Extending PKI Interoperability in Computational Grids

Scott Rea, Massimiliano Pala, Shreyas Cholia, and Sean Smith

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Outline

- Introduction
  - Introduction & Motivations
  - Current Solutions & Limitations
- PKI Data distribution and Trust Model
  - IGTF Trust Model
  - PKI Resource Query Protocol
- Conclusions
  - Implementation Details
  - Future Work

Introduction

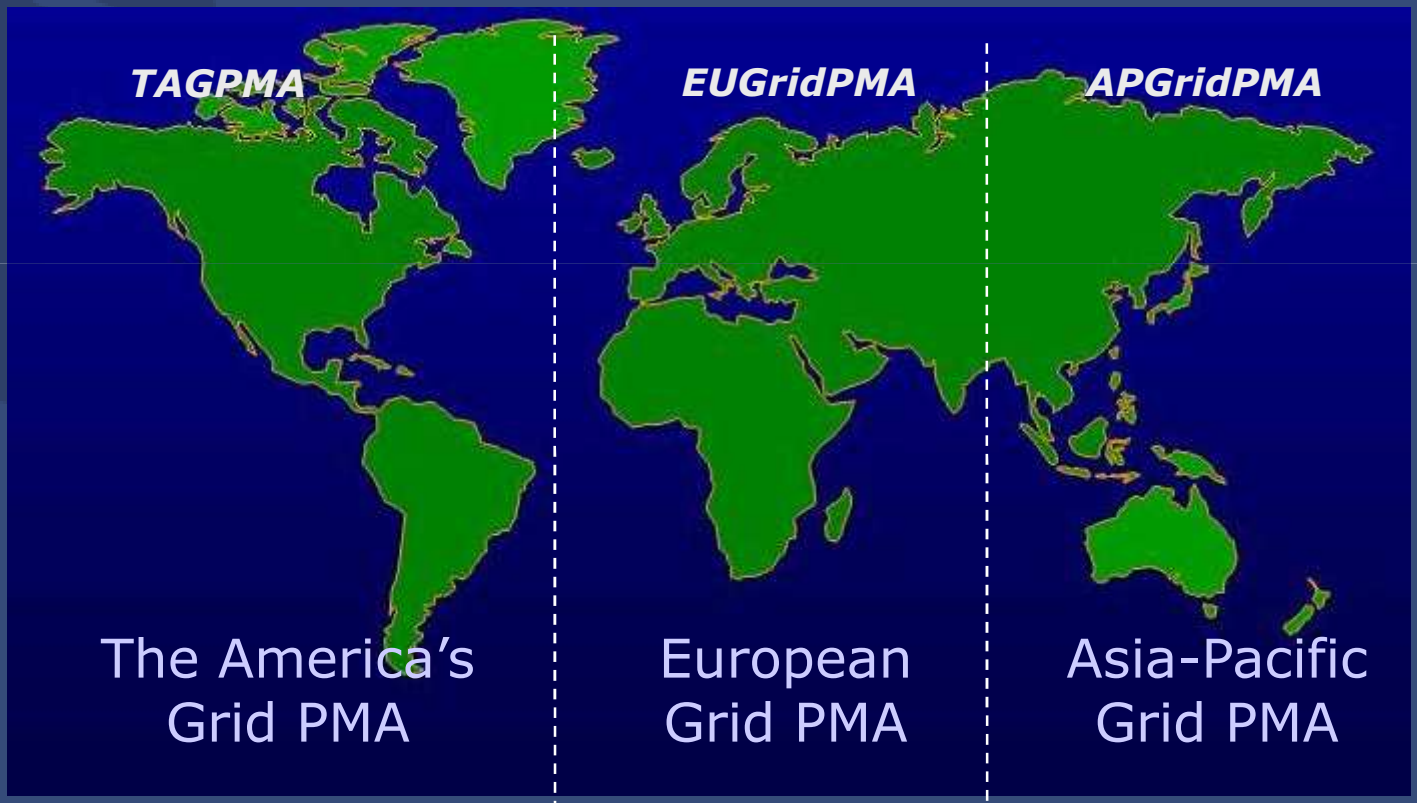
- Computational grids rely heavily on Public Key Infrastructures
  - Authentication in grids is PKI based
  - Authorization in grids can also be PKI based via VOMS
- The trust and integrity of grid transactions is underpinned by the PKIs that facilitate them
- Trust in any system that uses PKI can be defined by the following questions:
  - How well do I trust the issuer of a given credential to authenticate the identity of the subject of the credential?
  - How well do I trust the issuer of a given credential to bind the identity of the subject to the credential?
  - How well do I trust the subject to use the credential responsibly?

Introduction

- If there was a single PKI for all grid computing, evaluation of the issuer practices would be simple
- The International Grid Trust Federation helps to solve the evaluation of issuer practices for trusting many PKIs
  - 3-member PMA federation covering different regions of the world
  - Publish standard profiles on how Certificate Authorities should operate and issue credentials
  - Evaluate CAs policies and procedures against the profiles via peer review
  - Publish an official list of accredited CAs
  - Package trust anchors and relevant data for distribution

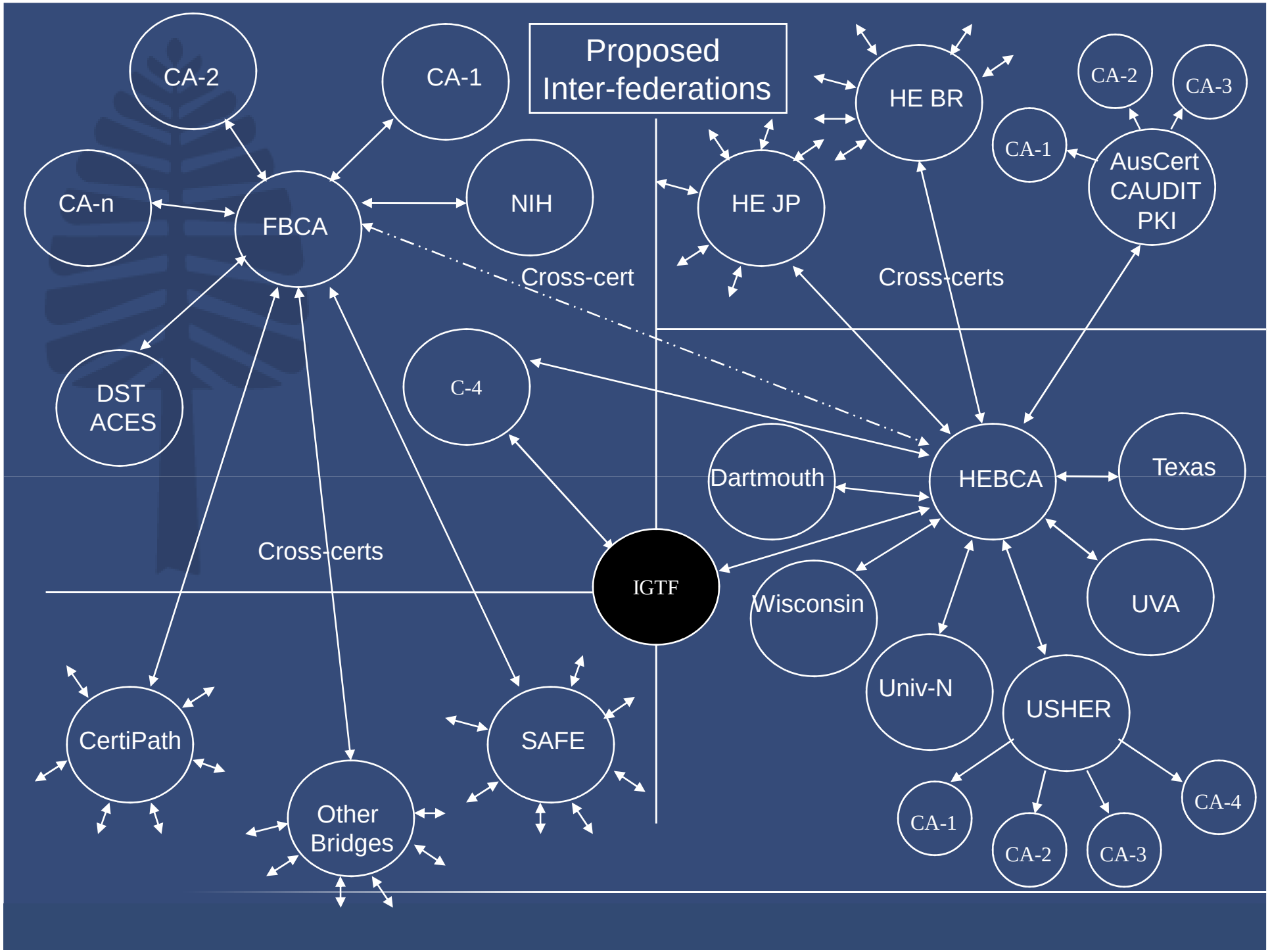
IGTF – the International Grid Trust Federation

- Common, global best practices for trust establishment
- Better manageability and response of the PMAs



Introduction

- Many grids also accept additional “local” PKIs for authentication and authorization purposes, that are not accredited by the IGTF
- The number of potential PKIs available to grids for authentication purposes is rapidly increasing
- Any grid that wants to take advantage of the plethora of PKIs available should carefully consider the policies and practices they employ to issue certificates
- The pressure for multiple sources of trusted PKIs and information regarding these PKIs is ever increasing
- Even if the IGTF accredited all these, the distribution would become to unwieldy for grids to process
- In future, grids will need a way to manage the subset of IGTF trust anchors that they wish to support and any additional “local” ones they also wish to trust


Proposed
Inter-federations
CA-2
CA-1
CA-n
FBCA
NIH
Cross-cert
DST
ACES
C-4
Cross-certs
IGTF
CertiPath
SAFE
Other
Bridges
HE BR
HE JP
CA-2
CA-3
CA-1
AusCert
CAUDIT
PKI
Cross-certs
Dartmouth
HEBCA
Texas
Wisconsin
UVA
Univ-N
USHER
CA-1
CA-2
CA-3
CA-4

Grids and PKI Data Distribution

- Download of trusted CA distributions
  - CA Certificates
  - CRL URL
  - Namespace
  - Signing Policy
  - *.info* (general information about the CA
- Possible Denial of Service
  - CRL downloaded at the same time by the Grid software
- Dynamic vs centralized Pull PKI data distribution model

Finding PKI Resources

- PRQP is a protocol that will allow relying parties to discover many different types of information about a given PKI
  - Validation Services (OCSP, SCVP, etc..)
  - Subscription/Revocation Services
- PRQP helps managing trusted PKIs details
- PRQP facilitates extended PKI interoperability within computational grids
  - Authorization framework
  - Attribute Authorities

Difficult PKI Questions (?)

Where can I ask for a certificate revocation ?

Where do I apply for a new Certificate ?

Where do I find the Certificates repository ?

PKI Resource Discovery

- Enhance Interoperability across PKIs
- Ease PKI Management Issues
  - Now connected to certificates' contents
- Foster simpler User Interfaces (UI)
  - User awareness Issues
- Usability of PKIs

Current Solutions

- Certificate Extensions
- DNS Records
- Web Services
- Local Network Oriented Solutions

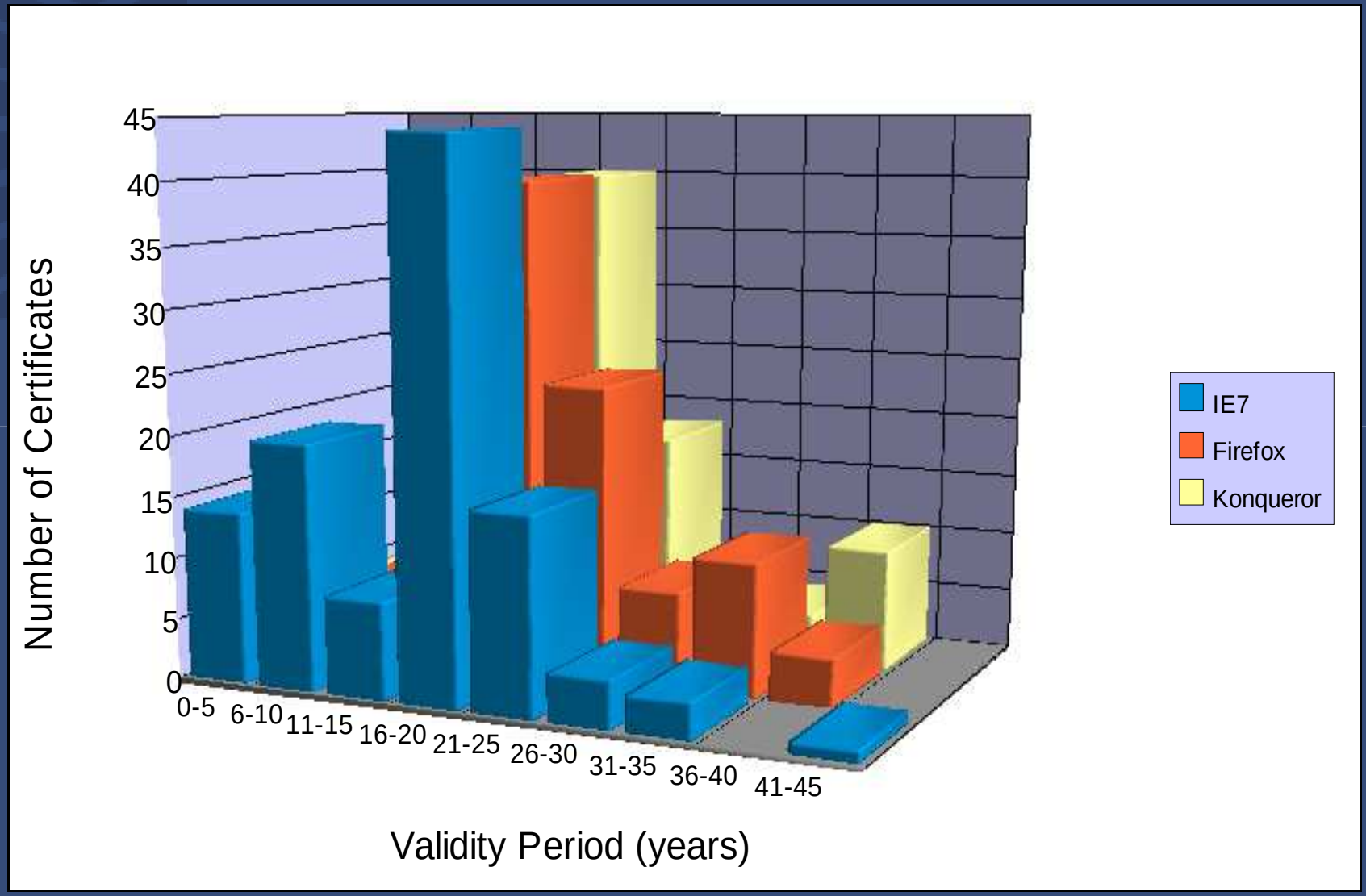
Certificate Extensions

- Certificate Extensions may be used to point to data and resources
  - AuthorityInformationAccess (AIA)
  - SubjectInformationAccess (SIA)
- *Different extensions for different locators (CDP, AIA/SIA)*
- *Too Static Approach*

Certificate Extensions

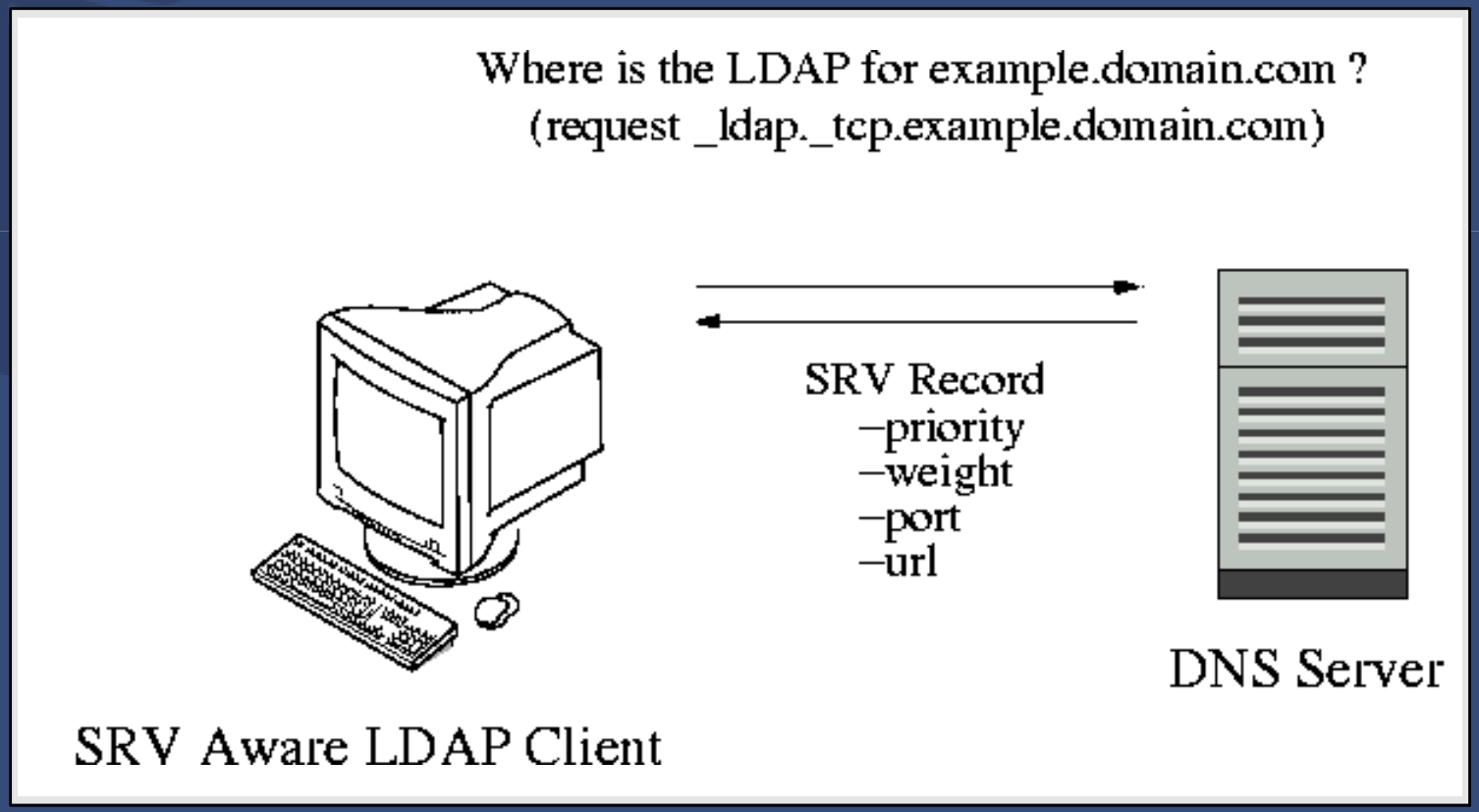
- Reissuing of certificates is needed for new extension values to be added/removed
  - feasible for CA's certificates
- Today
  - *OCSP pointer in 11% of Firefox Embedded Certs*
  - *No pointers in IE/KDE applications*

Certificate Extensions



DNS Records

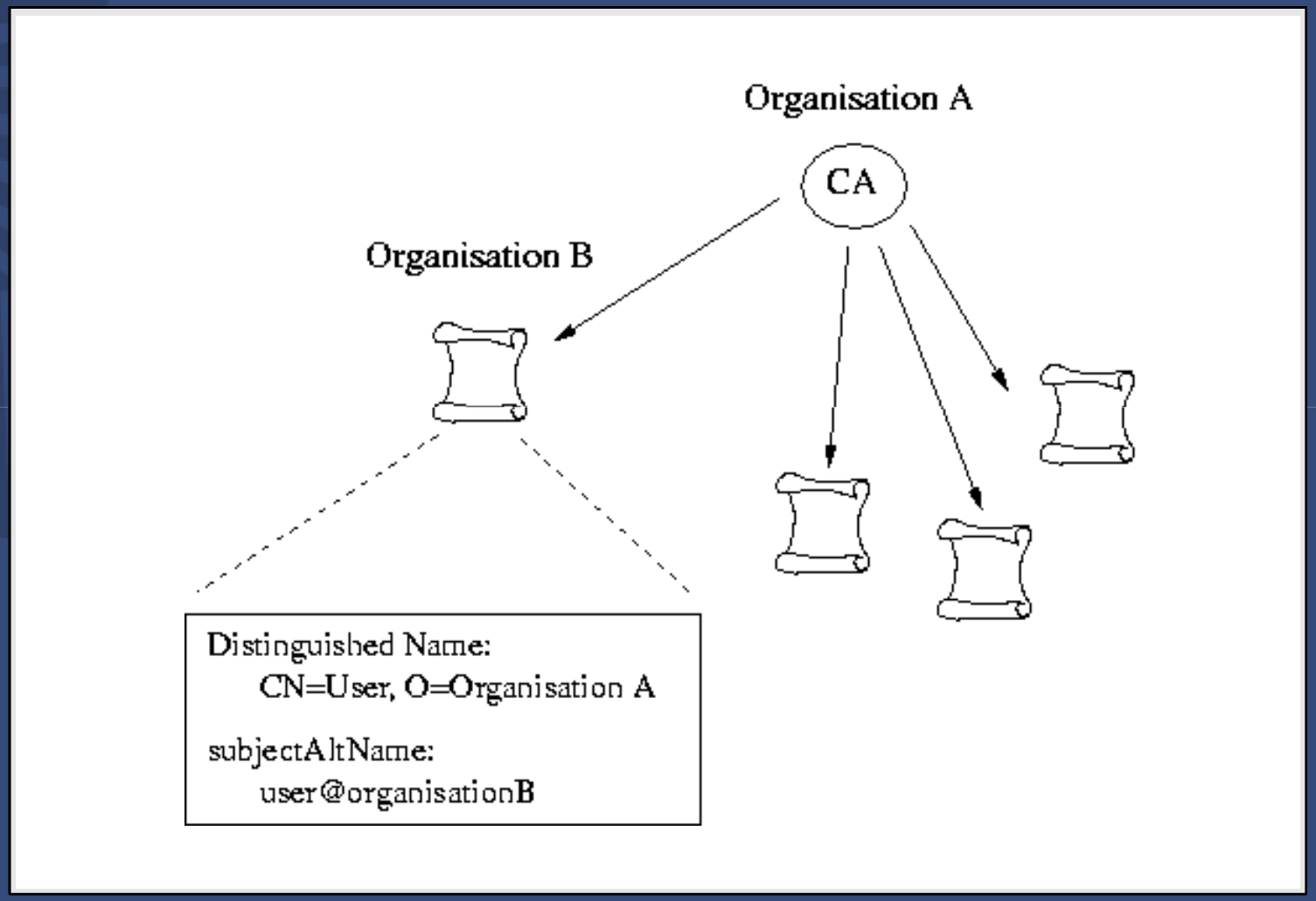
- DNS SRV Records can be used to store informations about provided services
- Provides pointers to servers in a certain domain



DNS Records: Open Issues

- Name space mapping issues
  - X500 global namespace never made it (sorry David)
  - No relationship between DNS names and PKI's Name Spaces (unless DC=”” format is used)
- The issuing organization does not always have control over DNS records
- Where domain should the client query?

DNS Records: Open Issues (cont.)



Webservices

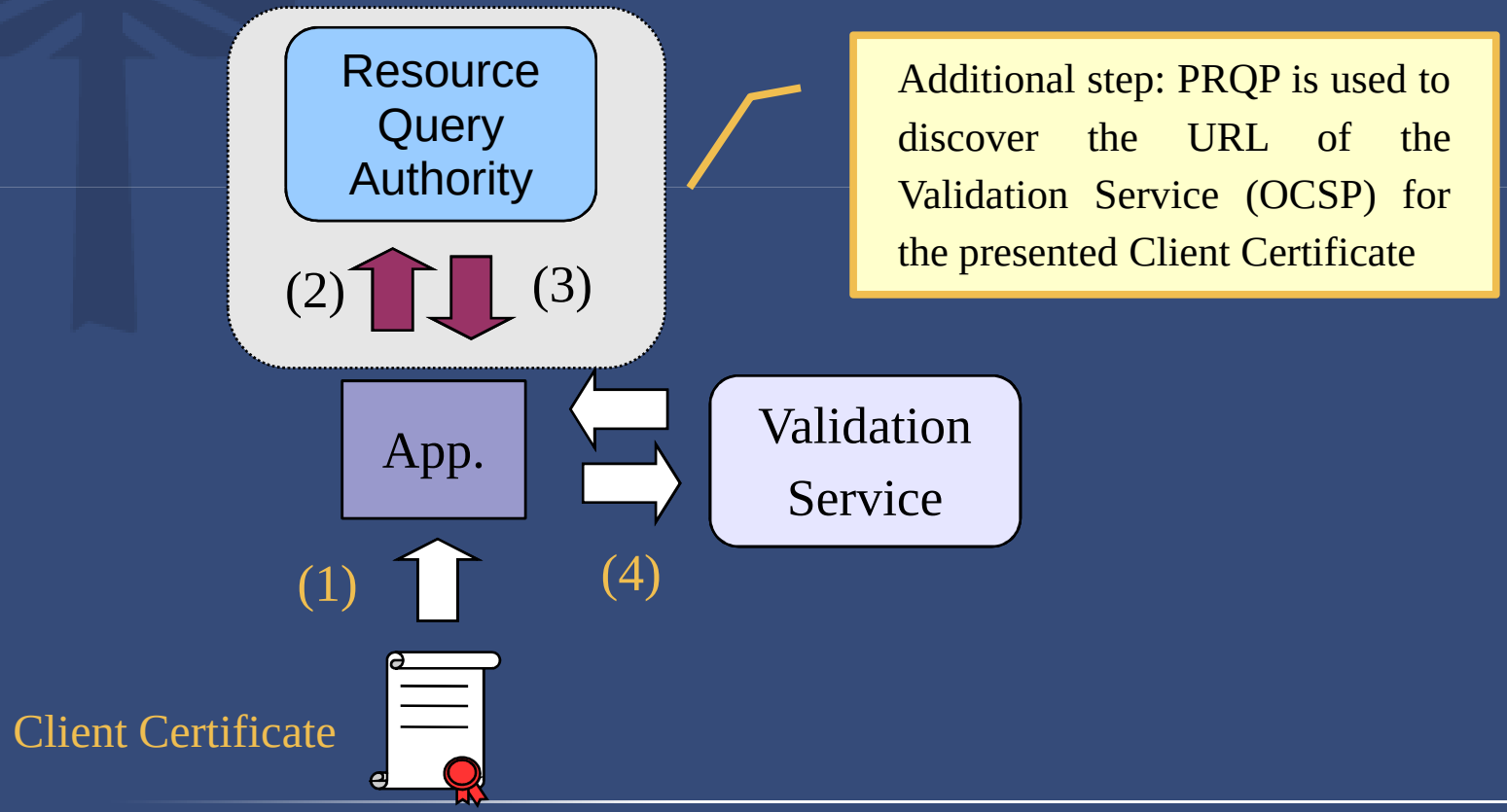
- applications can discover available webservices (by using SOAP, WSDL and UDDI)
- Easier than CORBA.. but...
- Issues:
  - Complex to deliver (WSDL, SOAP, UDDI)
  - Verbose XML format
    - cumbersome for mobile devices
  - XML not really supported by every X509 clients
    - Schemas (?!?!?)

The Proposed Solution

- The PKI Resources Query Protocol
- Allows a client to request services and repositories URL associated with a CA
- Provides “discovery” for any services (current and future):
  - Repositories (CRLs and Certs)
  - Validation Services (OCSP, SCVP, etc...)
  - Other Services (TimeStamping, Revocation, Subscription, etc...)
  - Future services

The Request Query Authority

- Authority designated to answer to PKI Resource Location
- Provides pointers to resources related to a CA



Implementation Details

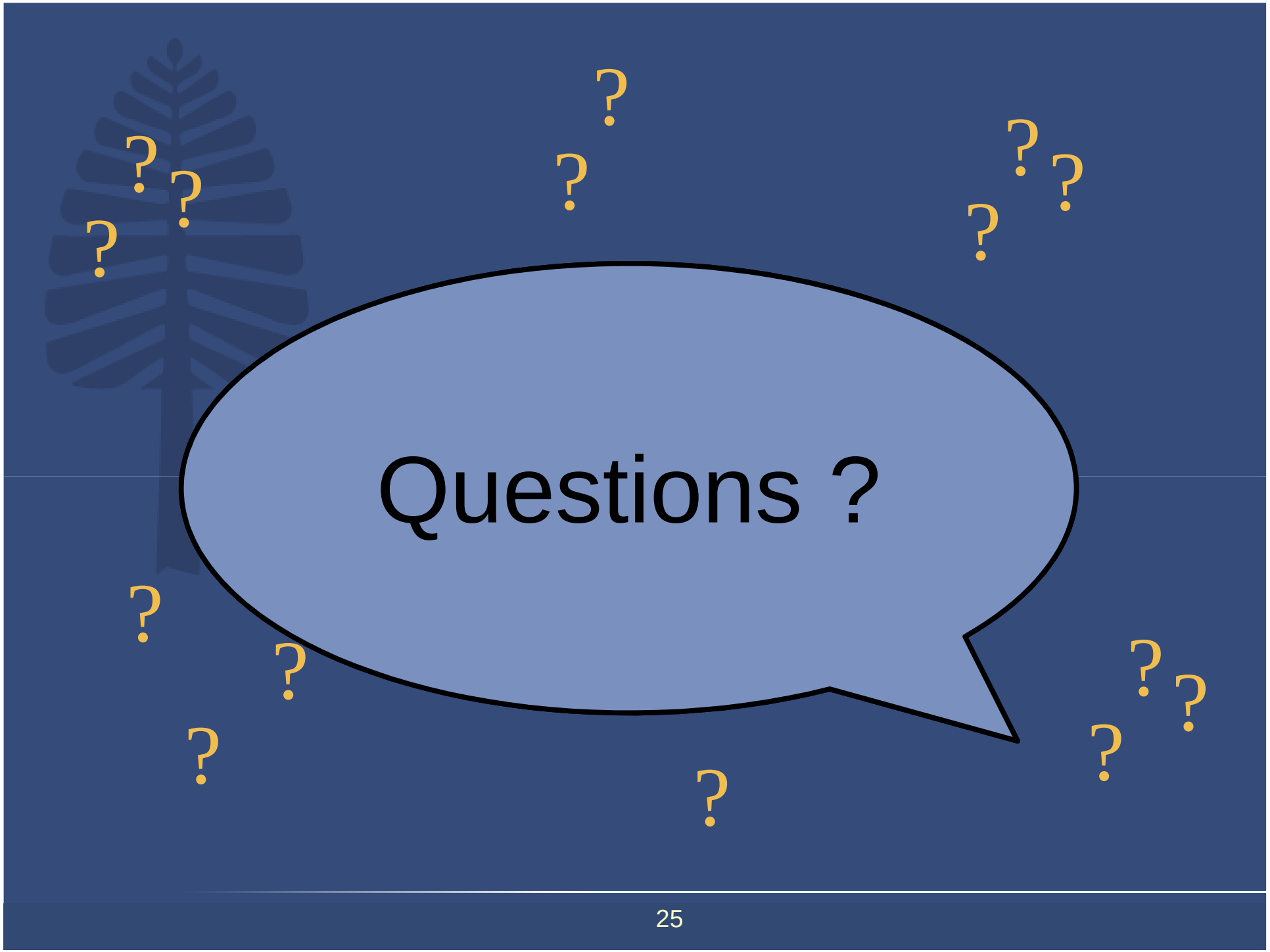
- PRQP API included into LibPKI (v0.1.8)
  - Provides easy-to-use functionality
    - PRQP_REQUEST_new_cert_file()
    - PRQP_REQUEST_new_cacert_file()
- CLI Utility (command line)
  - Generates a PRQP requests
  - Sends it to a specified RQA via HTTP
  - Prints out the PRQP response
- PRQP Server (available version at OpenCA - v0.1.1)
  - Based on OpenCA OCSPD
  - Implements PRQP over HTTP

Conclusions

- Dynamic Solution
- Fast and easy to implement
- Specific solution for the problem
- Ease rollover of services
- Facilitates extending PKI interoperability within Grids
  - Ease integration of new Trust Anchors
- PKI usability
  - Ease PKI management
  - less client/server configurations needed
- Dynamic PKI Data distribution model
  - More scalable than Centralized Pull model

Future Works

- PKI ***Usability and Interoperability project*** at Dartmouth College:
  - Advance the IETF Proposal (pala-prqp-01.txt) as new Working Item for PKIX-WG (now on experimental track)
  - Study and Deploy an RQA (Resource Query Authority)
    - Guys, we need your CAs' data
  - Extending the PRQP to a Peer-2-Peer Authenticated Network (PEACH Network)
    - Work will be presented at EuroPKI 2008


Questions ?

Thank You!

- Contacts:

Massimiliano Pala <pala@cs.dartmouth.edu>

OpenCA <project.manager@openca.org>

Scott Rea <Scott.Rea@dartmouth.edu>

HEBCA <HEBCA@Dartmouth.EDU>

- Website

https://www.openca.org/projects/prqpd/