# An Architecture for a Secure Service Discovery Service

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# Overview

1. Introduction
    - Motivation
    - Goals
2. Design Concepts
3. Architecture
4. Wide Area Support

# Outline

1. Introduction
   - Motivation
   - Goals

# Motivation

- Large scale deployment of networks and devices
- Cheaper networks and network-enabled devices

# Goals

- Locate a service out of thousands
- Secure and trusted services with minimum client intervention
- Repository of (running) service descriptions
- Hierarchical load-balancing and recovery

# Outline

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- Goals

2 Design Concepts

# Design Concepts

- Annoucement-based Information Dissemination
  Use of perodic multicast annoucements for recovery, bootstrapping and updating. Suitable for eventual consistency.
- Hierarchical Organisation
  If a server is overloaded a child node is started. Downwards cascading recovery for several server failures.
- XML Service Descriptions
  Flexibility, validation ability and backward compatibility.
- Privacy and Authentication
  Hybrid cryptography: symmetric and asymmetric cryptography. Principals and component's public keys assure authentication.

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3 Architecture

# SDS Server

- Global multicasts authenticated messages
- Authenticated advertisements contain:
  - Certificate Authority and Capabilities Manager contact
  - Address for sending service announcements
  - Service annoucement rate
- Aggregate rate set by administrators
- Overloaded servers reaching a given threshold start another server
- Failure handled individually or cascading through the hierarchical organisation
- Privacy and authentication possible through the *secure one-way service broadcast*

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2. Multicast its service descriptions to the appropriate channel/frequency
3. Set appropriate capabilities by contacting the Capabilities Manager

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2. Stores encryption key certificates and the principal's certificates
3. The CA's public key is public
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2. Services specify an ACL for principals principals
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- **Authenticated RMI**
  A handshake establishes the symmetric key for the session between client and SDS servers and between pairs of SDS servers

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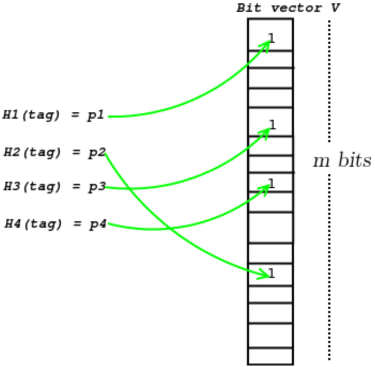
   - Administrative domain
   - Network topology
   - Physical location
2. **Aggregate service description (lossy)**
3. **Use aggregation tables for routing queries**

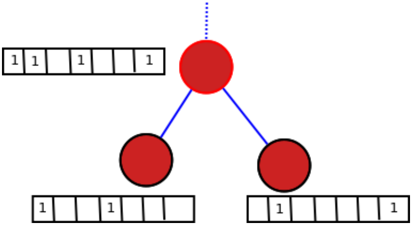
# Lossy aggregation & query routing

- Hash values of tag subsets of service descriptions used as summary
- Algorithm:
    1. When adding: compute description tag subset, insert into Bloom Filter table
    2. When querying: compute tag subsets, examine corresponding entries in Bloom Filter table for possible matches
- Limitations:
    - Computation required: fewer subset hashes
    - Space required: use bloom filters

# Bloom filters



# Index aggregation & routing



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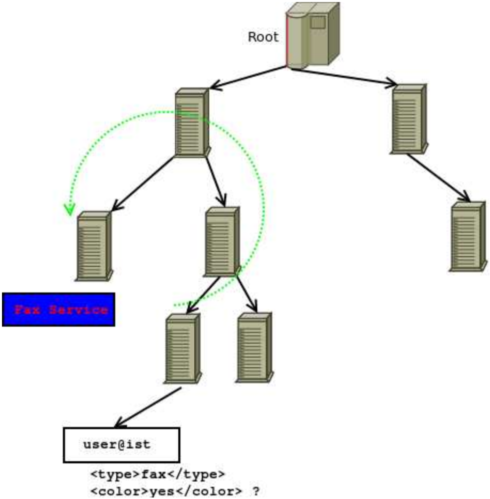
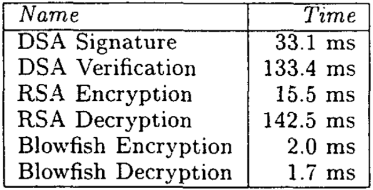


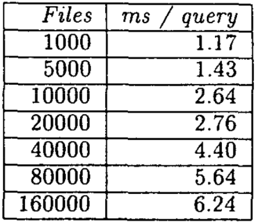
# System Performance



| *Name* | *Time* |
|---|---|
| DSA Signature | 33.1 ms |
| DSA Verification | 133.4 ms |
| RSA Encryption | 15.5 ms |
| RSA Decryption | 142.5 ms |
| Blowfish Encryption | 2.0 ms |
| Blowfish Decryption | 1.7 ms |

Table 1: Timings of cryptographic routines

# System Performance



| *Files* | *ms / query* |
|---:|---:|
| 1000 | 1.17 |
| 5000 | 1.43 |
| 10000 | 2.64 |
| 20000 | 2.76 |
| 40000 | 4.40 |
| 80000 | 5.64 |
| 160000 | 6.24 |

Table 2: XSet Query Performance

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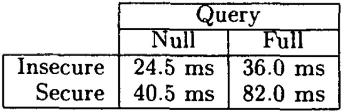

| | Query | |
|---|---|---|
| | Null | Full |
| Insecure | 24.5 ms | 36.0 ms |
| Secure | 40.5 ms | 82.0 ms |

Table 3: Query Latencies for Various Configurations

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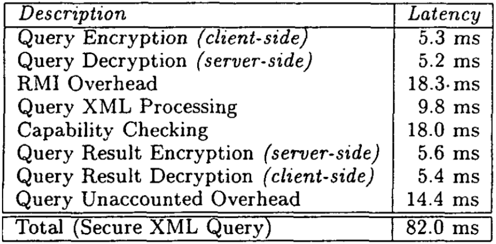

| *Description* | *Latency* |
|---|---|
| Query Encryption *(client-side)* | 5.3 ms |
| Query Decryption *(server-side)* | 5.2 ms |
| RMI Overhead | 18.3 ms |
| Query XML Processing | 9.8 ms |
| Capability Checking | 18.0 ms |
| Query Result Encryption *(server-side)* | 5.6 ms |
| Query Result Decryption *(client-side)* | 5.4 ms |
| Query Unaccounted Overhead | 14.4 ms |
| Total (Secure XML Query) | 82.0 ms |

Table 4: Secure Query Latency Breakdown

# Related Work

- **DNS & Globe**
- **Condor Classads**
- **JINI**
- **Service Location Protocol**

# Conclusion

Work still needed on:

- **Wide area implementation**
- **Benchmarking**
- **Ninja infrastructure necessary to evaluate**

# Questions ?