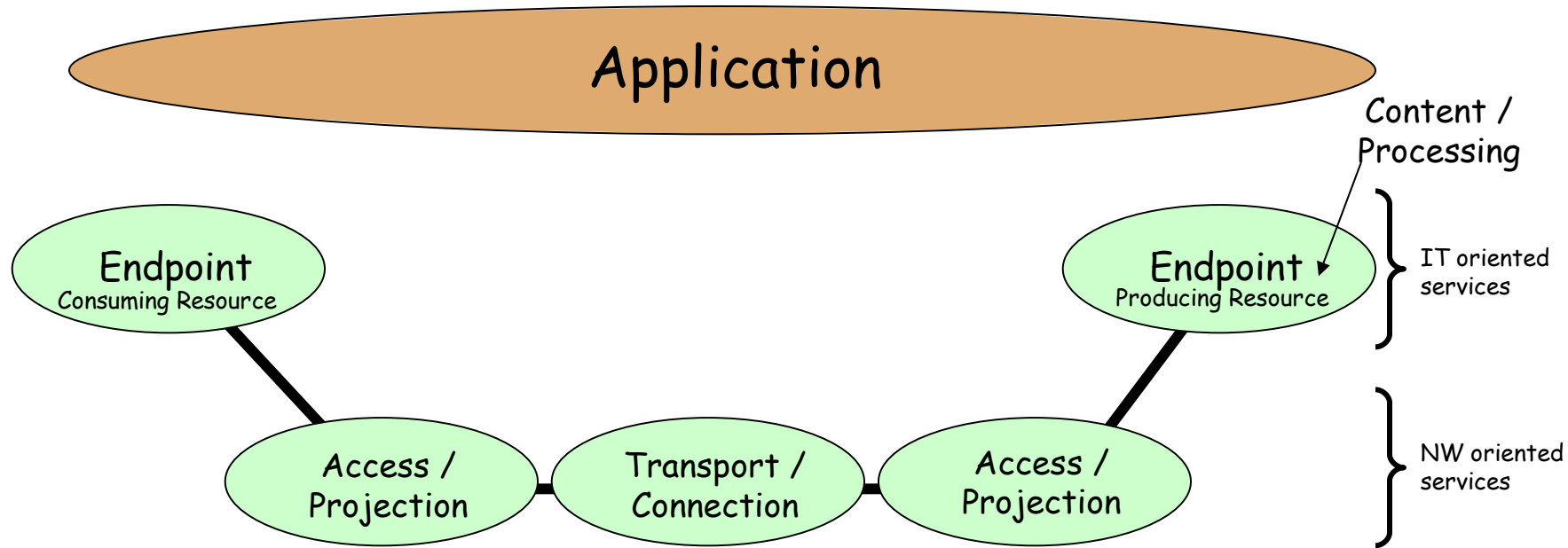
A typical application or retail service is made up of a series of "Elements" from one or more of the classes shown above. Endpoint Elements represent either service users/access points or content/processing capabilities (storage, grid, ASP, etc.). Access/Projection is the Element that represents the "last mile" connection to the user; it could be DSL, cable, wireless, etc. Transport/Connection represents the core network.

Each Element used to create a service is contributed by a provider by publishing it via the Service Structuring Stratum. The process of service creation in the IPsphere model is the process of assembling published Elements into services/applications.
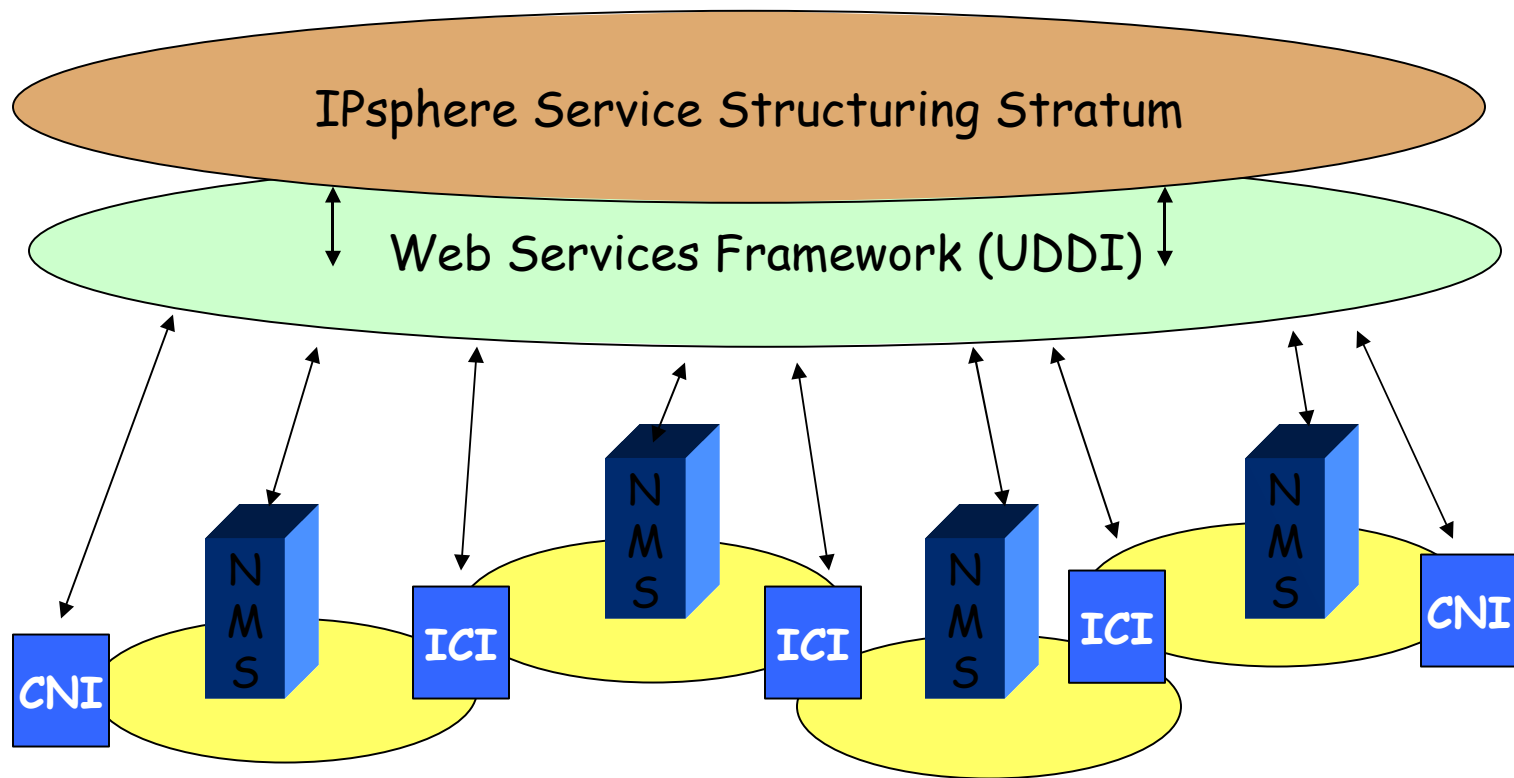
An Element is also a software link between the IPsphere's business-layer functions and the control behavior of the network.

Elements, Components, Messages

Service

Transport/ Connection

Access/ Projection
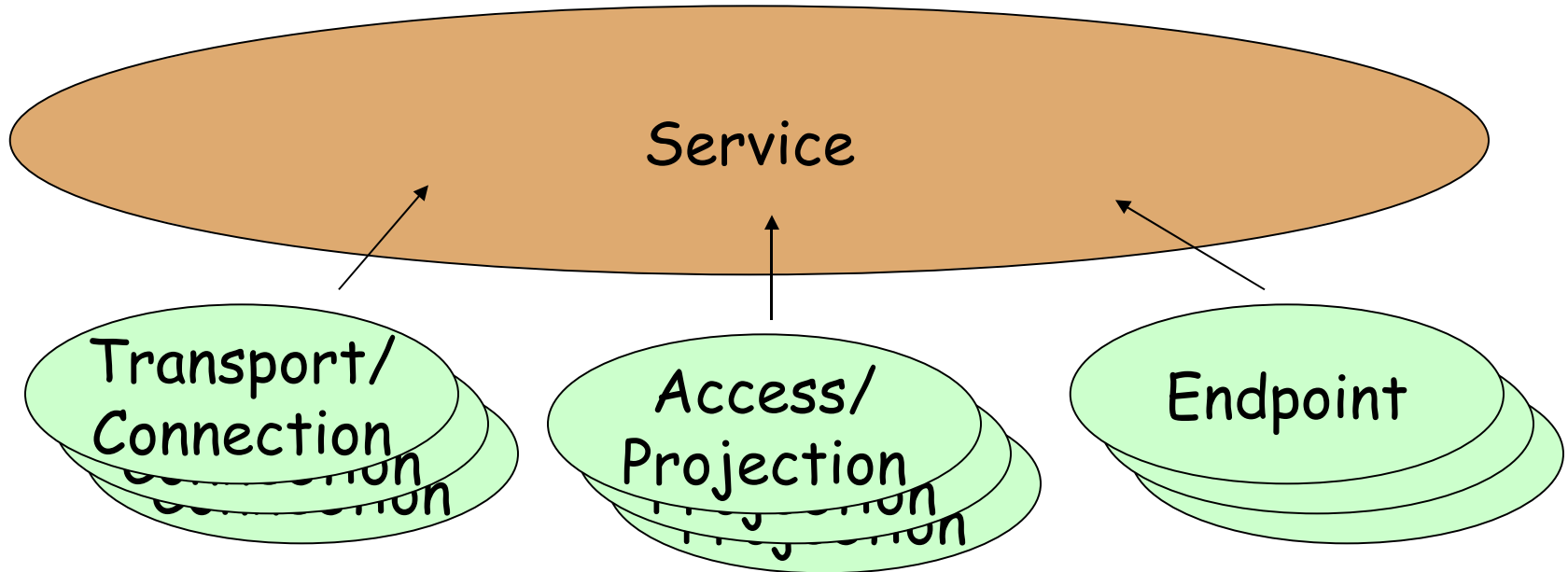
Endpoint

A service is made up of a series of "Elements", "Transport Connection", "Access/Projection", and "Endpoint". For each element, there are a series of "Components" representing the phases of service setup. These are "Setup" for initial business negotiation, "Execute" for actual service creation on the network, and "Assure" for the ongoing operational phase of the service. Each Component phase consists of four message steps; "Start" which initiates the Component, "Negotiate" which exchanges parameter values until a set is agreed upon, "Complete", which signals the end of a Component activity, and "Alert" which is an out-of-sequence indicator of a problem that has arisen.

How SSS Messages Influence the Network

IPsphere Service Structuring Stratum

Web Services Framework (UDDI)

NMS   ICI   NMS   ICI   NMS   ICI   NMS

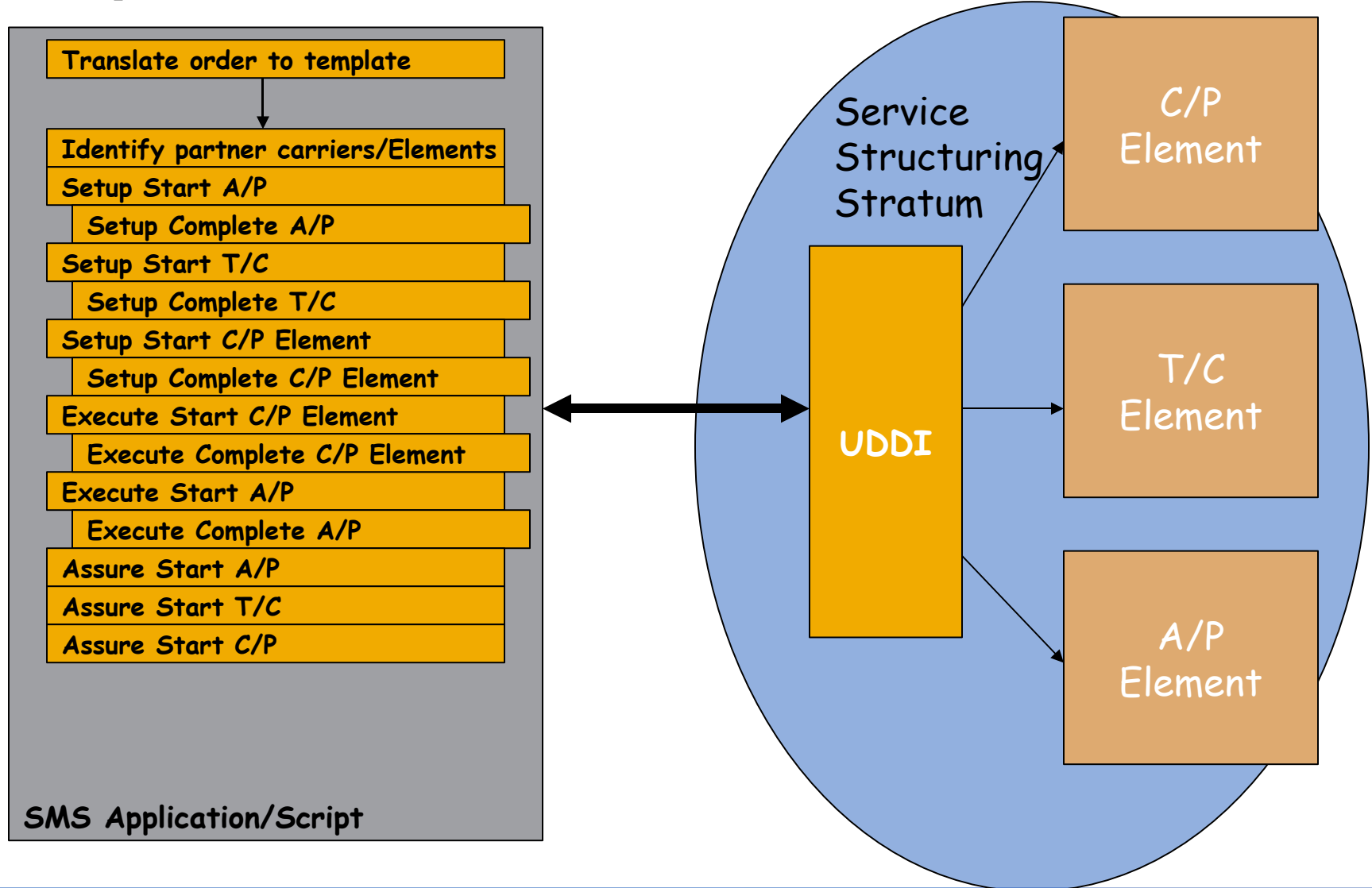CNI   CNI

There are several models for service creation based on how partner providers connect:

- Facility Connect: Permissive (Internet-like) connection

- Policy Connect: Signalling through the ICI is policy-mediated

- Service Connect: Provisioned services explicitly linked at the ICI (NMS provisioning)

A Quick Summary of Principles

- The IPsphere divides a service into Elements, which include Access/Projection, Transport/Connection, and Endpoint. A given service may have any number of elements of any of these types as needed, and services are created by combining Elements contributed by providers.

- A provider participating in the IPsphere will contribute at least one Element for at least one service, but will likely contribute many elements for many services.

- The contribution will be made by publishing a set of web services onto the SSS VPN, supporting all of the components associated with each element/service combination the carrier supports.

- The creation of a pan-provider service involves a web-service-based exchange of messages between the administrative owner who coordinates the service on behalf of the customer, and the providers who contribute elements to the service.

- Each Element is a software "method" or module that is published as a web service and which links to underlying network management or policy management capabilities to actually control the service.

- This process takes place at the Service Structuring Stratum level of the IPsphere Reference Architecture.

IPsphere SOA Framework

Translate order to template

Identify partner carriers/Elements

Setup Start A/P

Setup Complete A/P

Setup Start T/C

Setup Complete T/C

Setup Start C/P Element

Setup Complete C/P Element

Execute Start C/P Element

Execute Complete C/P Element

Execute Start A/P

Execute Complete A/P

Assure Start A/P

Assure Start T/C

Assure Start C/P

SMS Application/Script

Service Structuring Stratum

UDDI

C/P Element

T/C Element

A/P Element

IPsphere Forum Membership

- Alcatel
- America Online
- Bezeq
- Brasil Telecom
- Brighthaul
- BT
- Cellcom
- China Unicom
- CIMI Corporation
- Cisco Systems
- Colubris Networks
- Datapower
- Ericsson
- fmc.service
- France Telecom
- GeoTrust
- Huawei
- Hewlett Packard
- IBM

- Internet 2
- Juniper Networks
- Korea Telecom
- Level 3
- Lucent Technologies
- Masergy
- Nexagent
- NexTone
- Oracle
- Packeteer
- Polycom
- Qwest
- Red Zinc
- Siemens
- T-Com
- Time Warner Telecom
- T-Systems
- Telenor
- Tellabs
- Telstra
- Ulticom

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What IPsphere Is...and Isn't

- IPsphere is a model for framing network services into a business context by linking service creation with service ordering and fulfillment

- The IPsphere is based on SOA/WS principles for the exchange of business information, making it easy for it to manage the elements of higher-layer services that require identity management and reliable communications, including grid computing and ASP services

- The IPsphere is <u>not</u> a strategy to create actual services within the network, provide QoS, or manage resources at the physical level. It is compatible with current & emerging standards, and the IPSF will work to ensure it stays that way

- The IPsphere is <u>not</u> an alternative to the Internet, it is an alternative to the classical "Internet" business framework being applied to non-Internet services

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Conclusion

- Deploying a **Inter-domain Services** requires:

  - Both a vertical and horizontal approach

  - A synergy between NREN, end-users (e.g. GRIDs communities), but also with industries

- The problem can be addressed from different angles: but practical development and standardization work should be conducted together

- The winning solution will be federative, vendor and domain independent, simple to adapt to any current or future infrastructures and technologies

- The top model will not solve specifically one network service

  - A common framework for all "on-demand" network services

- IPSPhere Forum: http://www.ipsphere.org/

  - Overview: http://www.ipsphereforum.org/newsevents/07nollereprint.pdf

Thank You !

"I made it !!"