Illustrating a Publish-Subscribe Internet Architecture
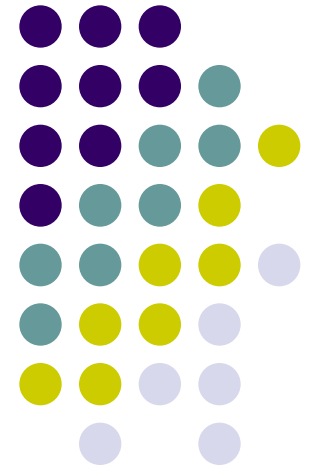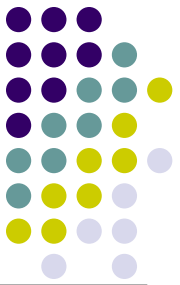
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Are Internet Fundamentals Still Valid?

Fundamentals of the Internet

- Cooperation
  - Reflected in trust among participants
- Collaboration
  - Reflected in forwarding and routing
- Endpoint-centric services
  - (mail, FTP, even web)
  - Reflected in E2E principle
- Stationary endpoints

- ⇒ **IP, full end-to-end reachability**

vs.

## Reality in the Internet Today

- Phishing, spam, viruses
  - There is no trust any more!
- Current economics favor senders
  - Receivers are forced to carry the cost of unwanted traffic
- Information-centric services
  - Endpoint-centric services move towards information retrieval through, e.g., CDNs
  - Cloud computing
- Mobility

⇒ **IP with middleboxes & significant decline in trust in the Internet**

It's the new ways Internet is used; that was not designed for…

Publish Subscribe Internet Routing Paradigm (PSIRP)
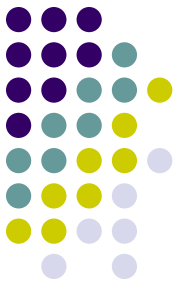
- Clean slate architecture for the Future Internet

- Pub/Sub based

- Multicast will be the preferred delivery method

- Security and caching will be native components of the architecture

- Mobility and data morphing will be considered from the early stages of the architecture design

- EU FP7 funded (http://www.psirp.org)
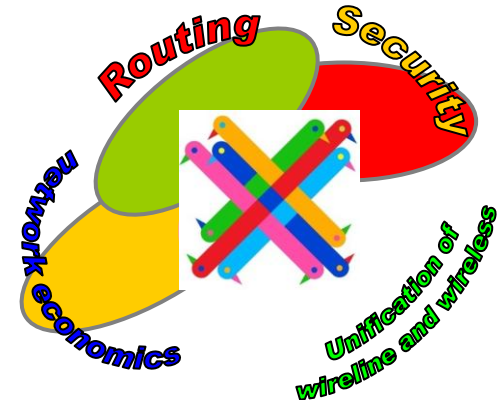
The Publish/Subscribe approach

- **Endpoints:**
  - Publishers: data owners
    - Provide pieces of information in the form of *publications*
  - Subscribers (data consumers)
    - Express interest in pieces of information via *subscriptions*
- **Network:**
  - Event notification service (broker substrate): matching *publications* and *subscriptions*

$\Rightarrow$

- *End-to-end decoupling*
  - Publishers/Subscribers need not be aware of corresponding Subscribers/Publishers
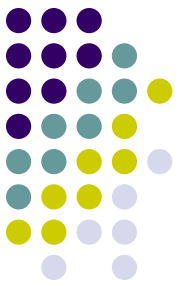 - Asynchronous communication
- *Multicast*
  - Multiple subscriptions can be grouped, brokers merge data streams
 - Norm in pub/sub
- *Caching*
  - Pub/sub state and multicast suitable for in-network caching

Publisher

Event
Notification
Service

Subscriber #2

Subscriber #1
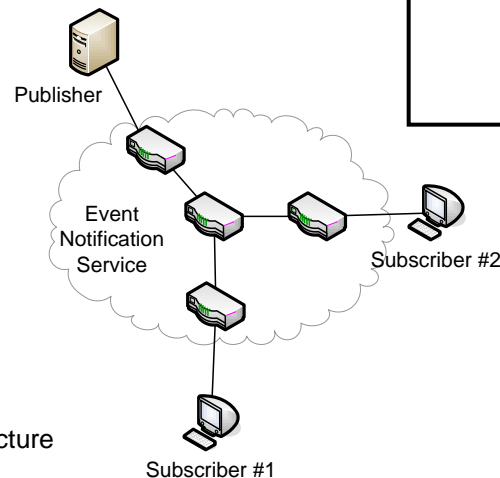
The PSIRP Architecture (1)

- Information becomes available through publications
- Each publication is identified by a unique identifier (rendezvous identifier – RId)
- Information is organized in *networks* called scopes, each one identified by a scope identifier (SId)
  - Physical networks, e.g. university campus
  - Logical networks, e.g. social network
  - Used for: locating information (*context*), access control
  - Hierarchically organized (*algorithmic* identifiers, AIds)
- Publishers initially publish *metadata* to the rendezvous point (RP) of the information
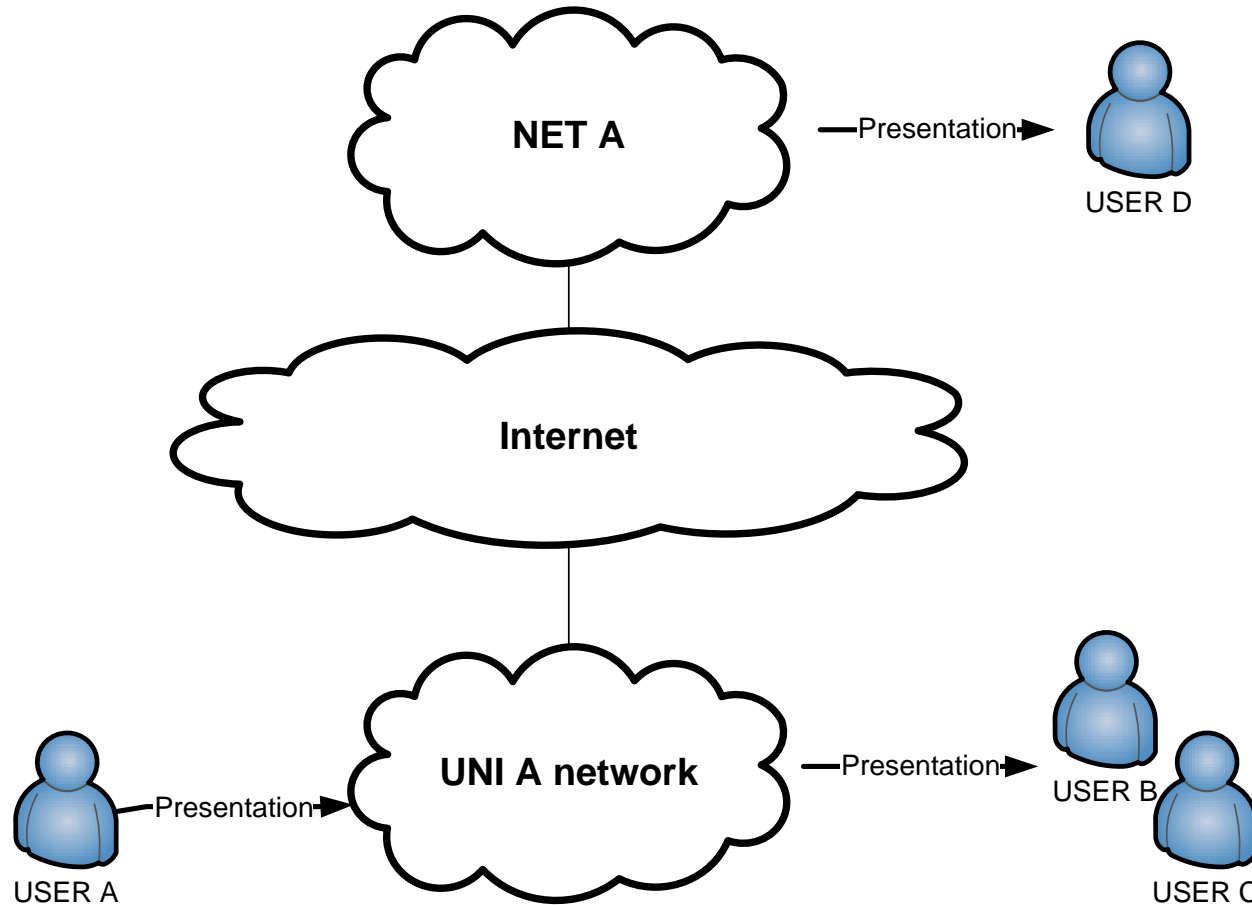 - RP responsible for the specific SId
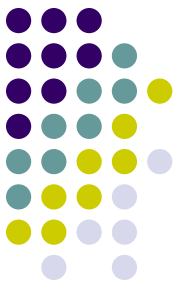
The PSIRP Architecture (2)

- Information is accessed through subscriptions issued to the rendezvous point (RP) of the information
  - RP responsible for the specific SId
- RP is responsible for *matching* publications with subscriptions i.e. matching RIds within a certain scope (SId)
- Information dissemination is achieved using a stack of forwarding identifiers (FIds) similar to MPLS
- Data do not necessarily pass through RP
- All identifiers are flat and location independent
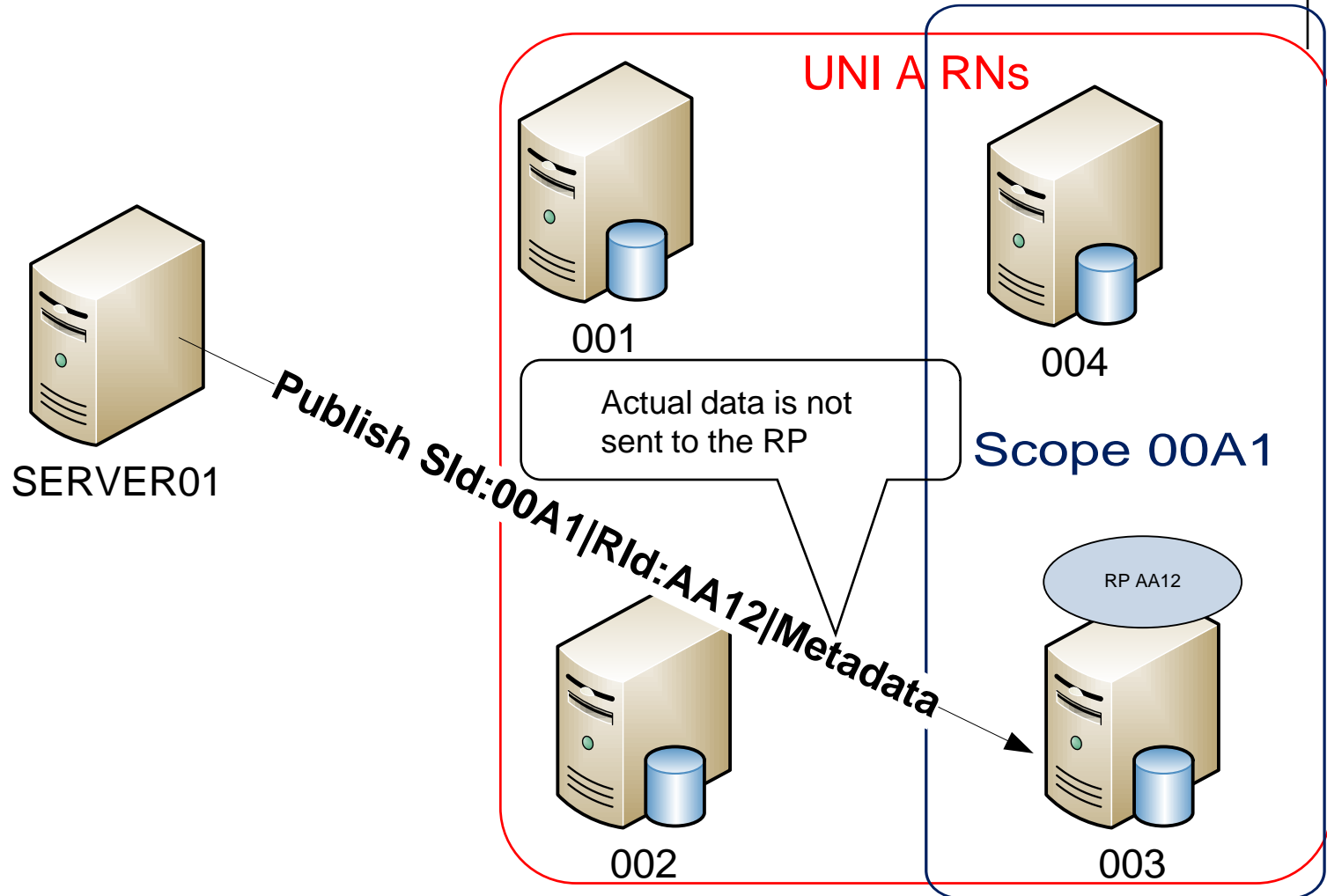- SIds and RIds can be of local or global significance
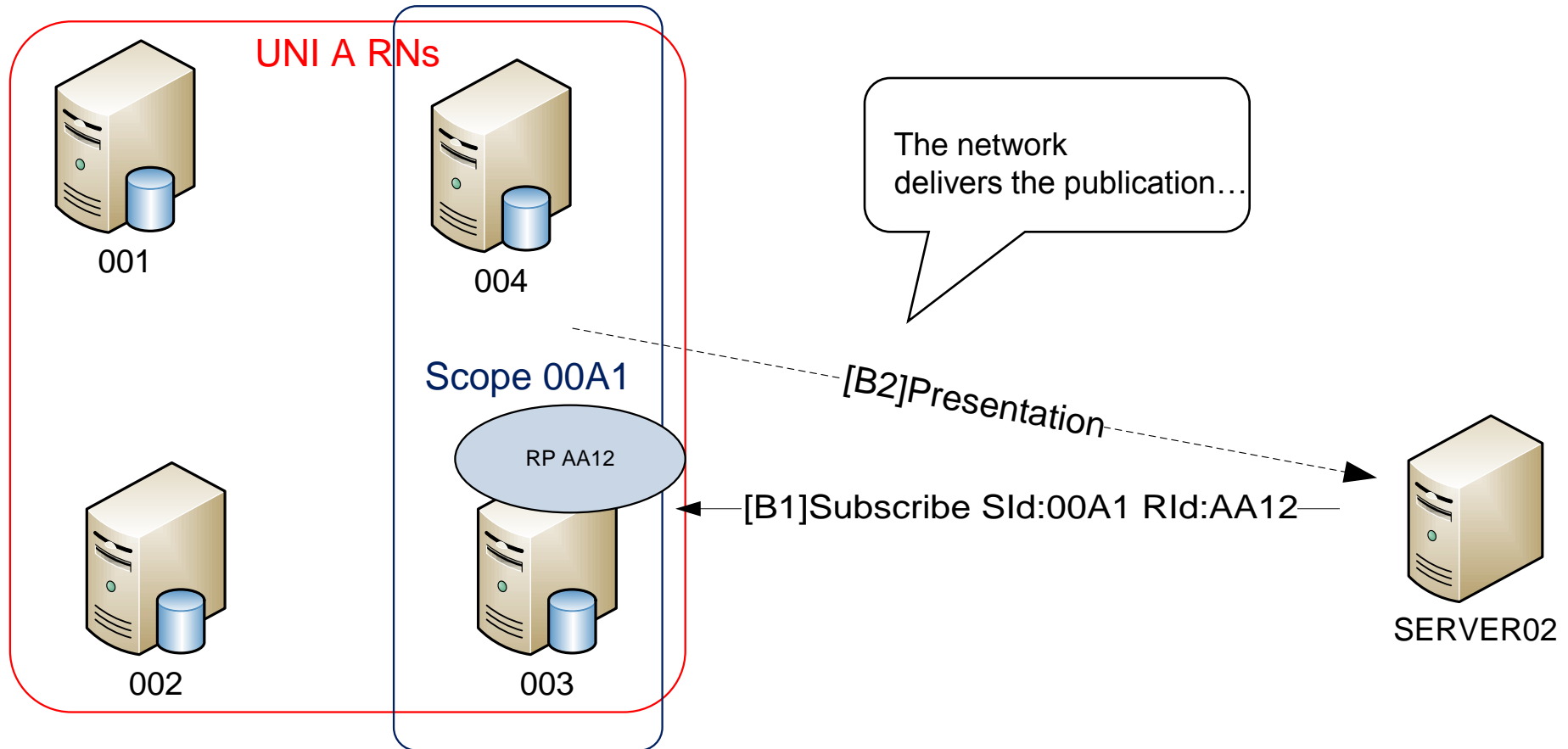
PSIRP Usage Scenario Overview

PSIRP Publish

UNI A RNs

001

004

Actual data is not
sent to the RP

Scope 00A1

SERVER01

Publish SId:00A1|RId:AA12|Metadata

RP AA12

002

003

PSIRP Subscribe from Internal Network

UNI A RNs

001

004

Scope 00A1

RP AA12

002

003

The network
delivers the publication…

[B2]Presentation

[B1]Subscribe SId:00A1 RId:AA12

SERVER02

PSIRP Forwarding

12|Data

SERVER01

14|Data

In FID|Out FID|Out Inf
  12 | 14 | 2

19|Data

In FID|Out FID|Out Inf
  14 | 19 | 2

20|Data

In FID|Out FID|Out Inf
  19 | 20 | 3

SERVER02
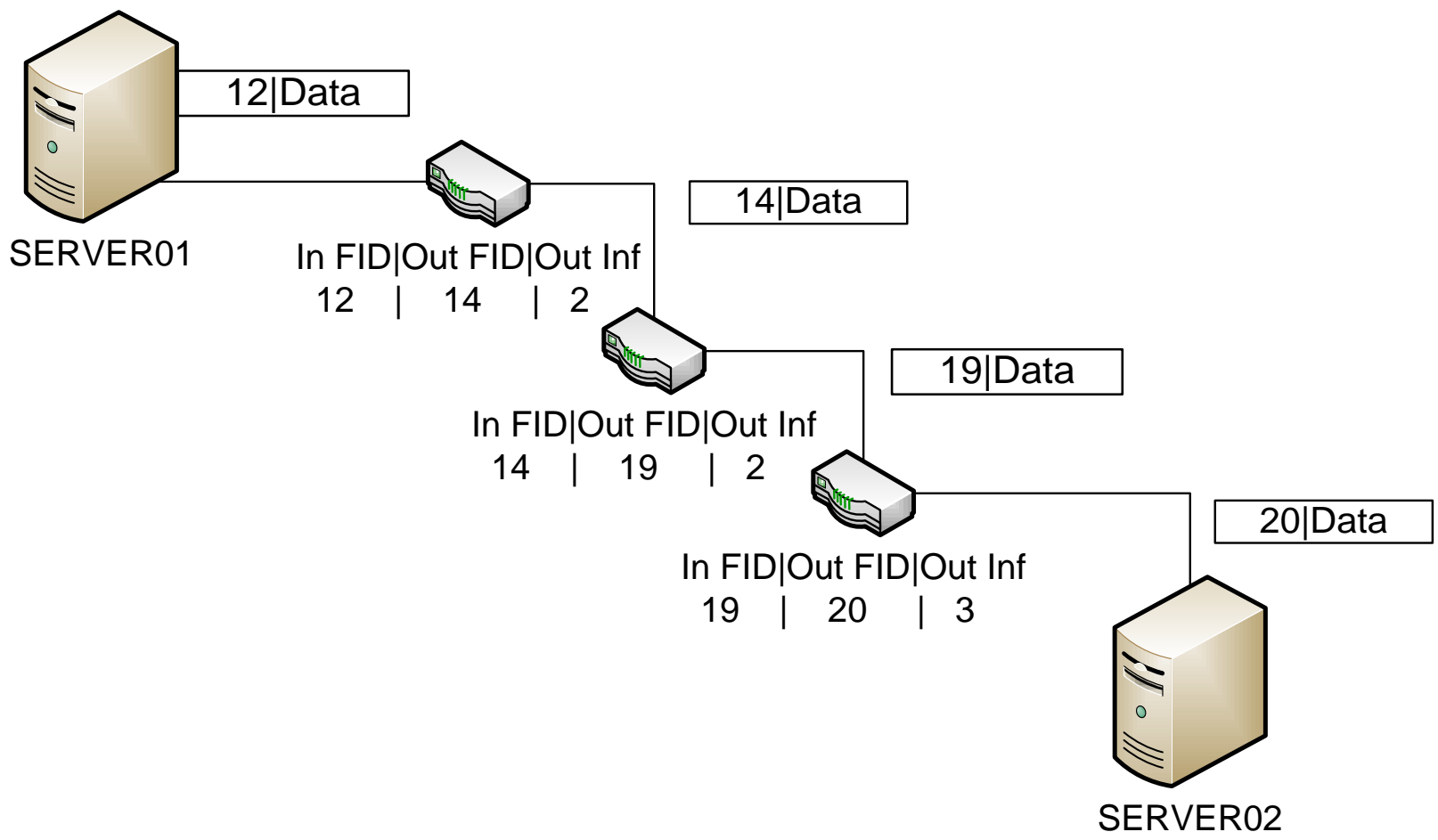
PSIRP Subscribe from External Network

Scope 32BE

001

004

RP AA12

002

003

[3]Subscribe SId:00A1 RId:AA12 (encrypted USERD's account)

[2]Subscribe AlgSId RId:AA12 (encrypted USERD's account)

[4]Publication

Internet

USERD's laptop

[1]Subscribe AlgSId| RId:AA12 (encrypted USERD's account)

NET A RNs

000A
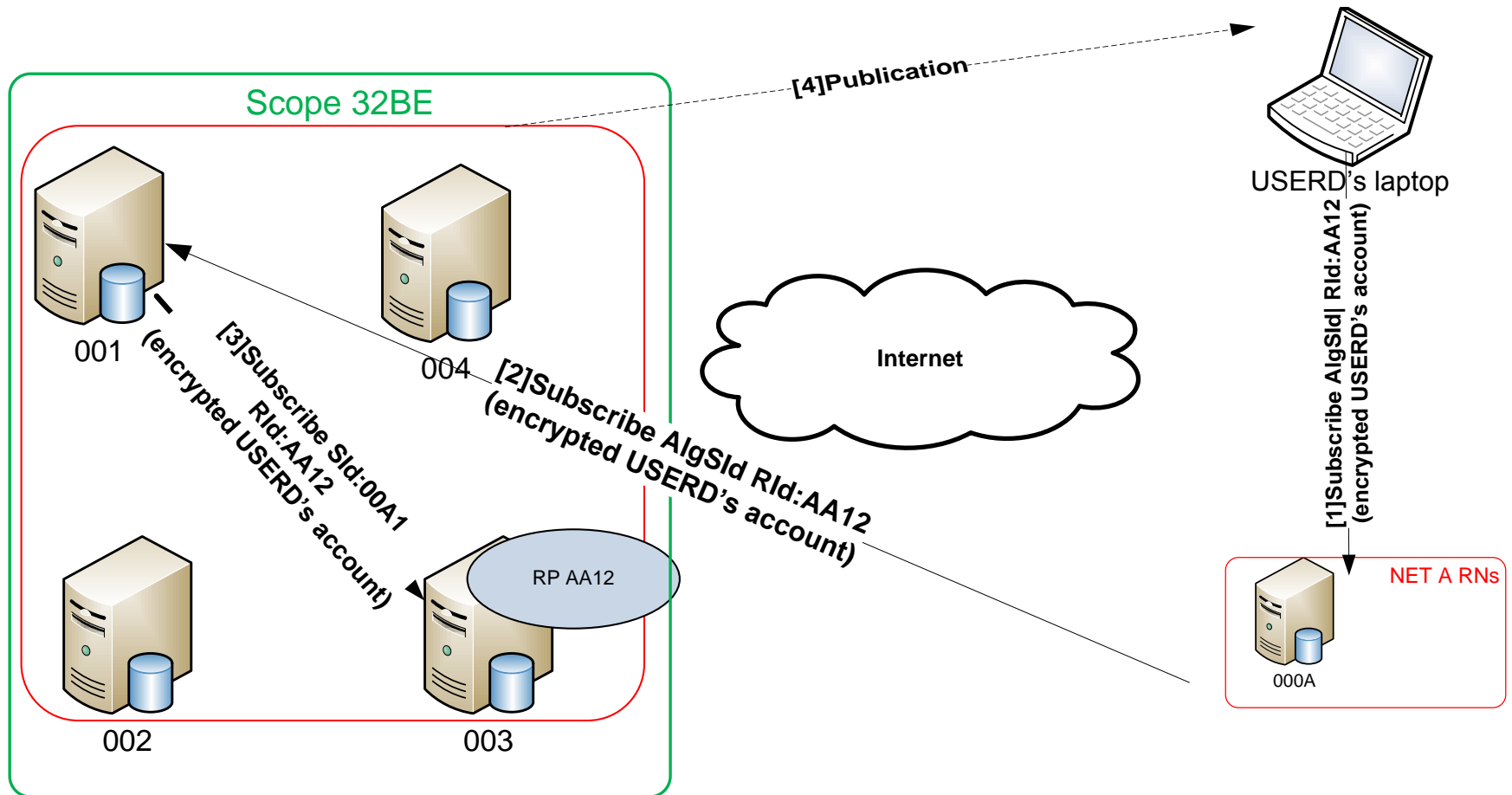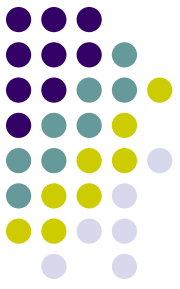
Current Status

- Network level working prototype
- Intra-domain routing using bloom filters
- Security mechanisms evaluation
- Application development using pub/sub and overlay multicast
- Multicast assisted mobility

Thank You

http://www.psirp.org