ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

University of Essex

Photonic Networks Laboratory

SIP-based service virtualization for future IT services and applications over high speed optical networks

***Franco Callegati*, Aldo Campi, Walter Cerroni**

D.E.I.S. - University of Bologna

Georgios Zervas, Reza Nejabati, Dimitra Simeonidou

Photonic Network Lab - University of Essex

e-Photon ONe

http://www.e-photon-one.org

Actors

- IT applications
  - Multi-data flow, multimedia, highly distributed
  - Application specific signalling
  - QoS requirements
  - *Intrinsically state-full*

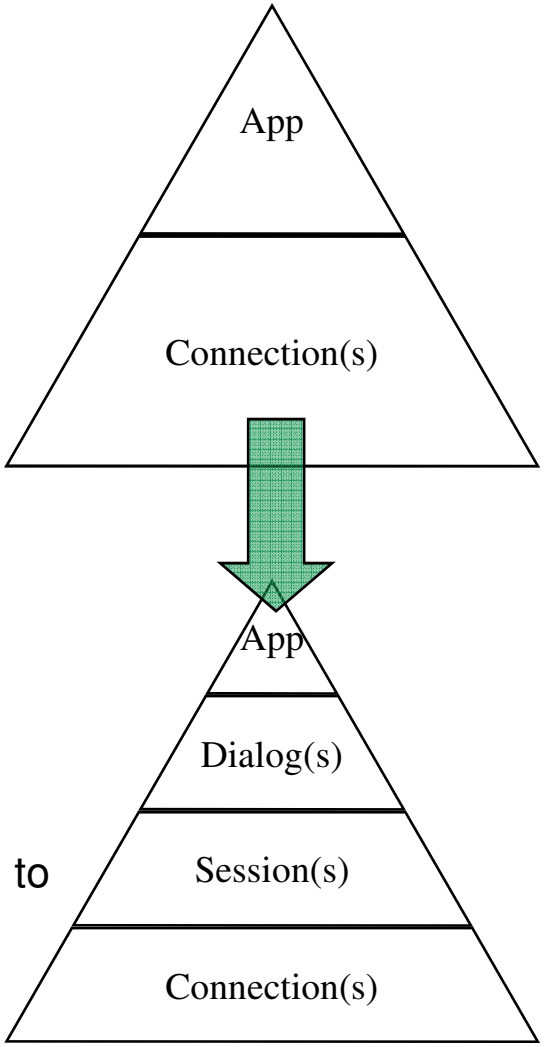
- High speed optical networks
  - Provide coarse (fiber/wavelength) and fine (Optical Burst and Packet Switching) bandwidth granularity
  - Have their own control plane (typically GMPLS)
  - *Tend to be "connection oriented"*

Motivations

- Users and applications see services
  - Storage space
  - User communication facilities
  - Computing resources
  - …
- Networks (and network control plane) see data flows and connections
  - Lightpath, burst, packet flow …
- **To do**
  - Easy access to the network resources for the user and the application
    - Virtualization
    - Authomatic provisioning and QoS management
    - …

The proposed solution

- Introduce session control in the network
  - Services are mapped into sessions
  - The network has the ability to manage the sessions
- The objective
  - De-couple applications issues from networking issues
    - One session many connections
    - One connection many sessions
    - Redirect, suspend and retrive, …
- By introducing the session layer
  - The network acquires the capability to understand the application instances expressed by means of session attributes
  - Network services (bandwitdh, QoS, etc…) are oriented to the application requirements and not simply to the connections attributes



How can we implement it?

- Session Initiation Protocol (SIP)
  - IETF *standard* application layer protocol
    - Hundreds of RFCs to date
  - *Independent of the networking technology*
  - *Transaction-oriented (state full)*
  - Based on domains
  - User location → personal mobility
  - Security (AAA)

- SIP is purely a mechanism to manage sessions
- SIP does not provide services
  - SIP provides primitives that can be used to implement services
    - Example: locate a user and deliver an opaque object to his current location

What have we done?

- Demonstrating application layer functionality into the transport layer by means of the session layer
  - Case study: grid applications

- How it happened
  - OBS test-bed at University of Essex
    - Embedded electronic network processing for OBS routers
  - SIP programming capabilities at University of Bologna
  - Unibo staff mobility at UEssex supported by e-Photon/ONe

The problems …

- SIP is used to
  - Carry application related information (JSDL, RDF)
  - Discover resources and establish communication sessions
  - Pass to the OBS control plane (JIT) the information to establish connections in the transport plane
  - Manage the ongoing sessions transparently for the application

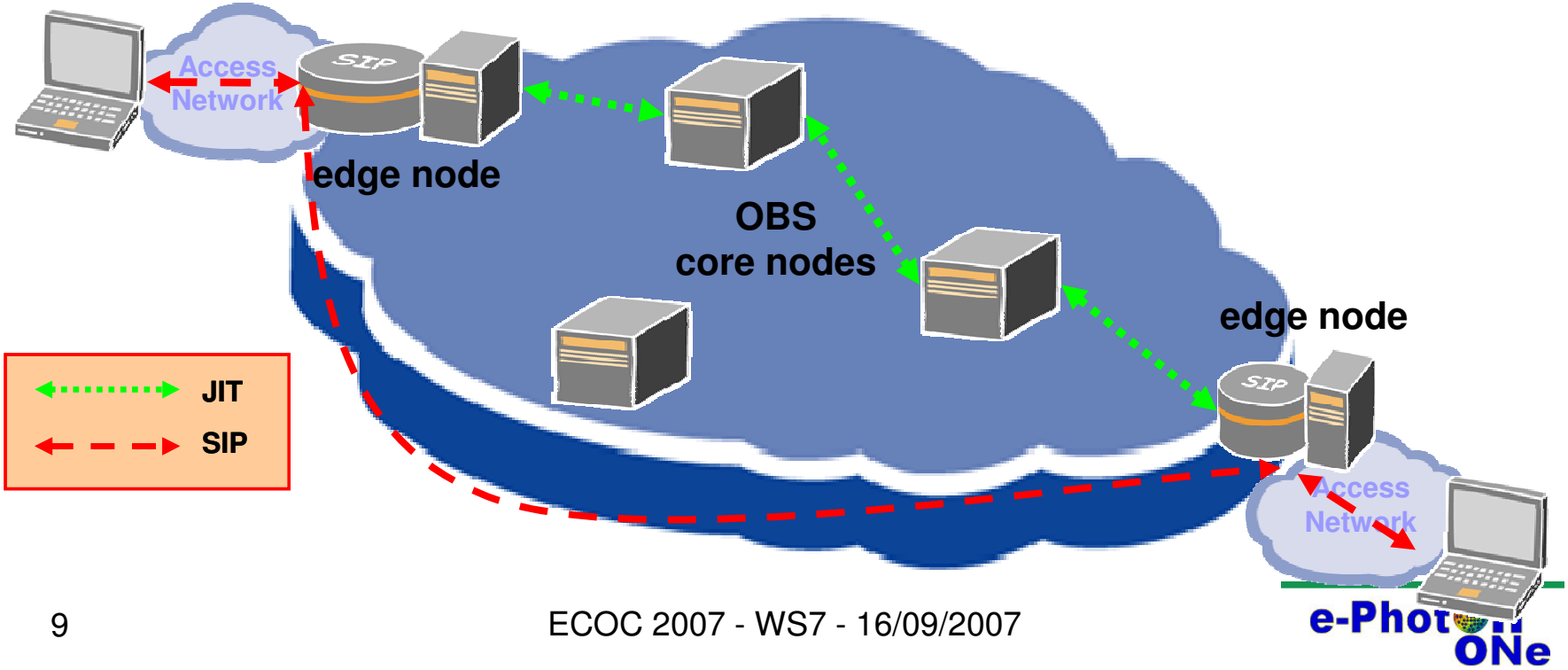
- But … several alternatives exists and decision have to be taken
  - Alternatives to transport the SIP signalling
  - Distribution and intelligence of the SIP proxy
  - Distribution of service related information among SIP domains

Network Architectures

- Overlay
  - Session and transport layers are separated
    - Logically
    - Physically
  - *Session management function in the OBS edge node*
- Integrated
  - Session management function with “full” functional SIP proxy in the OBS edge and core node
- Partially integrated
  - “Full” set of session management function integrated in the OBS edge node
  - Limited subset of session management function integrated in the OBS core node

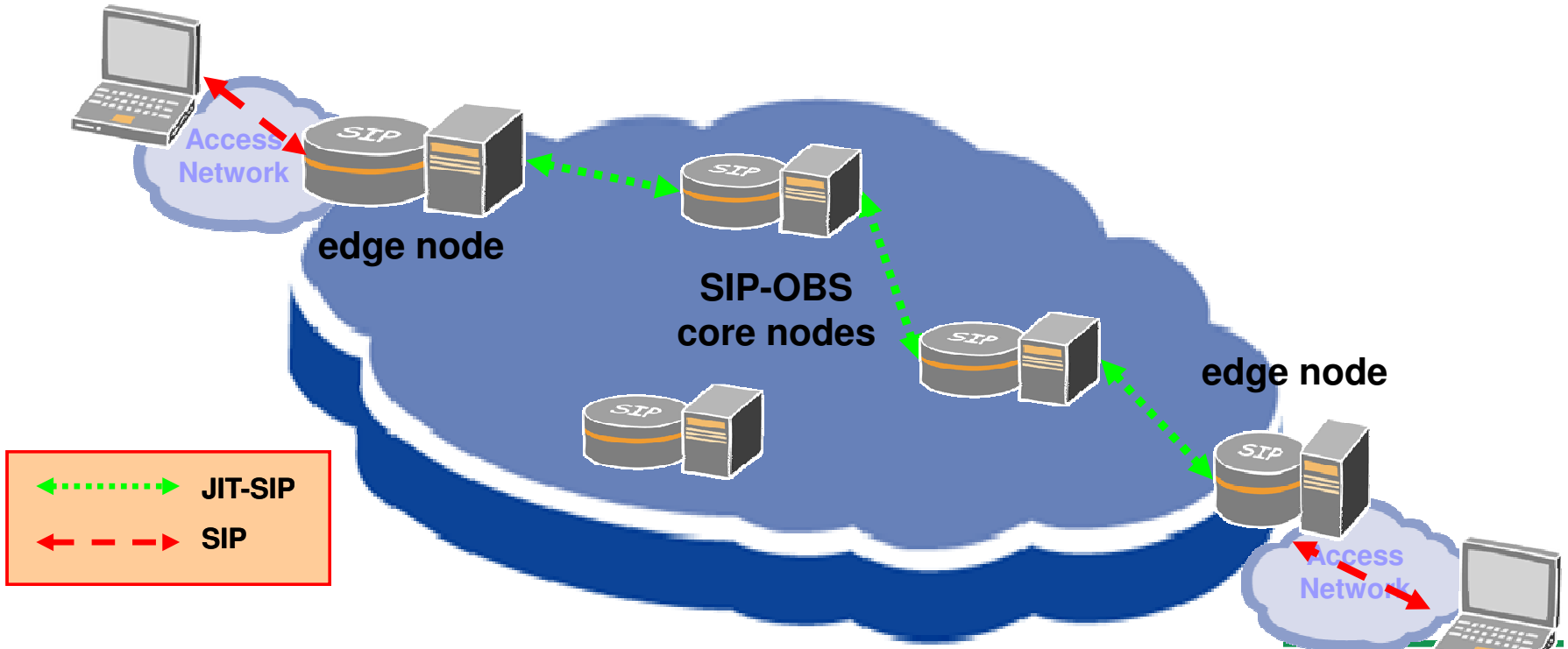
Overlay

- Both physical and logical separation between the SIP layer and the optical transport network
  - IP legacy network carrying the SIP messages is used for the signalling
  - OBS network is used only for data transmission.
- The SIP-Grid proxies
  - on top of OBS edge routers
  - request a data path between the edge routers involved in the session



(Partially) Integrated

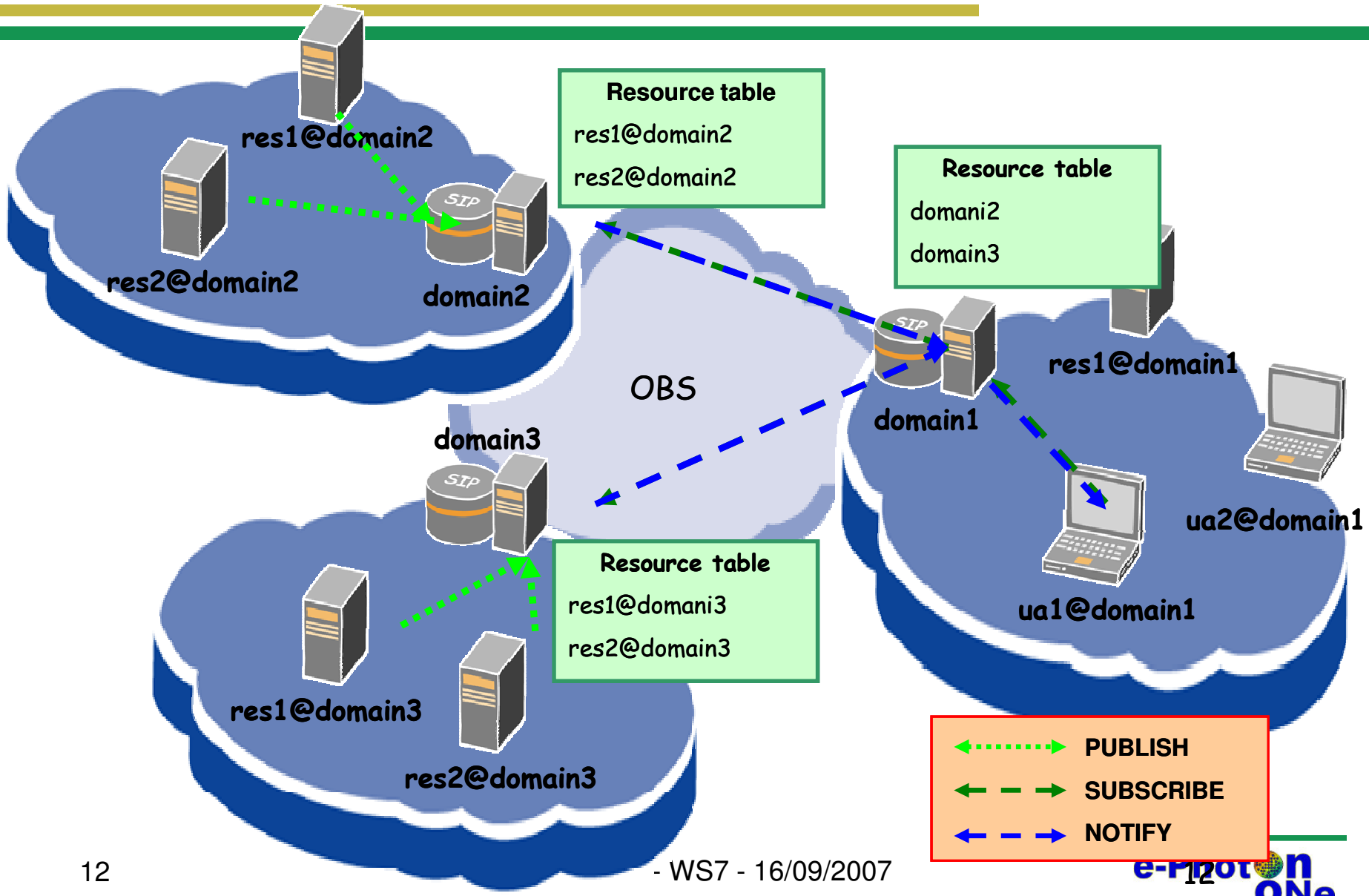
- Enriches the optical control plane with SIP functionalities
  - SIP messages are sent over the OBS control plane
- All OBS nodes must have the capability to read, parse and forward SIP messages
  - Intelligent Edge SIP-G proxies
  - Light Core SIP-G proxies



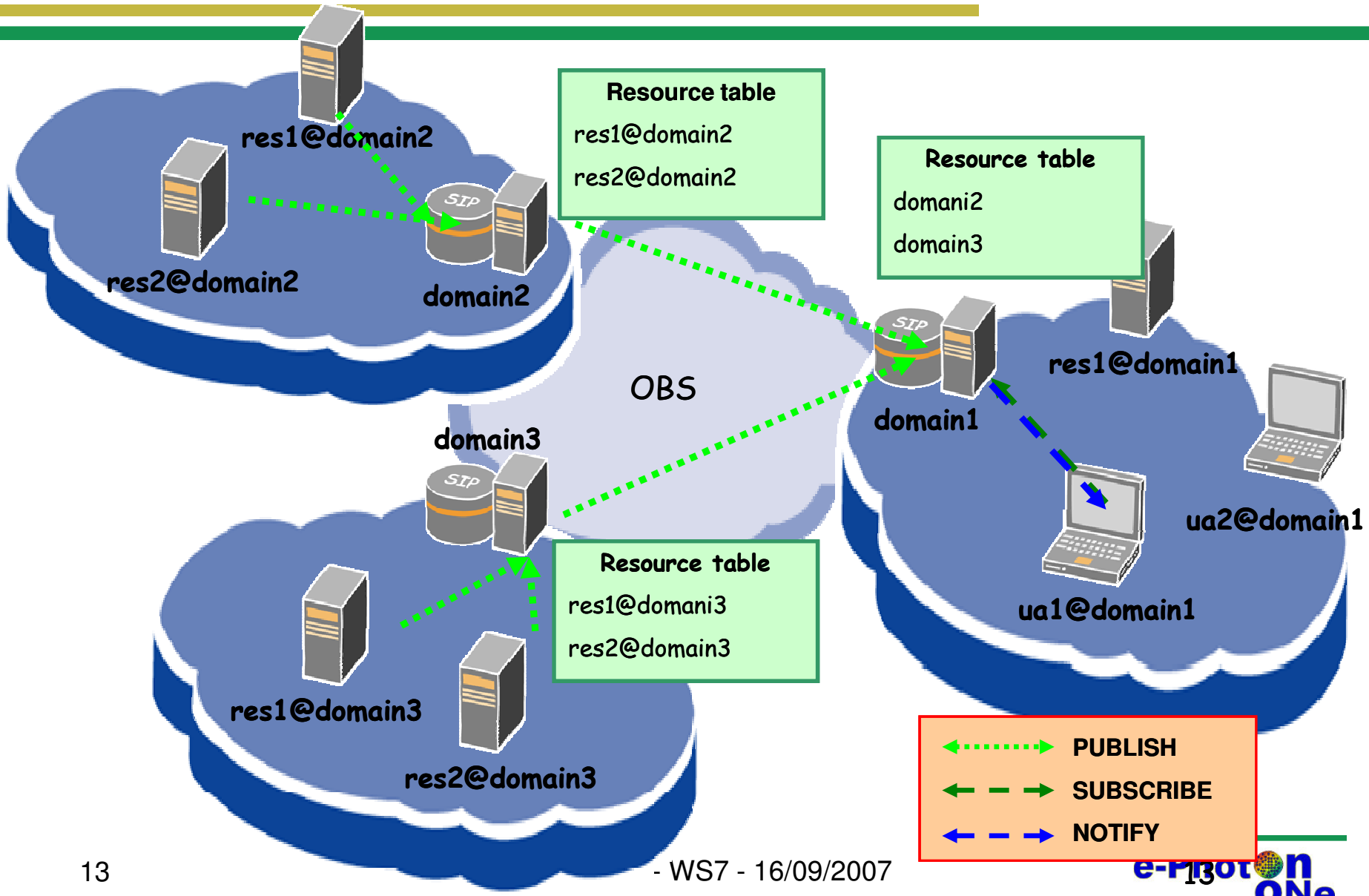
To do what?

- Grid users and resources act as SIP user agents
- SIP is used to
  - Discover and reserve resources
    - 1 phase or 2 phases
  - Interact with OBS control plane to establish the physical connection
    - Anycast, re-route, …
- The SIP proxy has been enriched with
    - SIP-OBS Middleware to interact with OBS (JIT)
    - Capabilities to embed and partially parse application specific messages (JSDL, RDF, …)

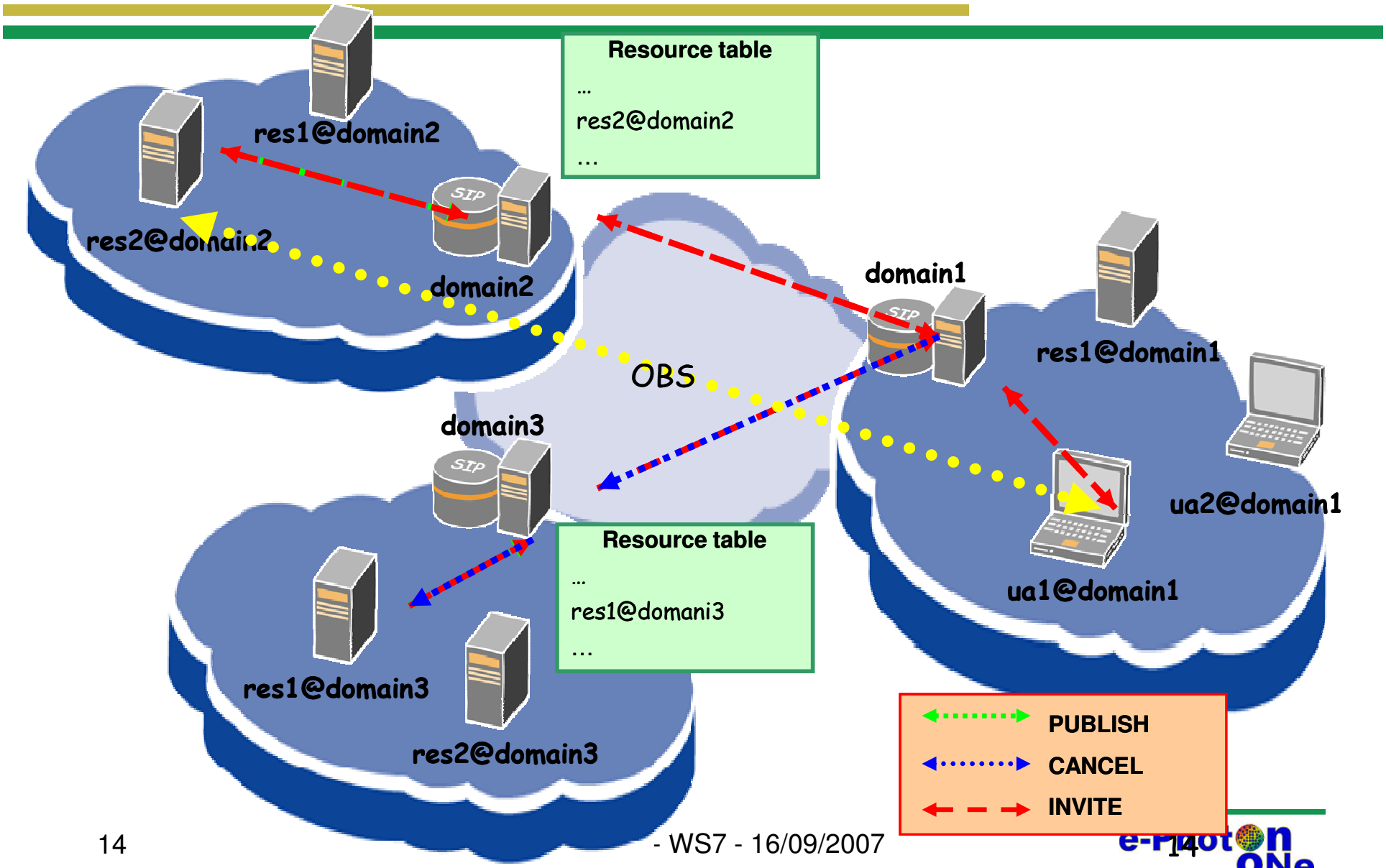
Resource discovery (localized approach)



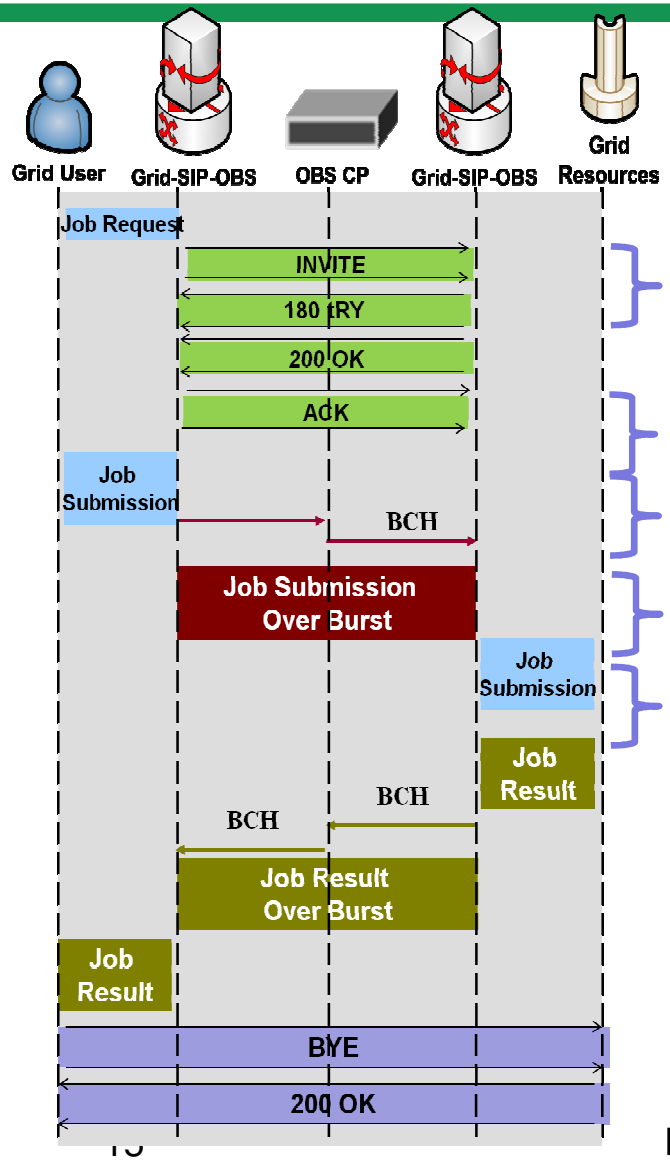
Resource discovery (distibuited approach)



Resource discovery and Reservation



Testbed results



Timings:

~20ms

~40ms

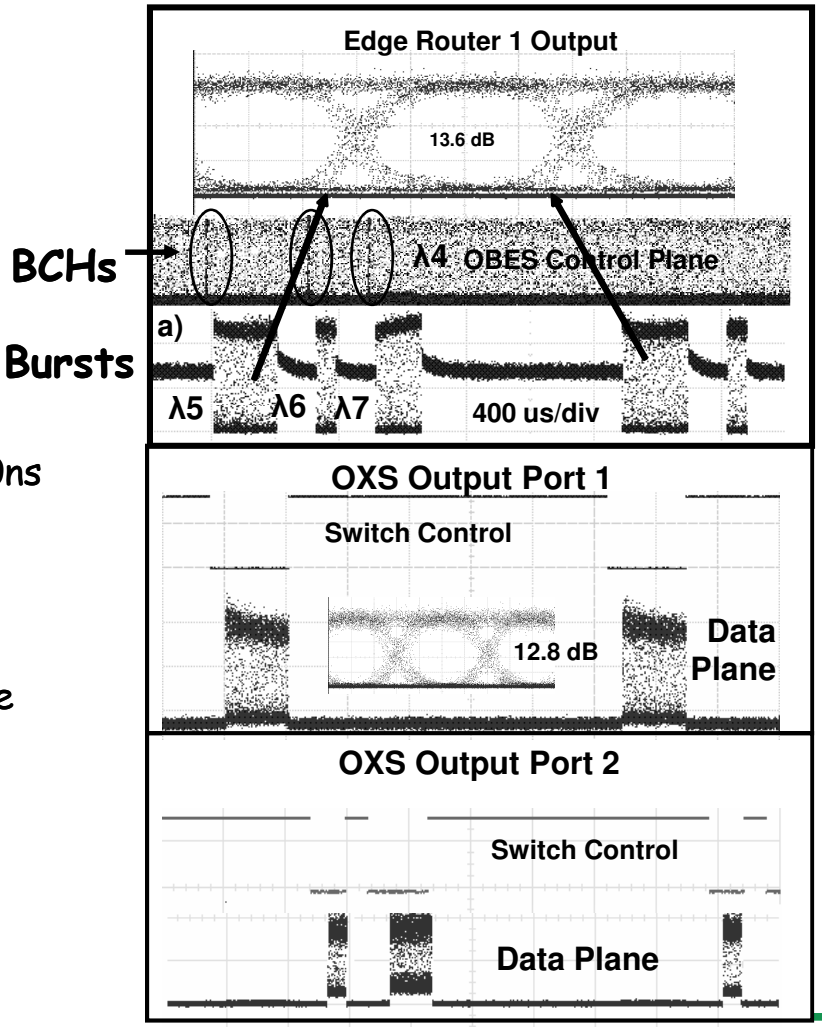
Core router: Proc+Conf=200ns

Aggregation varies

Emulated processing time

...

...



Conclusions

- Results
  - Development of resource discovery
  - Development of reservation of both network resources (e.g. bandwidth) and non-network resources (e.g. computing resources)
- Developed modules applicable to different transport techonologies with minor adjustments

- Key message: the proposed solution is
  - Feasible
  - Flexible
  - Scalable