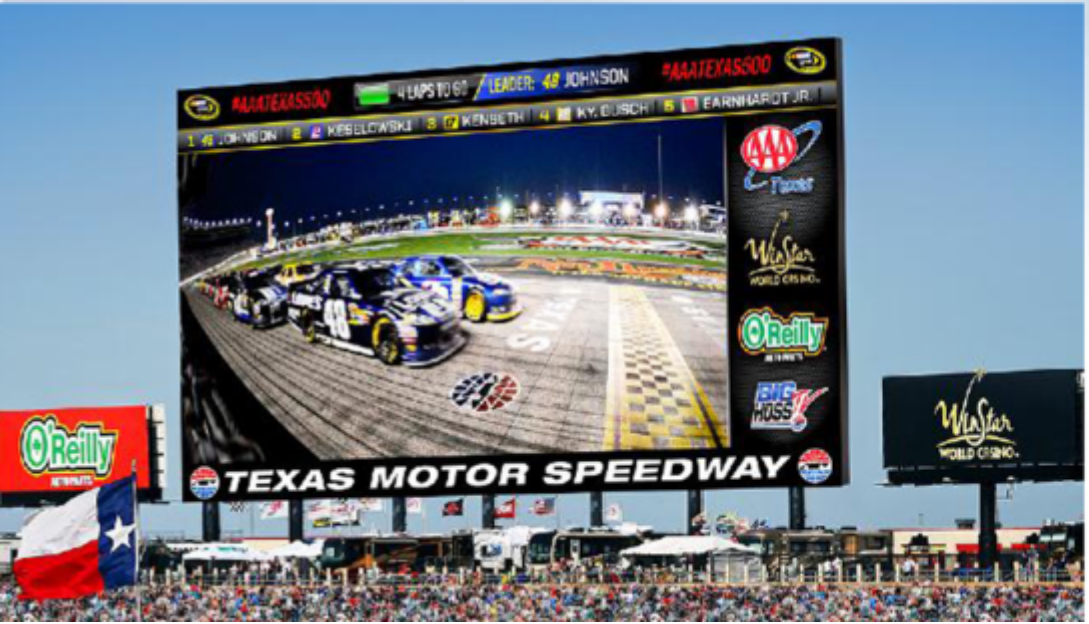
Panasonic IoT Technologies

Panasonic Avionics — A 747 is a ‘Thing’

Panasonic

A Better Life, A Better World

Panasonic Solutions — A 20,000 Sq. Foot ‘Thing’



Panasonic Automotive — A Car is a ‘Thing’

No. 1 Global Provider of Infotainment Systems

Preview Of Coming Attractions…

- DOF
  - **D**istributed
  - **O**bject
  - **F**ramework
- OpenDOF
  - Open source specifications and implementation

OpenDOF

Terminology

- **Object** is a distributed set of uniquely identified capabilities, bound to an Object Identifier
- **Interface** is a defined set of items (properties, methods, events, exceptions) bound to an Interface Identifier
- **Identity** is a unique persona associated with a secret and permissions
- **Domain** is a centrally managed set of identities

Object Identifiers (OID)

- Globally unique, no registration required
  - Class ID (compressed 32 bit, 2^30 space) is registered
- Unique data (depends on class ID, 63 byte max. length)
- Optional attributes (attribute ID + length + data, 257 byte max. length)
- Maximum OID length = 68 + 128*257

Object Identifiers (OID)

[3:bryant.eastham@us.panasonic.com]

03 1F 62 72 79 61 6e 74 2e 65 61 73 74 68 61 6d 40 75 73 2e 70 61 6e 61 73 6f 6e 69 63 2e 63 6f 6d

[2:{d0 67 e5 43 f8 ff}]

02 06 d0 67 e5 43 f8 ff

Interface Identifiers (IID)

- Globally unique through registration
- Registry ID (6 bits, 2 values reserved, 2 assigned, 60 available)
- Length flag (1 byte, 2 byte, 4 byte)
- Data
- 5 byte max. length

Interface Identifiers (IID)

[1:{01}]

05 01

[2:{01 07}]

0A 01 07

Item Identifiers (ItemID)

- Unique within a single interface
- Identifier (compressed 16 bit, 2^15 possible)
- Represents an item type and data type
  - Property, Method, Event, Exception
  - Includes semantic and syntactic information

Putting It All Together

- **Bindings** are OID plus IID
- Operations usually require binding plus ItemID
- Context allows a short alias for the binding

Putting It All Together

Item 1 of the Status interface of my computer

1 [1:{01}] [2:{d0 67 e5 43 f8 ff}]

01 05 01 02 06 d0 67 e5 43 f8 ff

Item 1 of the Status interface of my computer, previously assigned alias 8

1 [1:{01}] [2:{d0 67 e5 43 f8 ff}]

01 08

Security Model

- Domains contain all security information
  - Identities (users, devices)
  - Secrets (keys, passwords)
  - Permissions

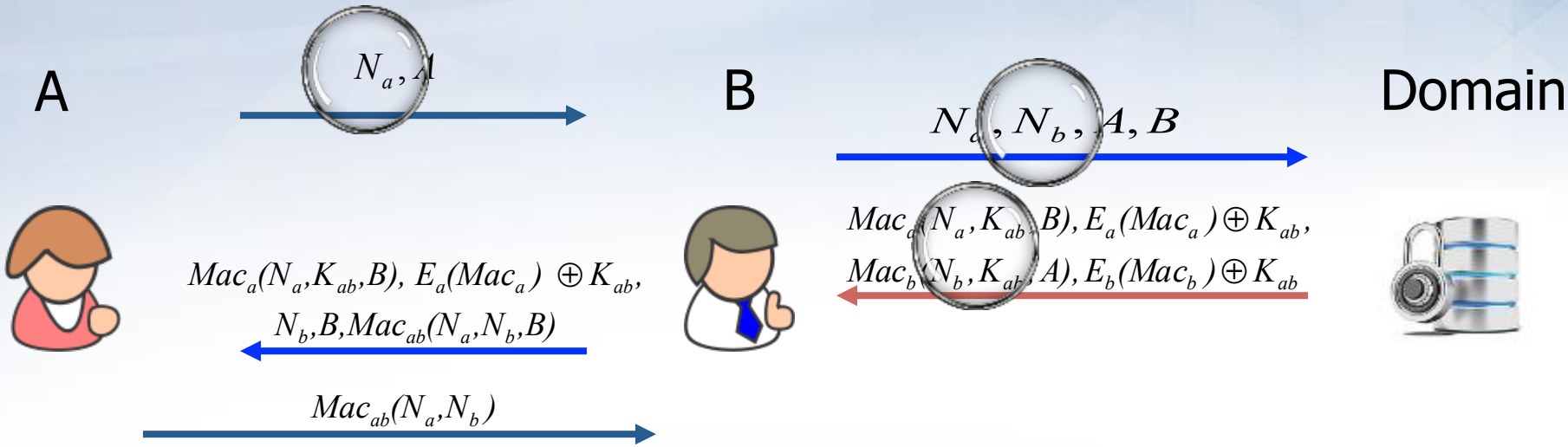
Security Model

- Each interaction typically requires two permissions
  - Permission for the request
  - Permission for the response

Security Model

- Identities are granted permissions
  - As requestors
  - As providers
  - As both requestors and providers (bridge or gateway)

Unified Key Distribution And Access Control



- Nonce is ‘unique’, but arbitrary length
- Ticket is flexible

API Introduction

- High-level API
  - Hides much of the lower level protocol detail
  - Removes fine-grained control over packets
- Written for the most general case
  - Not always the most scalable
- APIs are hard – they never please everyone

API Example – Instantiate A DOF

```
import org.opendof.oal.*;
DOF.Config dofConfig;
DOFSystem.Config sysConfig;
DOFCredentials user;

user = DOFCredentials.Password.create(
     DOFObjectID.Domain.create( "[6:bar.com]" ),
     DOFObjectID.Identity.create( "[3:foo@bar.com]" ),
     "password" );
dofConfig = new DOF.Config.Builder().build();
sysConfig = new DOFSystem.Config.Builder()
          .setCredentials( user ).build();

DOF dof = new DOF( dofConfig );
DOFSystem system1 = dof.createSystem( sysConfig );
DOFSystem system2 = dof.createSystem( sysConfig );
```

opaque container used throughout the API – hides secret, represents user

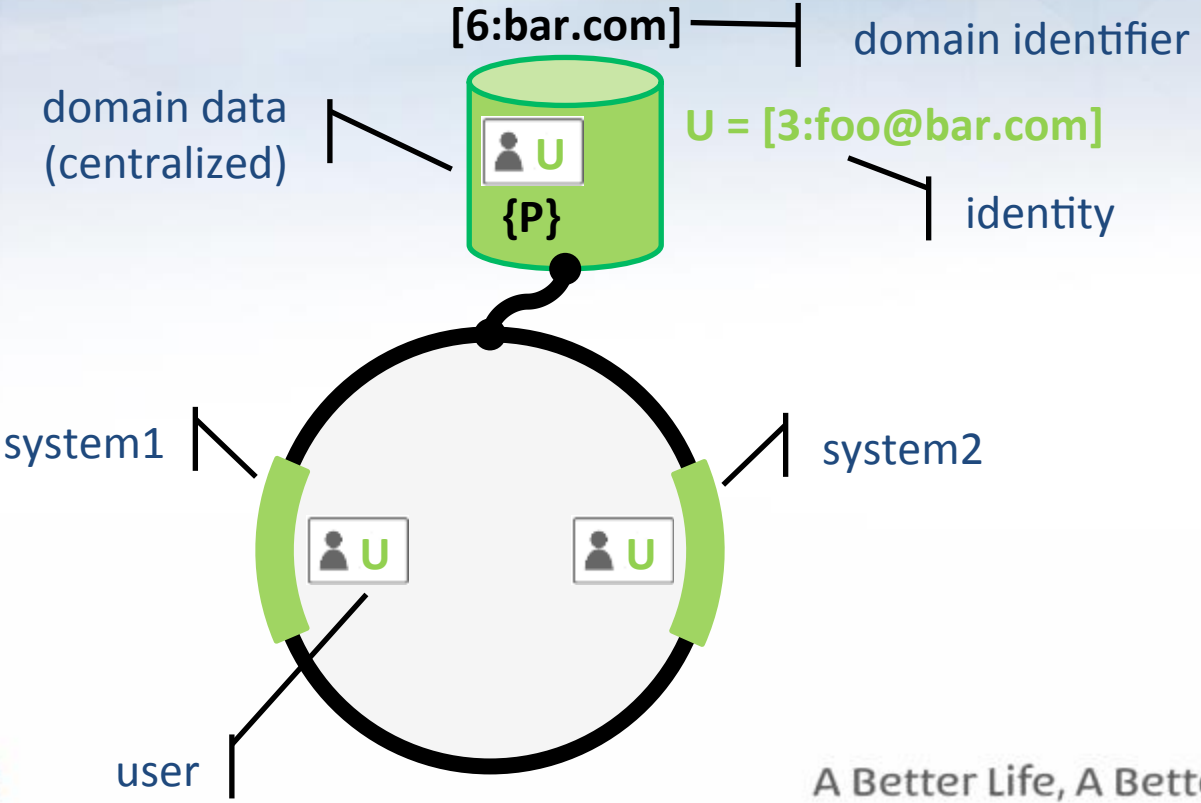
domain

secret

identity

application interacts with the DOF

Result


[6:bar.com]
domain identifier
domain data
(centralized)
U
{P}
U = [3:foo@bar.com]
identity
system1
system2
U
U
user

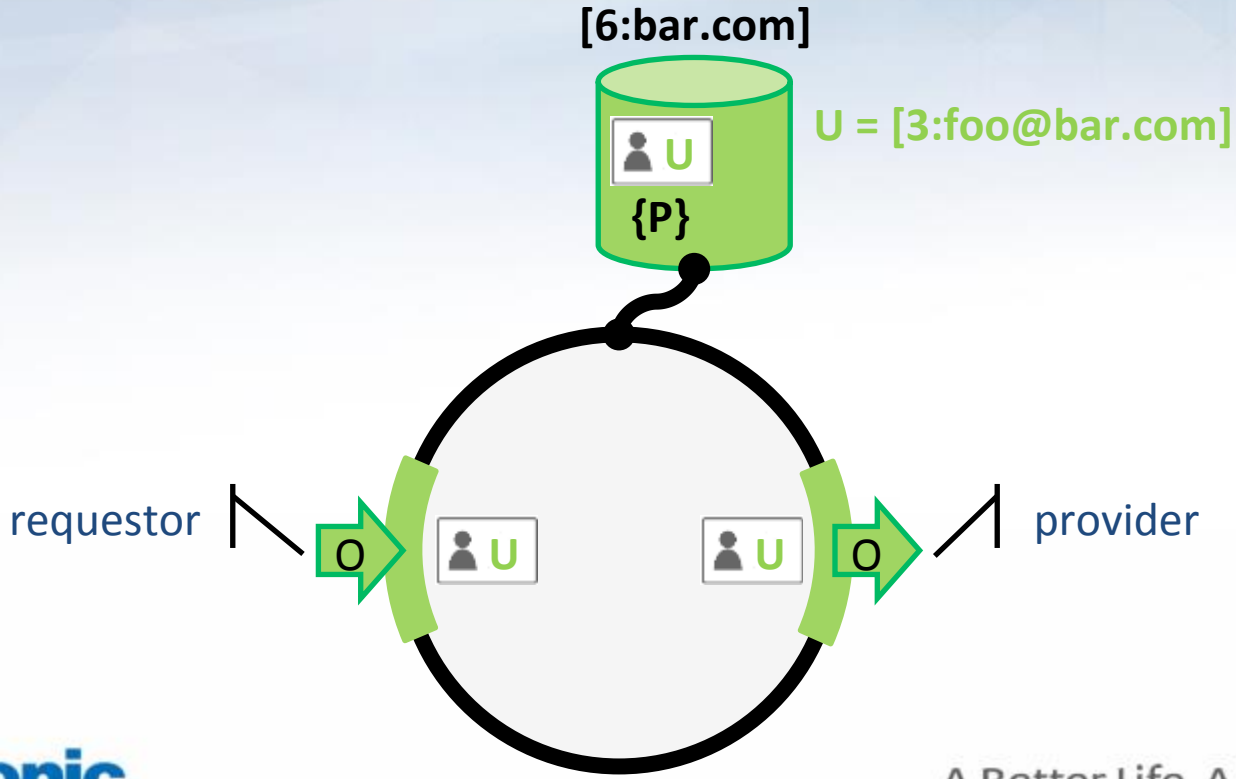
API Example – Instantiate An Object

```
import org.opendof.oal.*;
DOFObjectID oid;
DOFObject requestor, provider;

oid = DOFObjectID.create( "[2:{d0 67 e5 43 f8 ff}]" );
requestor = system1.createObject( oid );
provider = system2.createObject( oid );
```

OID = unique identifier

objects

Result



API Example – Provide An Interface

```
import org.opendof.oal.*;
DOFOperation provide;

provide = provider.beginProvide( Status.DEF,
          new ProvideListener() );

private class ProvideListener extends
     DOFObject.DefaultProvider {
     public void get( Provide op,
                      DOFRequest.Get request,
                      Property property ) {
          request.respond( new DOFUInt8( 0 ) );
     }
}
```

includes IID as well as definition

API Example – Discover A Provider

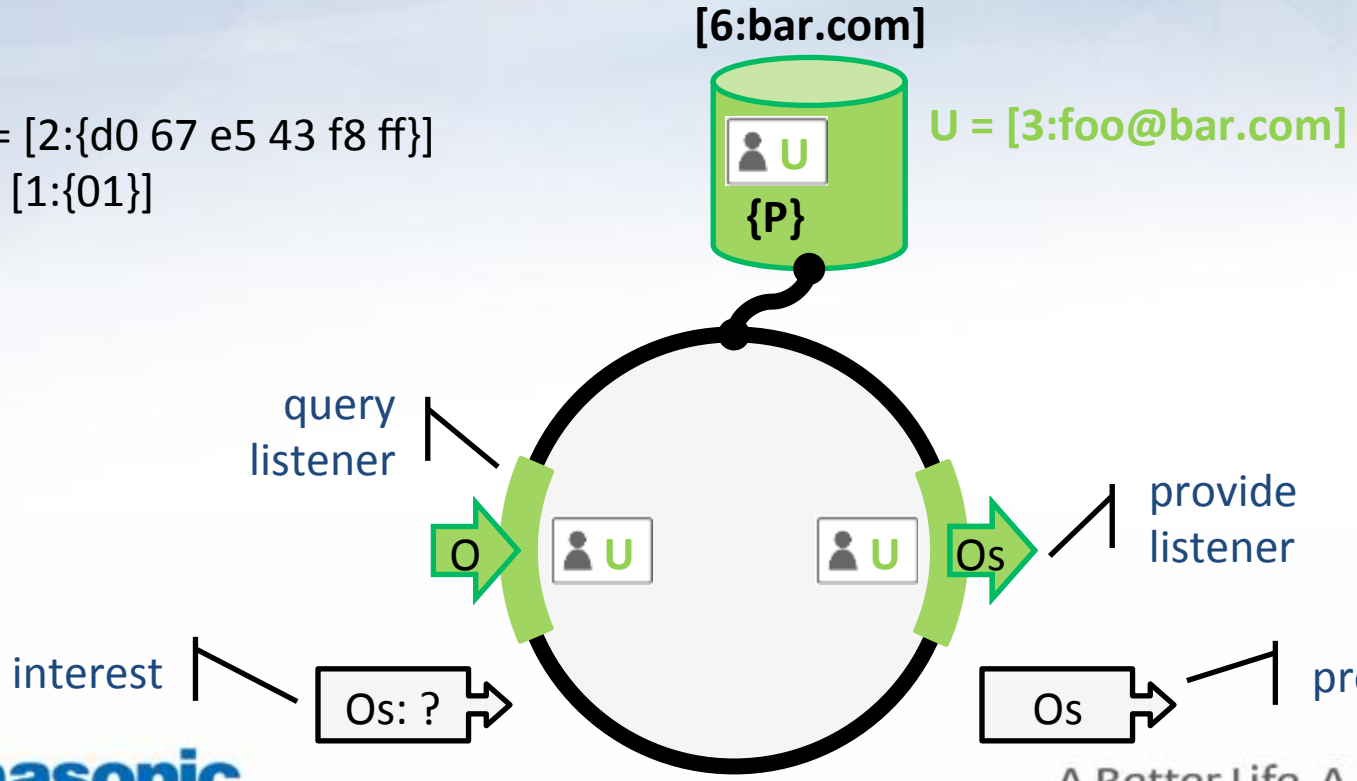
```
import org.opendof.oal.*;
DOFOperation interest;
DOFQuery query;

interest = system1.beginInterest( oid, Status.IID, DOFInterestLevel.WATCH );
query = new DOFQuery.Builder()
          .addFilter( oid, Status.IID )
          .build();
system1.beginQuery( query, new QueryListener() );

class QueryListener implements
     DOFSystem.QueryOperationListener {
     public void interfaceAdded( query, oid, iid ) …
     public void interfaceRemoved( query, oid, iid ) …
     public void providerRemoved( query, oid ) …
}
```

Network request

Local request

Result

O = [2:{d0 67 e5 43 f8 ff}]
s = [1:{01}]



API Example – Interact With A Provider

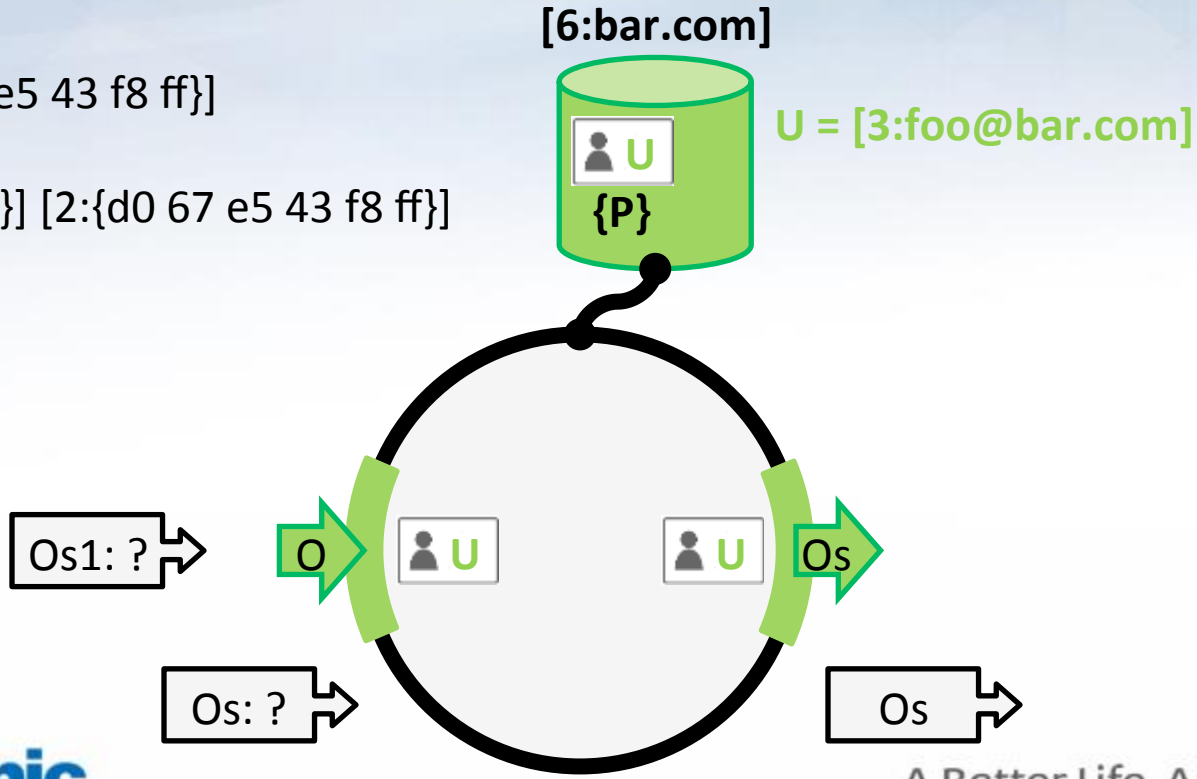
```
import org.opendof.oal.*;
DOFResult<DOFValue> result;
int timeout = 5000;

result = requestor.get( Status.VALUE, timeout );
int value = DOFType.asInt( result );
```

Interactions include

- Session (end-to-end tunnel)
- Property get/set/subscribe
- Method invoke
- Event register

Result

O = [2:{d0 67 e5 43 f8 ff}]
s = [1:{01}]
Os1 = 1 [1:{01}] [2:{d0 67 e5 43 f8 ff}]



Result

O = [2:{d0 67 e5 43 f8 ff}]
s = [1:{01}]
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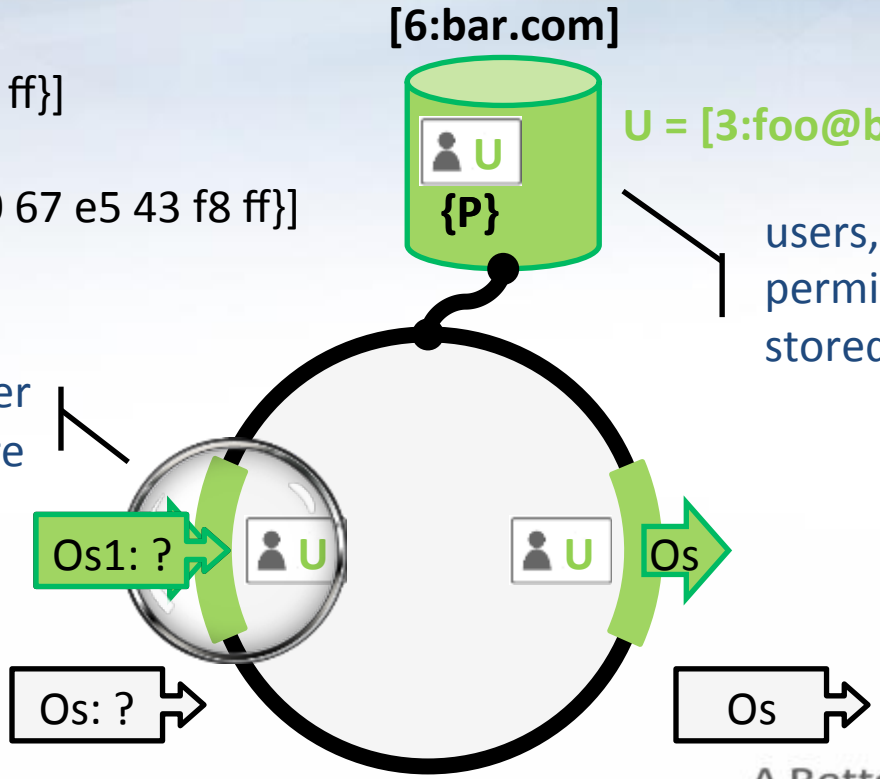
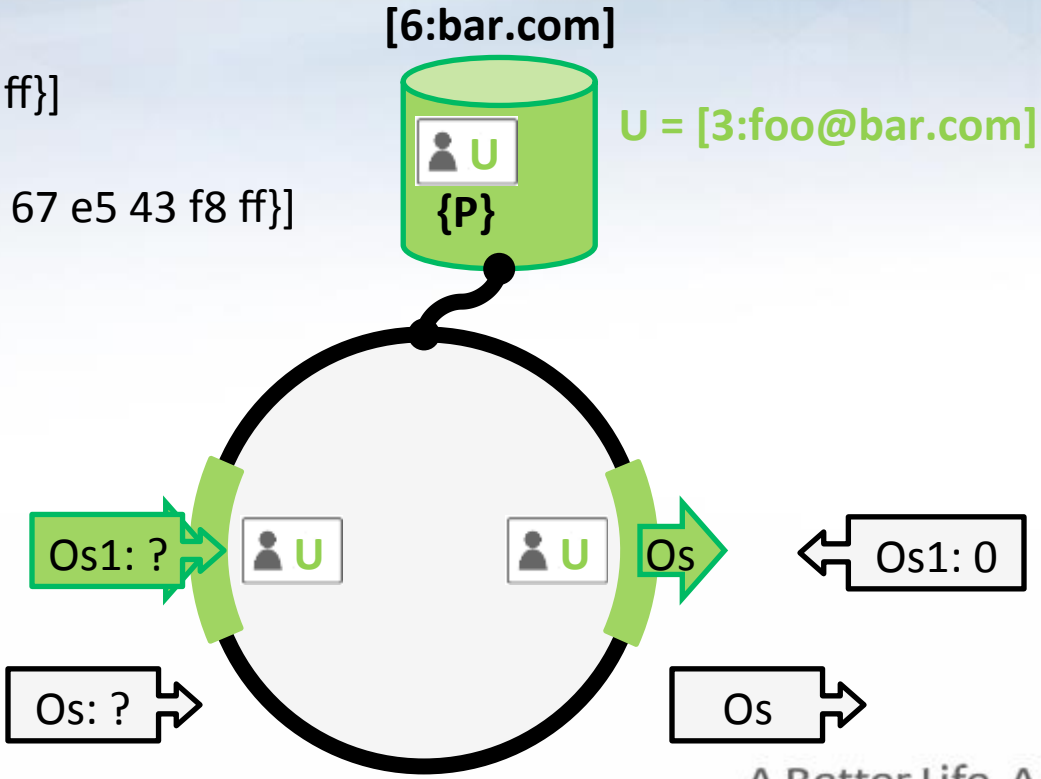


users, credentials, and permissions are centrally stored and managed

all interactions are validated based on user and permissions before being accepted

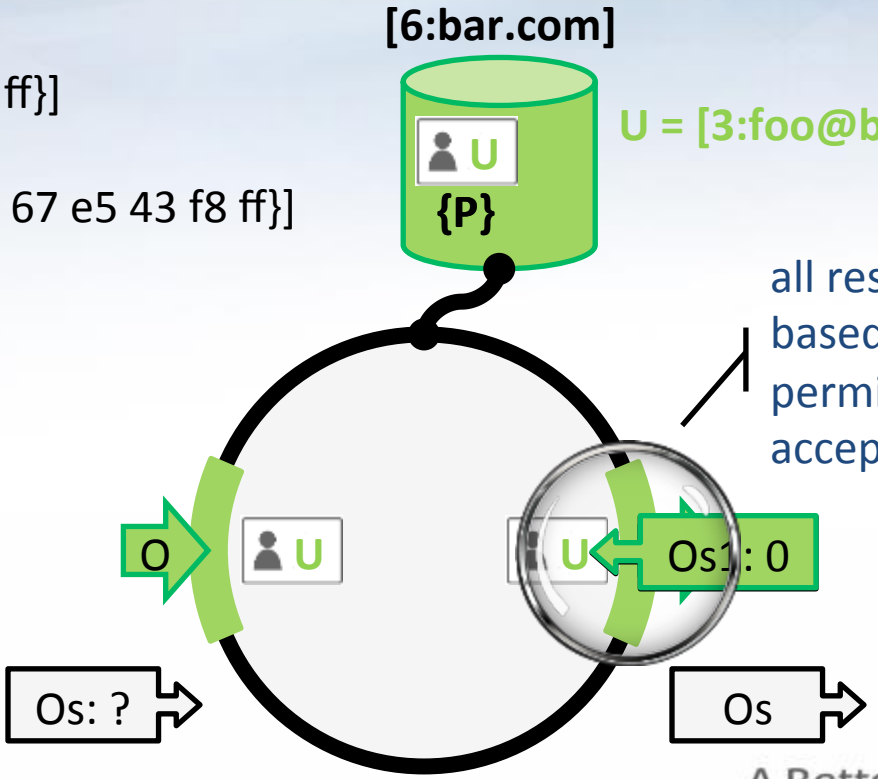
Result

O = [2:{d0 67 e5 43 f8 ff}]
s = [1:{01}]
Os1 = 1 [1:{01}] [2:{d0 67 e5 43 f8 ff}]



Result

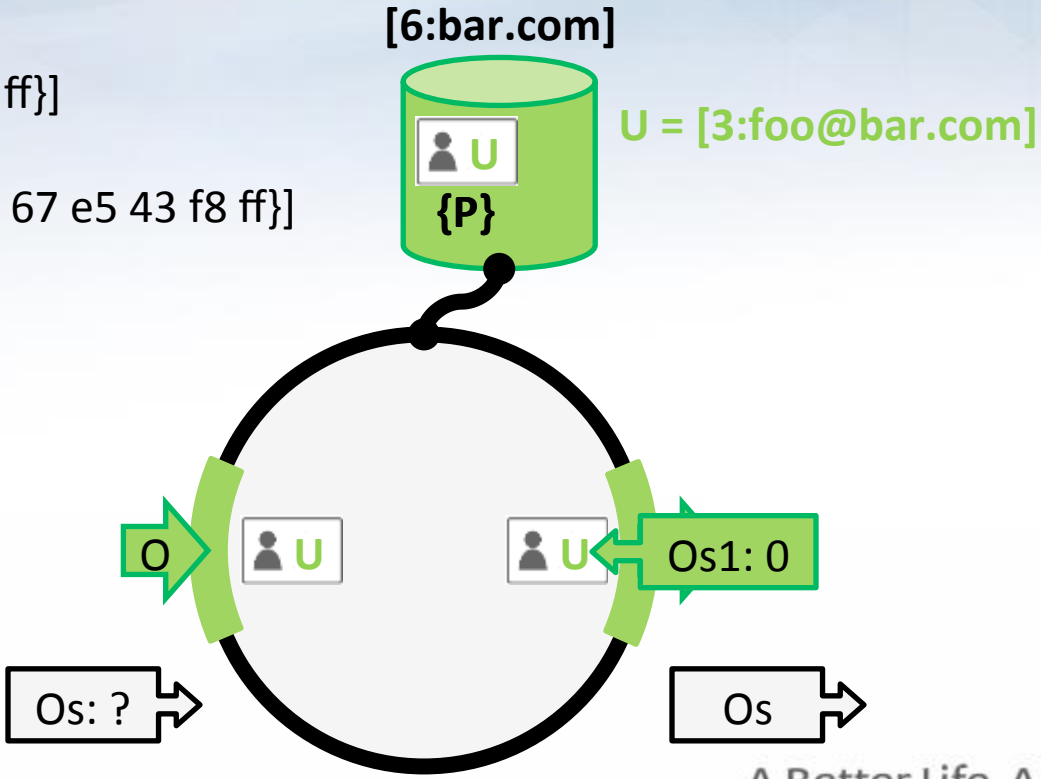
O = [2:{d0 67 e5 43 f8 ff}]
s = [1:{01}]
Os1 = 1 [1:{01}] [2:{d0 67 e5 43 f8 ff}]



all responses are validated based on user and permissions before being accepted

Result

O = [2:{d0 67 e5 43 f8 ff}]
s = [1:{01}]
Os1 = 1 [1:{01}] [2:{d0 67 e5 43 f8 ff}]



API Example – Start A Server

```
import org.opendof.*;
DOFServer server;
DOFServer.Config config;
DOFAddress me;
int timeout = 10000;

me = InetTransport.createAddress( "0.0.0.0", 3567 );
config = new DOFServer.Config.BuildSecureStream( me, user );
server = dof.createServer( config );
server.start( timeout );
```

plugin that implements the transport – fully extensible

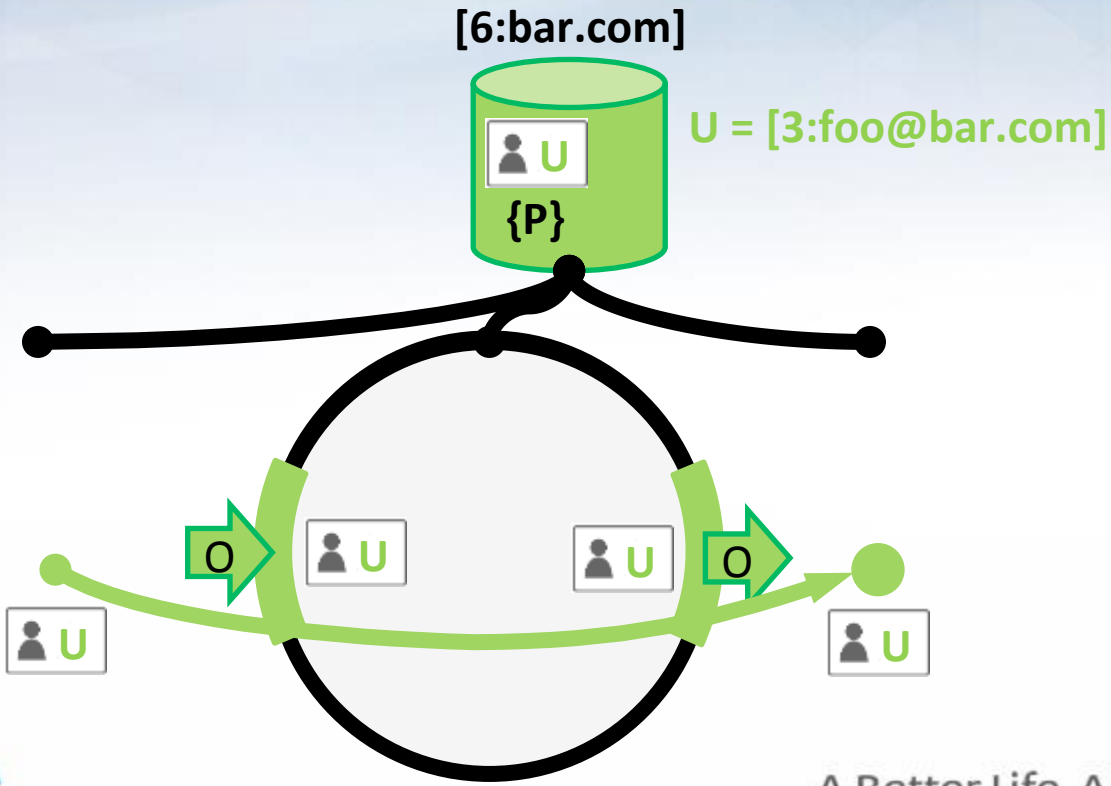
convenience method – stream and datagram

API Example – Establish A Connection

```
import org.opendof.oal.*;
DOFConnection connection;
DOFConnection.Config config;
DOFAddress other;
int timeout = 10000;

other = InetTransport.createAddress( “host”, 3567 );
config = new DOFConnection.Config.BuildSecureStream( other, user );
connection = dof.createConnection( config );
connection.connect( timeout );
```

Result



What Is Next?

- Scalability to millions of connections
  - Distributed routing problem for discovery
- Optimizations
  - Handling failover for redundant connections
  - Minimizing state updates without too much memory

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