TITOLO DA DEFINIRE

(The university community: new services and technologies)

M. Amoretti, G. Conte, M. Reggiani, F. Zanichelli

Contents

- *The university community as a Virtual Organization*

- *A hierarchy of levels for community-oriented services*

- *Technologies for accessing and sharing learning resources*
  - *A video streaming architecture based on Grid Services*

The university community as a Virtual Organization

The availability of portable devices and wireless technologies
and

their functional integration
can foster new ways in which

- Students attend their education
- Professors communicate with students
- Students communicate each other

Virtual Organizations (VO) are defined as
dynamic collections of individuals and/or institutions defined by
flexible, secure, coordinated resource sharing rules.

The university community as a Virtual Organization (2)

Students obtain great advantage by the ability to access to

- lecture notes
- case studies
- multimedia contents (e.g. video recordings of previous classes)

made available by teachers and instructors or by other students.

Traditional solution:
e-learning model based on the access to unconnected or statically organized
sources of content (e.g. web pages) that the user must look for

Next-generation solution:
platforms supporting cooperative use of geographically distributed computing
and educational resources as an aggregated single e-learning environment

The university community as a Virtual Organization (3)

Our activity is addressing

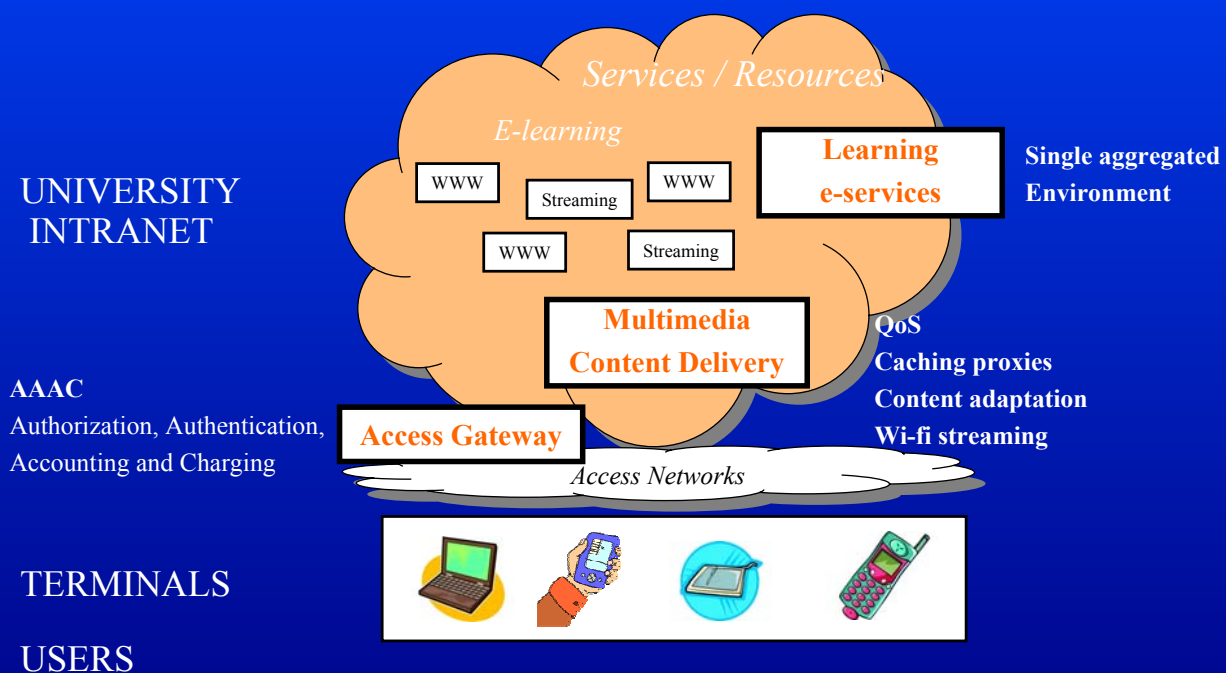*the definition and implementation of advanced services for the e-learning environment of the university VO*

To support this, we are working on

the design and experimentation of an infrastructure for content distribution and multimedia streaming

in light of edge device heterogeneity, mobility, content adaptation and scalability.

The Big Picture

UNIVERSITY
INTRANET

Services / Resources

E-learning

WWW   Streaming   WWW

WWW   Streaming

Learning e-services

Single aggregated Environment

Multimedia Content Delivery

QoS
Caching proxies
Content adaptation
Wi-fi streaming

AAAC
Authorization, Authentication, Accounting and Charging

Access Gateway

Access Networks

TERMINALS

USERS

A hierarchy of levels for community-oriented services

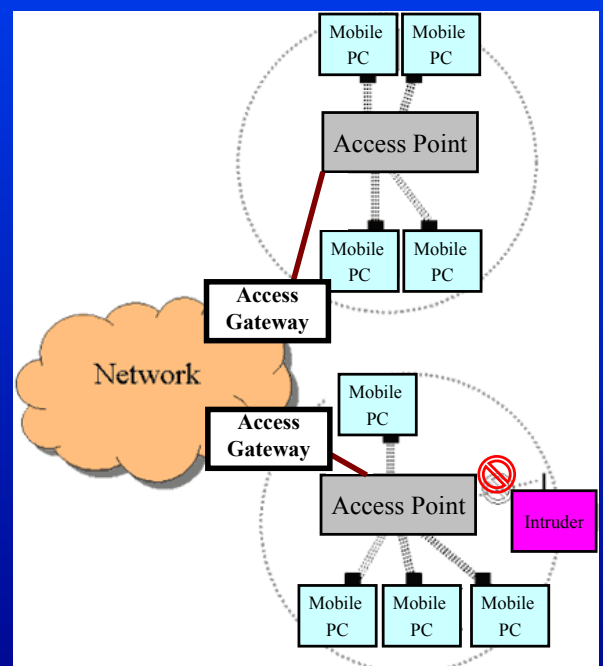In our view, these are the milestones for our current and future work:

Level 4
P2P E-Learning Services
Level 3
Aggregated E-learning Services
Level 2
Traditional E-learning Services
Level 1
Connectivity Services

A hierarchy of levels for community-oriented services

Level 1: Connectivity Services

Suitable *authentication*, *authorization* and *accounting* (AAA) facilities to allow intranet and Internet access.

We are investigating different techniques for secure and flexible wireless user authentication, ranging from web-based (https) from Virtual Private Network solutions.

Experimental testbed: wireless access points in the Engineering Departement and soon in the whole University Campus of Parma
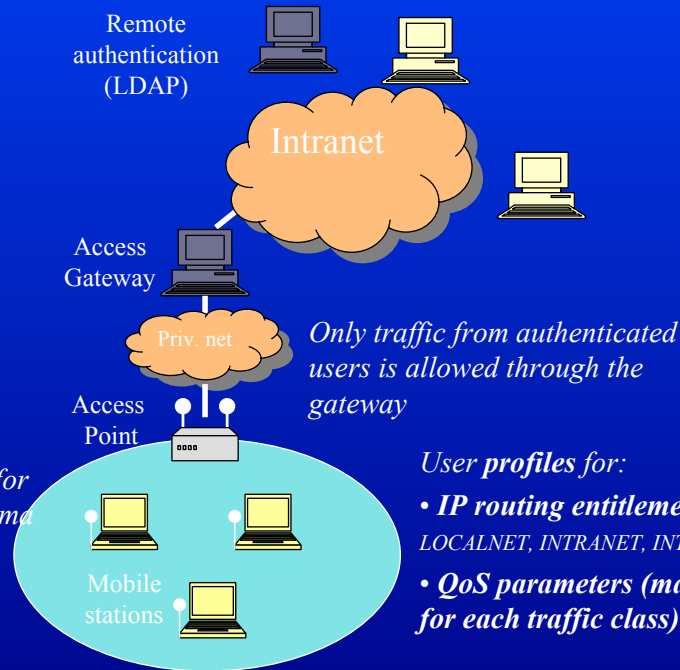
WI-FI AAA(C)

Remote authentication (LDAP)

Intranet

NoCat / Linux

Access Gateway

Priv. net

URLS of unauthenticated users are redirected to the HTTPS-based auth service

Access Point

Only traffic from authenticated users is allowed through the gateway

Mobile stations

Single remote LDAP authenticator for all students of the University of Parma

(Appost@ per te)

*User **profiles** for:*
- *IP routing entitlements (e.g. LOCALNET, INTRANET, INTERNET)*
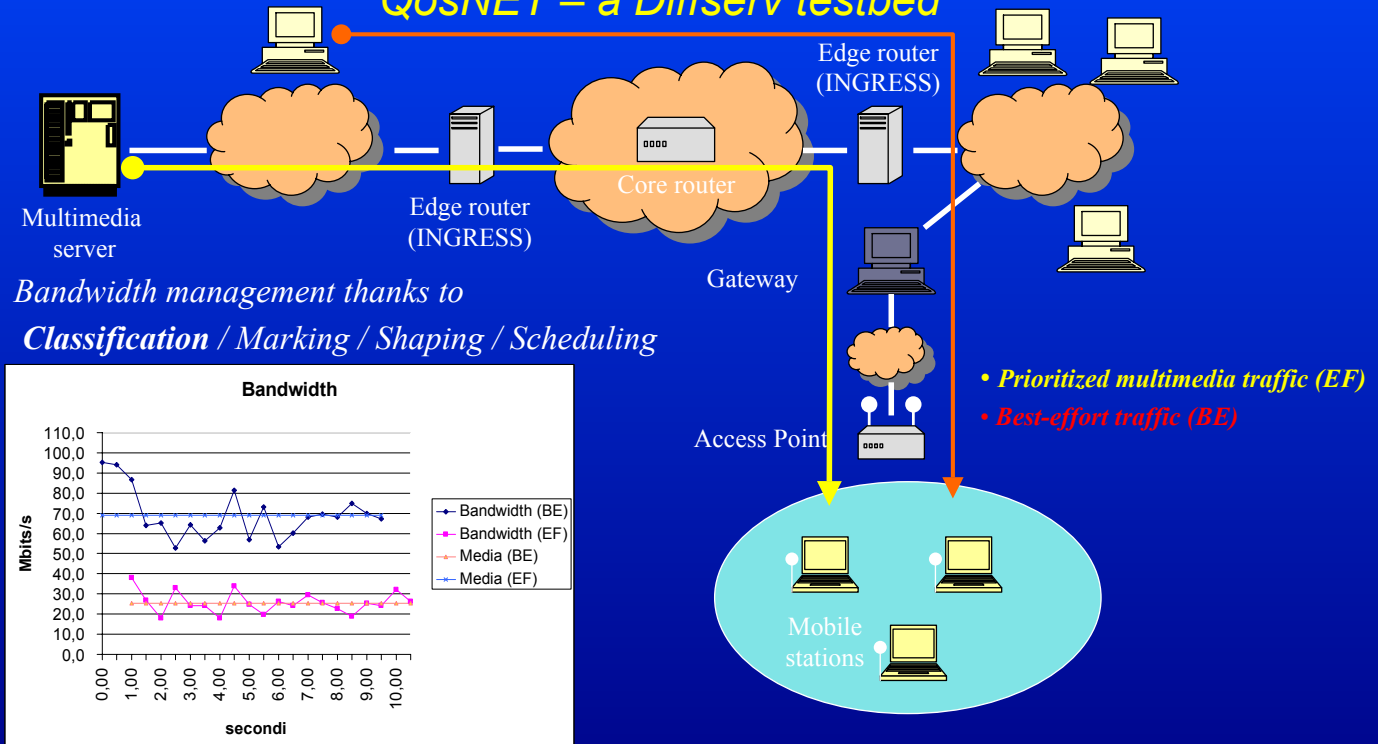- *QoS parameters (max traffic allowed for each traffic class)*

Wi-fi AAA implementation

QosNET – a Diffserv testbed

Multimedia delivery and QoS
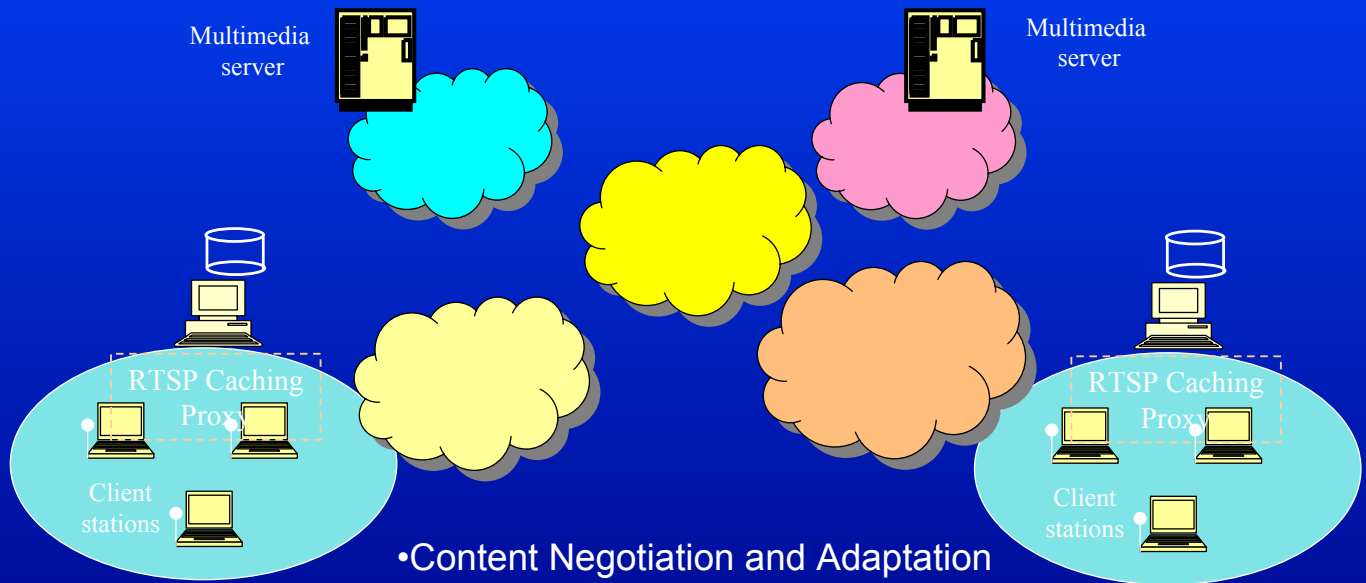
End to End QoS is necessary…

Some issues

- The infrastucture can provide either advanced (Campus) or limited QoS support (but even none at all)

- In a Diffserv domain, a **Bandwidth Broker** service should be responsible for bandwidth allocation and admission control

- **C**ontent **D**elivery **N**etworks exploit **caches** to move rich data closer to network edges, i.e. to users.

- QoS in WLANs is still work in progress:
  802.11a/b/g $\Rightarrow$ traffic prioritization (VoIP/Streaming) $\Rightarrow$ 802.11e

Content Distribution Networks

Multimedia server

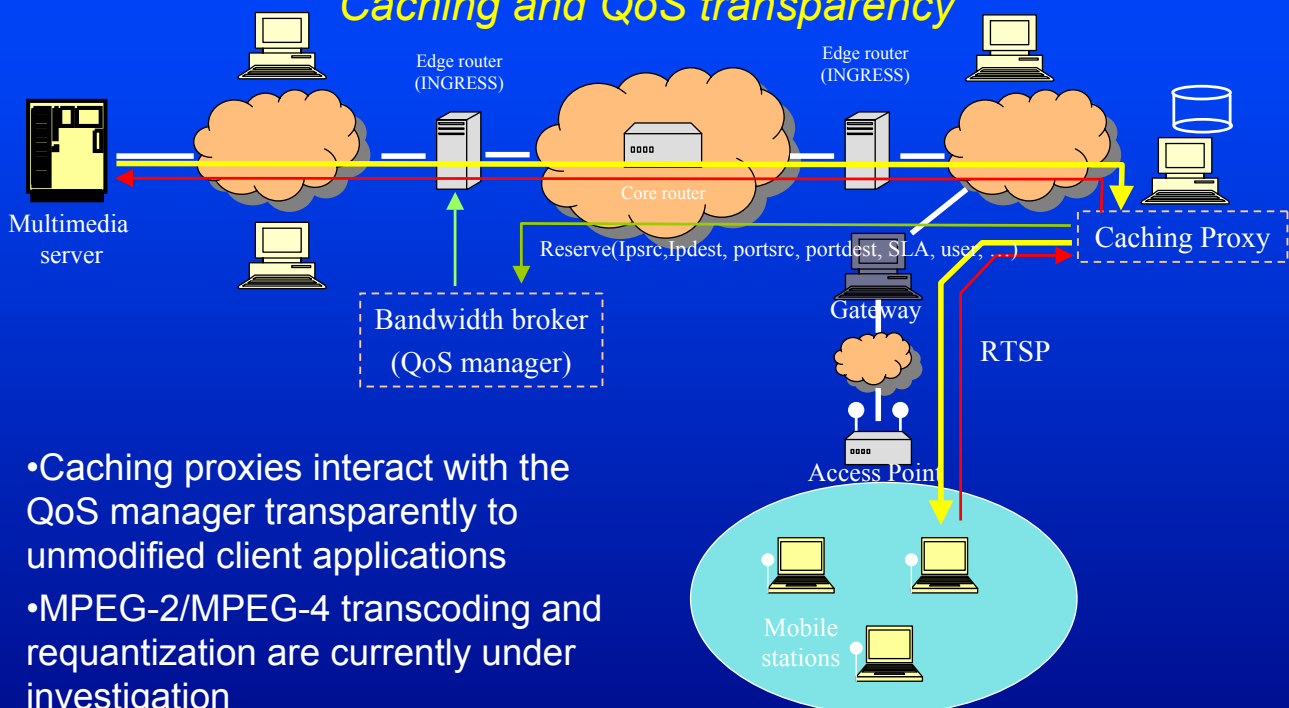Multimedia server

RTSP Caching Proxy

RTSP Caching Proxy

Client stations

Client stations

- Content Negotiation and Adaptation
- Exploitation of QoS facilities
- Dynamic Server Selection

Caching and QoS transparency

Edge router (INGRESS)

Edge router (INGRESS)

Core router

Multimedia server

Reserve(Ipsrc,Ipdest, portsrc, portdest, SLA, user, …)

Caching Proxy

Bandwidth broker (QoS manager)

Gateway

RTSP

Access Point

- Caching proxies interact with the QoS manager transparently to unmodified client applications
- MPEG-2/MPEG-4 transcoding and requantization are currently under investigation

Mobile stations

Requirements for Profiles and policies

Description of static features (terminal capabilities, network connectivity, …)

Description of user preferences and policies referencing
  – dynamic values from monitoring probes (current available bitrate, server load,…)
  – descriptors obtained by queries to UDDI/service providers (e.g. QoS manager)

Examples

If(content.resolution == HIGH) && (terminal.screen_resolution == LOW) &&
    (service.content_adaptation == AVAILABLE) && (s.c_a.cost_increase < 0.1)
        request_content(adaptation=TRUE) ;

If(qos_request(content.bitrate) != GUARANTEED) && (terminal.memory== LARGE)
        request_content() ;

A hierarchy of levels for community-oriented services

Level 2: Traditional E-Learning Services

This level represents the current state of e-learning services offered by many universities around the world.

  • Lessons notes
  • On-line exercises
  • Videoconference for courses
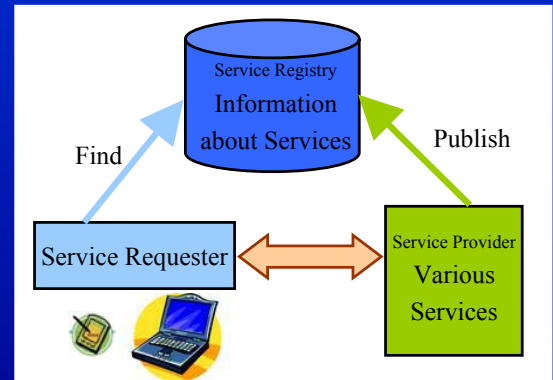 • Virtual Laboratories
  • etc.

A hierarchy of levels for community-oriented services
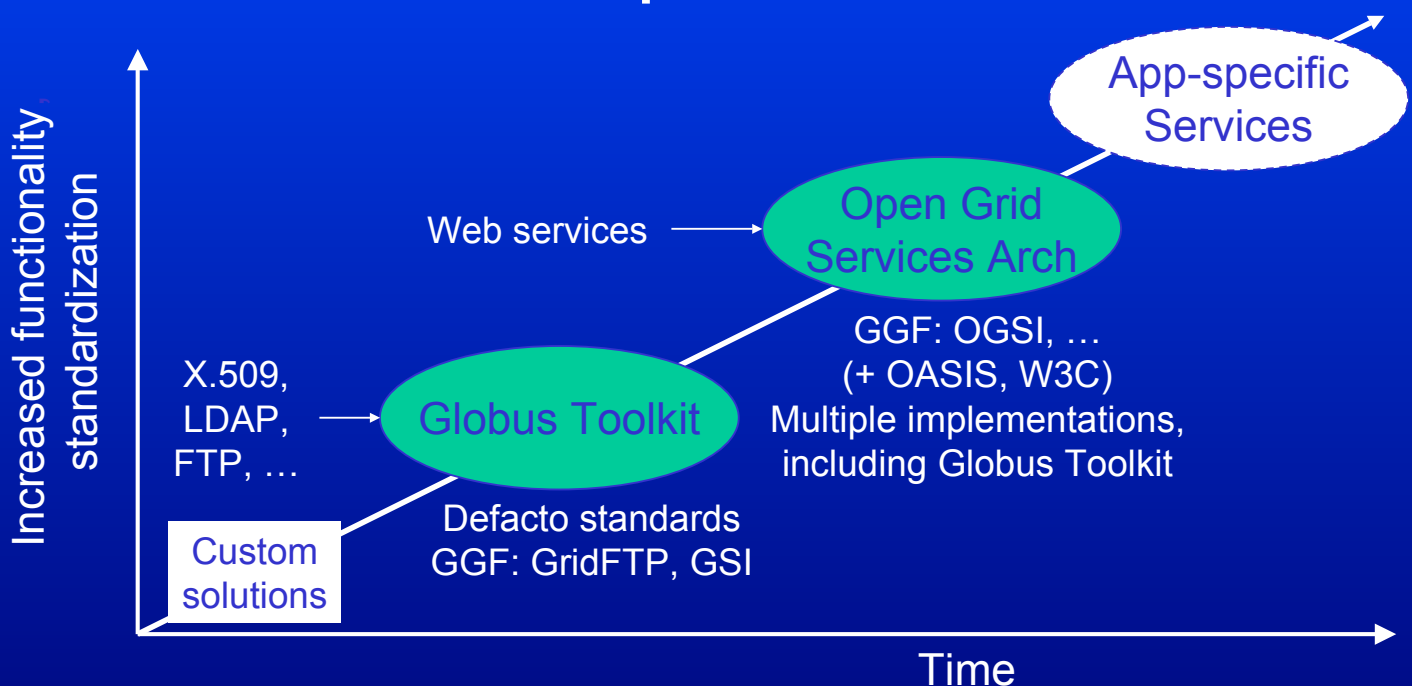
Level 3: Aggregated E-Learning Services

Distributed computing and educational resources as an aggregated single e-learning environment.

Service abstractions and specific middleware for:

– service discovery
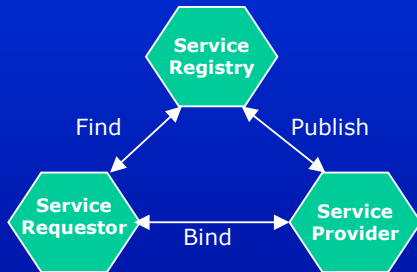– Authorization
– QoS
– resource allocation

Service Registry — Information about Services

Find

Publish

Service Requester

Service Provider — Various Services

Grid and Open Standards

Increased functionality standardization

App-specific Services

Web services → Open Grid Services Arch

GGF: OGSI, …
(+ OASIS, W3C)
Multiple implementations, including Globus Toolkit

X.509, LDAP, FTP, … → Globus Toolkit

Custom solutions

Defacto standards
GGF: GridFTP, GSI

Time

Service–Oriented Architecture

- **Publish**
  - WSDL: Web Services Description Language
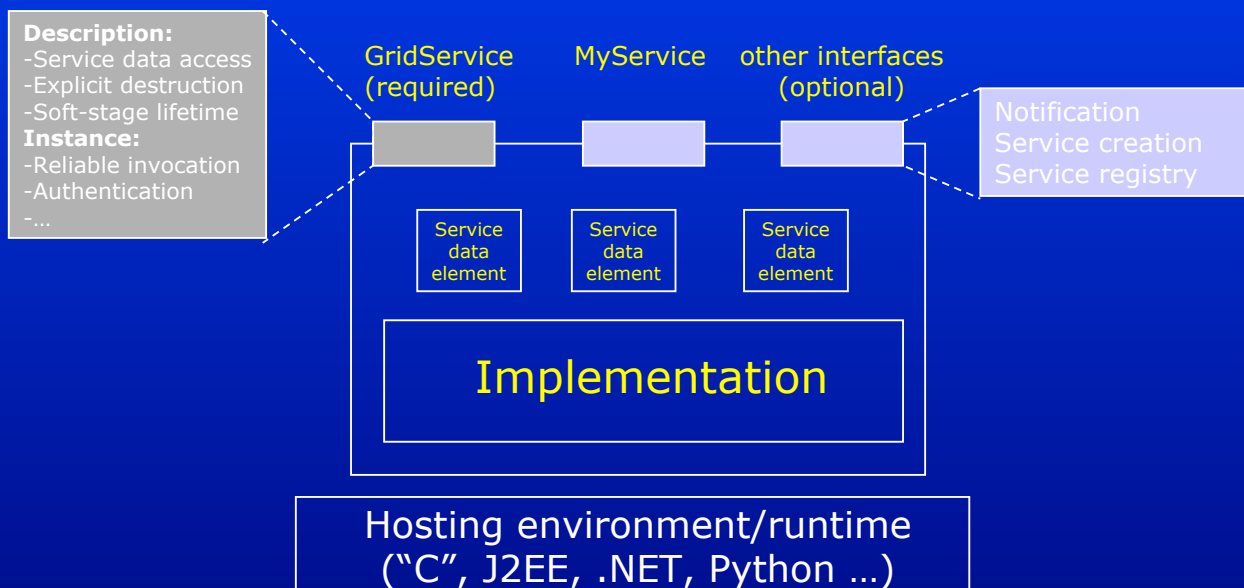 - UDDI: Universal Description, Discovery & Integration
- **Find**
  - WS–Inspection
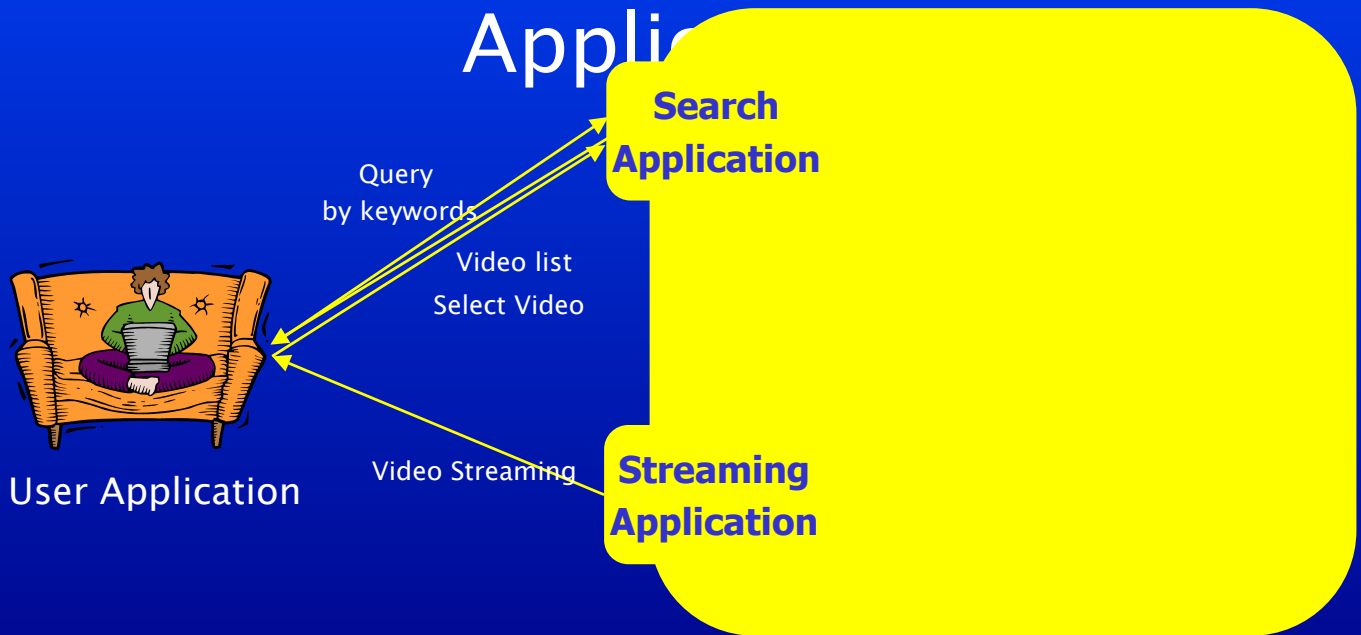- **Bind**
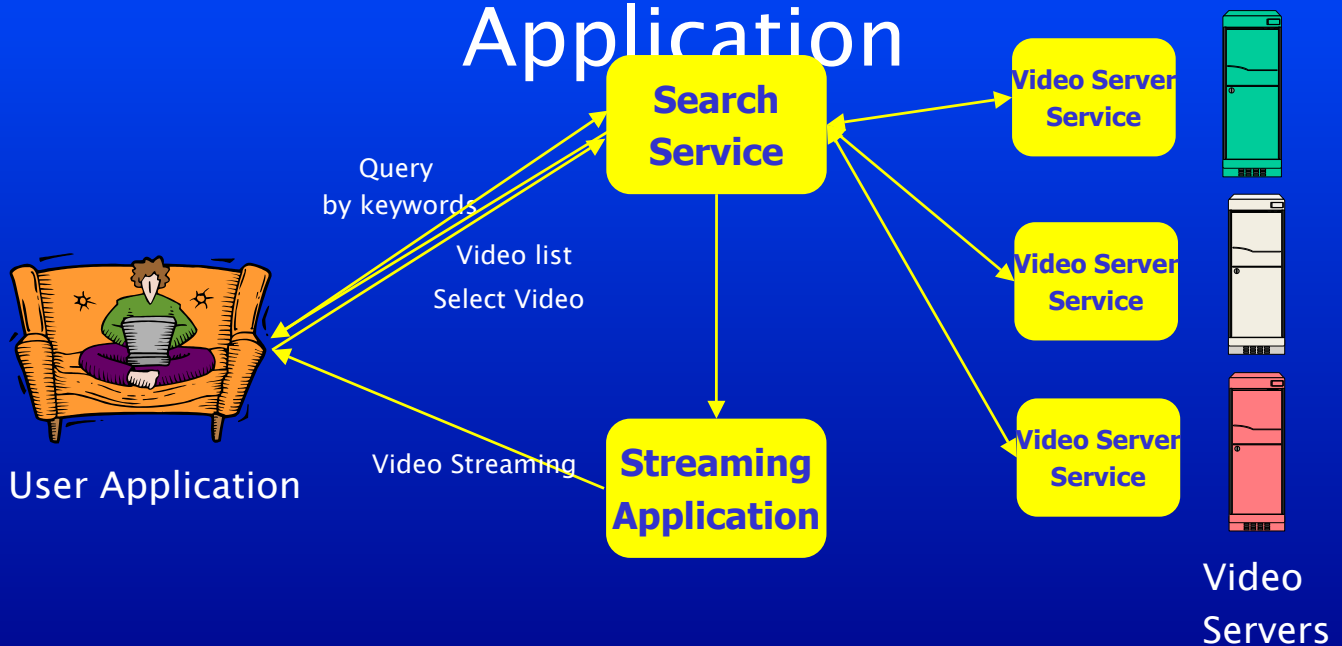 - SOAP: Simple Object Access Protocol

---

The Grid Service

Description:
-Service data access
-Explicit destruction
-Soft-stage lifetime
Instance:
-Reliable invocation
-Authentication
-…

GridService (required)   MyService   other interfaces (optional)

Notification
Service creation
Service registry

Service data element   Service data element   Service data element

Implementation

Hosting environment/runtime
("C", J2EE, .NET, Python …)

VO Structures

OGSA mechanisms

GRAM	GridFTP	MDS

Grid Services Abstraction

SOAP+TLS/GSI	Other Transports

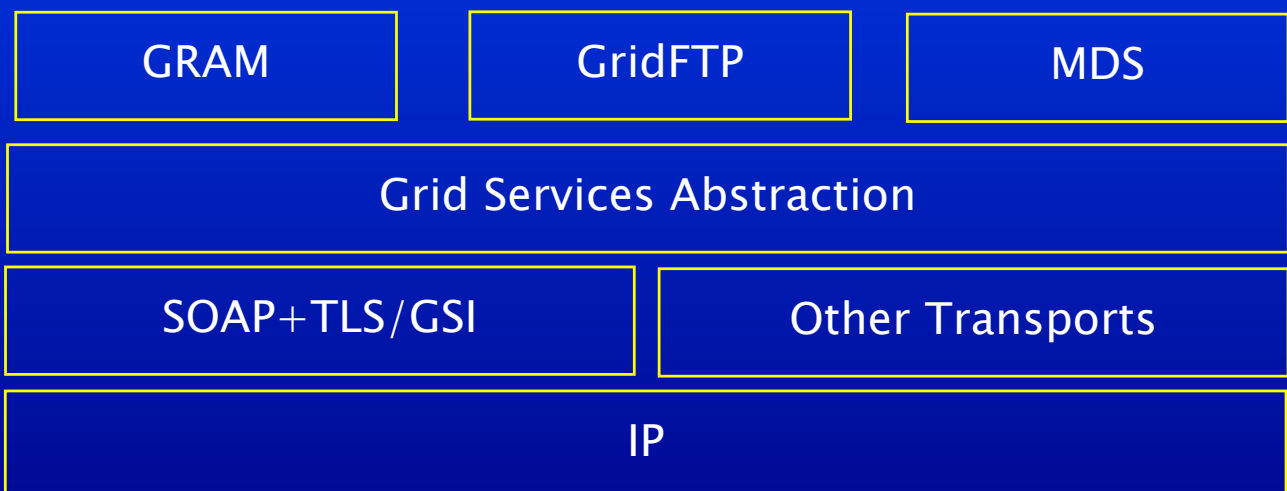| IP |
|---|
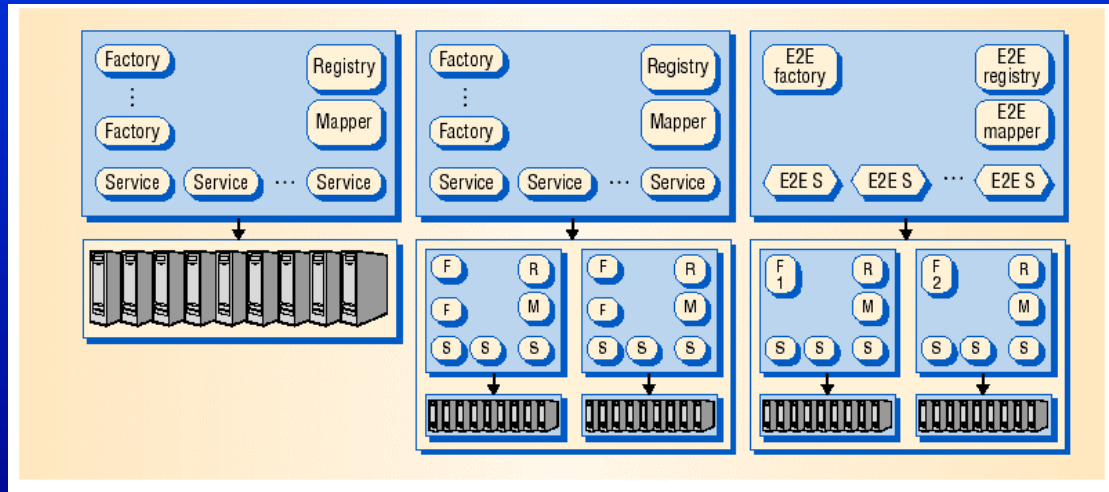
Level 4: P2P E-Learning services

Resources and contents are not only provided
by the official infrastructure, but also
by the whole university community.

Example:
Students own capable notebooks; they can
partially and temporarily share their
resources (personal data like lesson notes,
exercises.. but also CPU cycles).

The aim is to increase the size and the dynamics of the distributed system and
To reduce the activity on official, persistent nodes.

Peer-to-Peer (P2P)

"P2P is new computing model which is rapidly evolving, so it is healthy
and desirable *not* to be locked down by a rigid definition."

David Barkai
Technology Research Labs, Intel Corp.

Basic characteristics:
- The "action" (computing, communication, etc.) is taking place at the
  edge of the Net. Each participating **peer** can act both as a Client and
  as a Server *in the context of some application*.
- Resources (computing cycles, storage, network bandwidth, etc.) are
  being shared.
- Direct communication between peers is almost always present.

The use of JXTA protocols

As enabling technologies for our prototypes we exploit the Open Grid Service Architecture (OGSA) implemented by the Globus Toolkit 3 (GT3), in conjunction with the extensible, programming-language independent P2P protocols defined by the JXTA Project.

The JXTA specification defines protocols for advertising and discovery of available services:
*   Peer Discovery Protocol
*   Peer Resolver Protocol
*   Peer Information Protocol
*   Peer Endpoint Protocol
*   Pipe Binding Protocol
*   Rendezvous Protocol

Motivating our choices

Grid Services seek to externalize and modularize application functionalities, with the aim to improve the sharing of eterogeneous resources and to increase the scale of the systems from intra-enterprise to inter-enterprise.
JXTA is a P2P technology that seeks to solve the problem that common methods of addressing the Internet (centralized servers and data centers, centralized search engines and portals) aren't scaling proportionately to the growth of the Internet itself.

Grid Services and JXTA both face two pragmatic challenges:

1. Connect providers of services with consumers of like services, across an uncontained Internet.

2. Liberate the use of services from platform dependencies, such as operating systems, programming languages, and proprietary means of invoking procedures on remote hosts.

	Grid	P2P
1) Target communities	From scientific community to masses.	Millions of file-sharing applications users…
2) Resources	Powerful, diverse and well connected resources.	Home computers are the majority of P2P resources.
3) Applications	From scientific applications to e-business to MMPG.	File-sharing, Cycles-sharing.
4) Scale	Institutions (tens), pooled computers (thousands), simultaneous users (hundreds). Large amount of activity.	Millions of simultaneous nodes. Significant amount of activity, but not always larger than in the relatively smaller-scale Grids.
5) Services and Infrastructures	Authentication, authorization, discovery, resource access, data movement,etc. Key words: *persistency* and *multipurpose.*	Search, network maintenance, anonymity, censorship resistance, fair sharing, reputation management.

Conclusions and Future Work

- We have outlined our response to the challenges and opportunities of ubiquitous and mobile computing in the university community.
- A hierarchy of levels of services has been presented
- We depicted our current effort in developing advanced multimedia streaming services

- Our future work will focus mainly on new methods for resource management, meeting user requirements for QoS
- We will investigate the very critical issue of providing security to P2P systems, using Grid technologies