DNS Registries

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These Slides

http://www.isc.org/misc/netsa2003/registries.pdf

- You might like to take notes
- These slides will not be a good record of my handwaving, my elaborate whiteboard scribbling or of the useful experience you hear from other people in the room

Theory

- What is a DNS Registry?
- Interaction with Others
- Registry Policy
- The Extensible Provisioning Protocol (EPP)
  - just a taste, not an exhaustive study
- ISC OpenReg
  - architectural overview

Brief Revision

things you remember from earlier

Surprise DNS Test!

- DNS
- Nameserver
- Resolver
- Zone
- Domain
- Resource Records

Surprise DNS Test!

- Master and Slave Servers
- Zone Transfers
- Root Servers
- Delegation
- Glue Records

What is a DNS Registry?

- The point of a registry is to publish a zone which delegates child zones to other nameservers

- If you're not in the business of delegating zones to others, you quite possibly don't care about how registries are run

- Registry systems provide a systematic and automated method of maintaining a zone with a limited and well-defined structure

DNS Registries

- Receive and validate external data
- Store data
- Publish data (DNS, whois, web sites, etc)

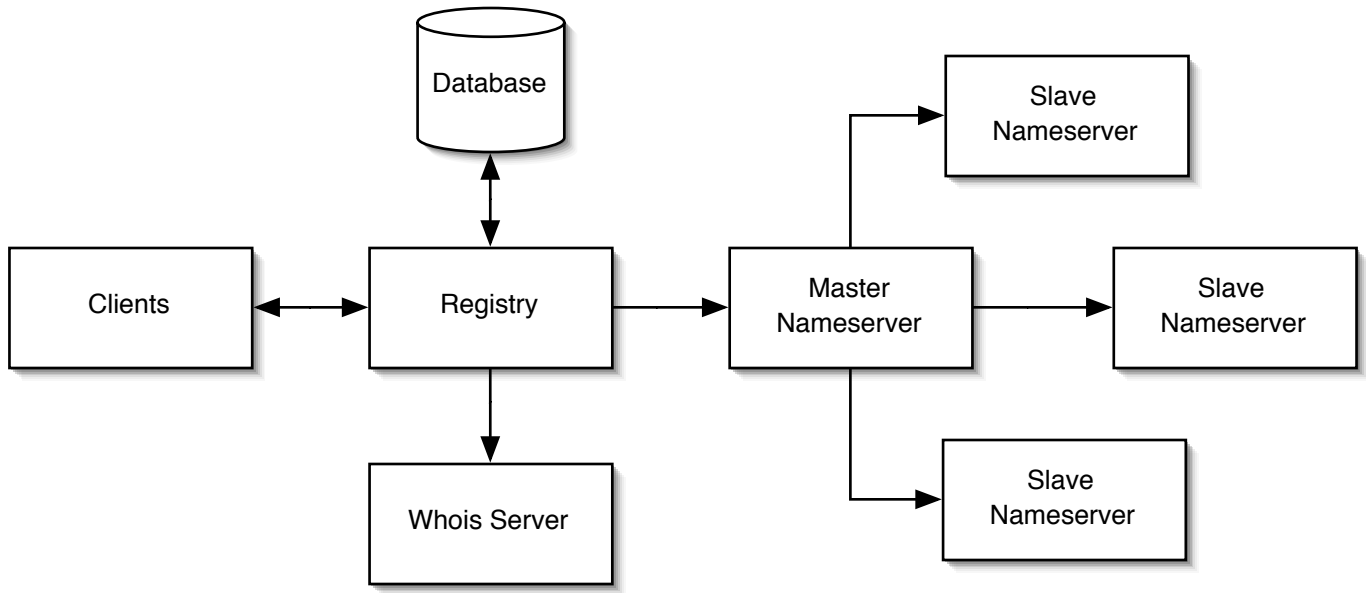
Data In

- Domain names
- Nameservers (names, addresses)
- Meta-data
  - authentication
  - technical coordination
  - billing (renewals, payments)

Data Out

- A Zone File
  - a list of delegations (NS records)
  - delegation glue (A, AAAA records)
  - published via a master nameserver, replicated to slaves
- Whois
- Other Data (statistics, logs)

Data Flow


Database
Slave Nameserver
Clients
Registry
Master Nameserver
Slave Nameserver
Slave Nameserver
Whois Server

Transactions

- Add and delete records
- Modify records
  - add, delete nameservers (change delegation)
  - change metadata
  - set status attributes

Manual Registries

- Some registries don't have to process many transactions
  - GOVT.NZ
  - AQ
  - INT
  - NAME (bad joke)
- A registry might just consist of a zone file edited by hand

The BILL Zone

- We have invented a fictional top-level domain called BILL for the purposes of this workshop
- Right now, the BILL zone is maintained manually
  - send mail to Bert
- Let's start by thinking about what the BILL zone might look like

The BILL Zone

```
$TTL 86400
$ORIGIN BILL.

@           SOA     A.BILL-SERVERS.BILL. BERT.SECRET-WG.ORG. (
                                2003021801   ; serial
                                1800         ; refresh (30 mins)
                                900          ; retry (15 mins)
                                604800       ; expire (7 days)
                                86400 )      ; negative cache TTL (1 day)

                        NS      A.BILL-SERVERS
                        NS      B.BILL-SERVERS

A.BILL-SERVERS          A       192.168.53.1
B.BILL-SERVERS          A       192.168.59.1

; Duck Corp.
; contact Archibald Featherington, +64 21 625-182, feathers@duck.bill
DUCK                    NS      NS1.CLEAR.NET.NZ.
                        NS      YELLOW.DUCK
YELLOW.DUCK             A       192.168.51.1

; Electricity Company Inc
; contact Penrose Moneygrabber, +1 650 779-7000, money@electricty.bill
ELECTRICITY             NS      DNS87.REGISTRAR.COM.
                        NS      DNS136.REGISTRAR.COM.
```

Transactions

- Add a domain
  - add NS records
  - add glue records (A, AAAA) if necessary
  - store meta-data

```
; Where-Is-Bill Enterprises Ltd
; contact Bill Manning, +1 310 555-8010, bmanning@ep.net
WHERE-IS                NS      FLAG.EP.NET.
                        NS      DOT.EP.NET.
```

Transactions

- Modify nameservers, metadata
  - change NS records
  - change glue records (A, AAAA) if necessary
  - change meta-data

```
; Where-Is-Bill Enterprises Ltd
; contact Bill Manning, +1 310 555-8010, bmanning@ep.net
WHERE-IS                NS      BANNER.EP.NET.
                        NS      SLASH.EP.NET.
```

Transactions

- Remove a domain
  - remove NS records
  - remove glue records (A, AAAA) if necessary
  - remove meta-data

```
; Where-Is-Bill Enterprises Ltd
; contact Bill Manning, +1 310 555-8010, bmanning@ep.net
; deleted 2003-02-20 by jabley@isc.org
; WHERE-IS                NS      BANNER.EP.NET.
;                         NS      SLASH.EP.NET.
```

Registries are Simple

- Relatively small number of transaction types
- Simple zone
- However, even a simple process can become complicated if it has to deal with several hundred transactions per second and provide high availability
  - automation can help

Registry Structure

Tedious Definitions

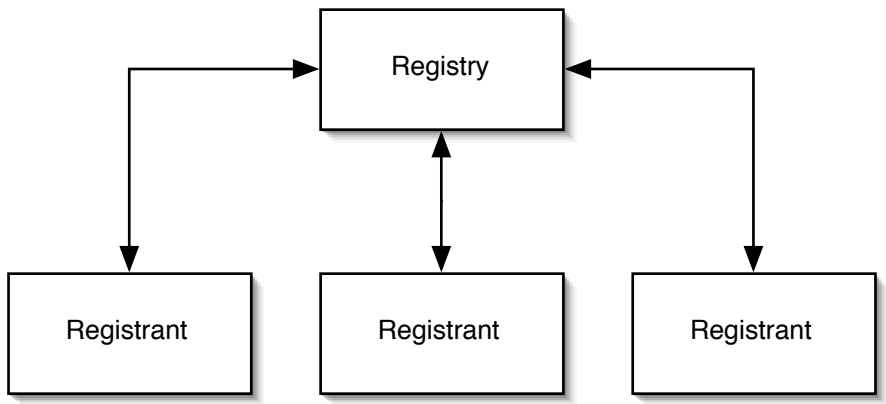
- “registrant” – the organisation or person responsible for a domain
- “registrar” – the middlemen who interact with registries on behalf of registrants
- “registry” – the organisation which maintains the register and publishes the zone
- “register” – the data that is maintained by the registry

Blame ICANN

- These definitions came about as part of the process by which Network Solutions were divested of some of the responsibilities for running COM, NET and ORG
- The words are very similar
- The words are hence very confusing
  - how convenient

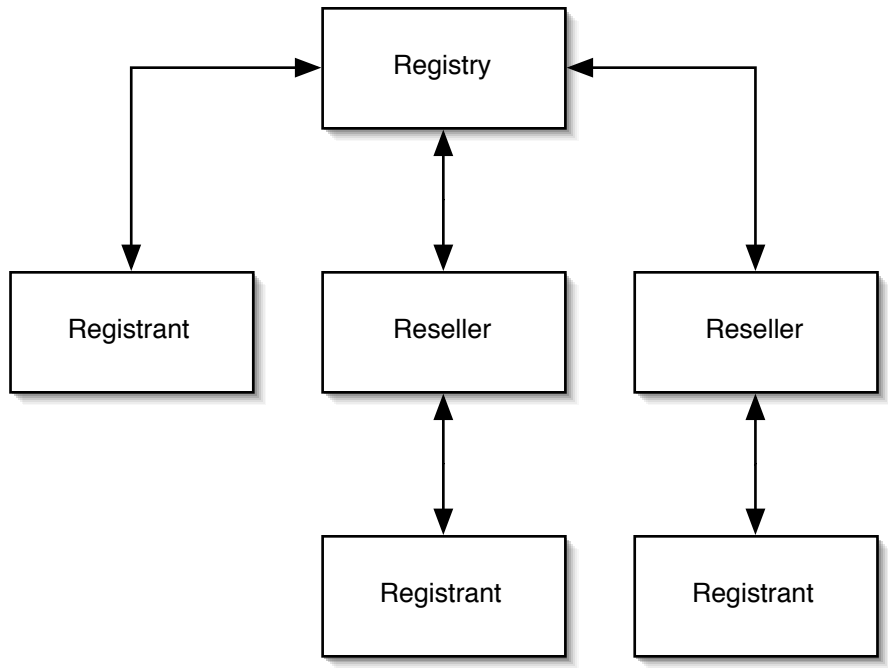
Simple Registry Model

- Registry deals directly with Registrants
- No Registrars
- “Single Access Registry”
- “Monopoly Registry”

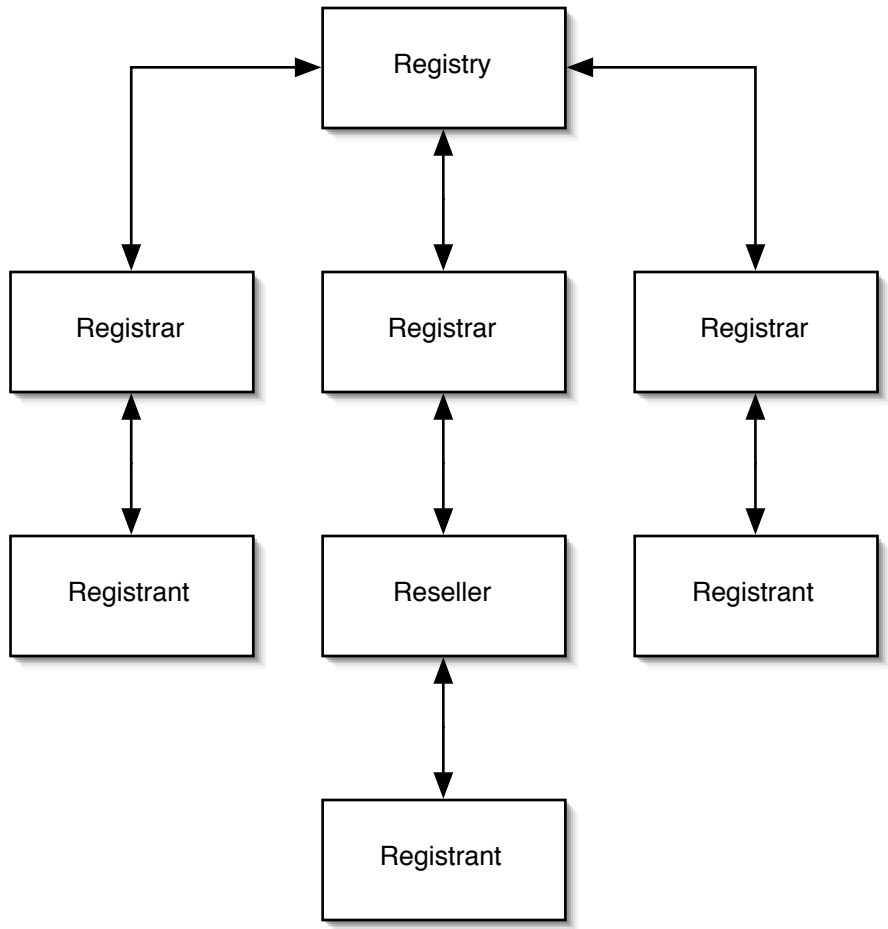


Simple Registry with Resellers

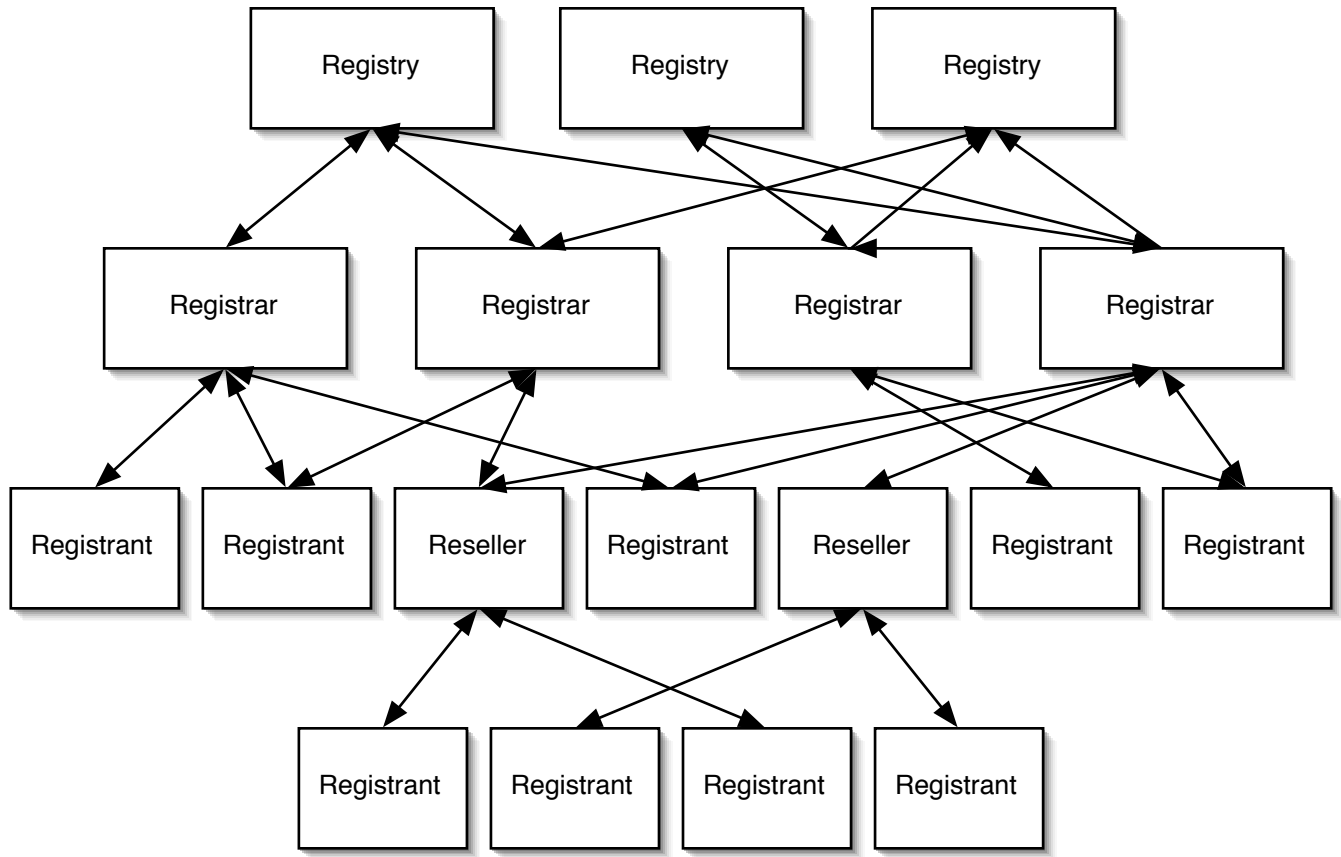
- Registrants can deal directly with the Registry, or they can deal with Resellers



The ICANN Shared Registry Model



Glorious in its Simplicity



Additional Transactions

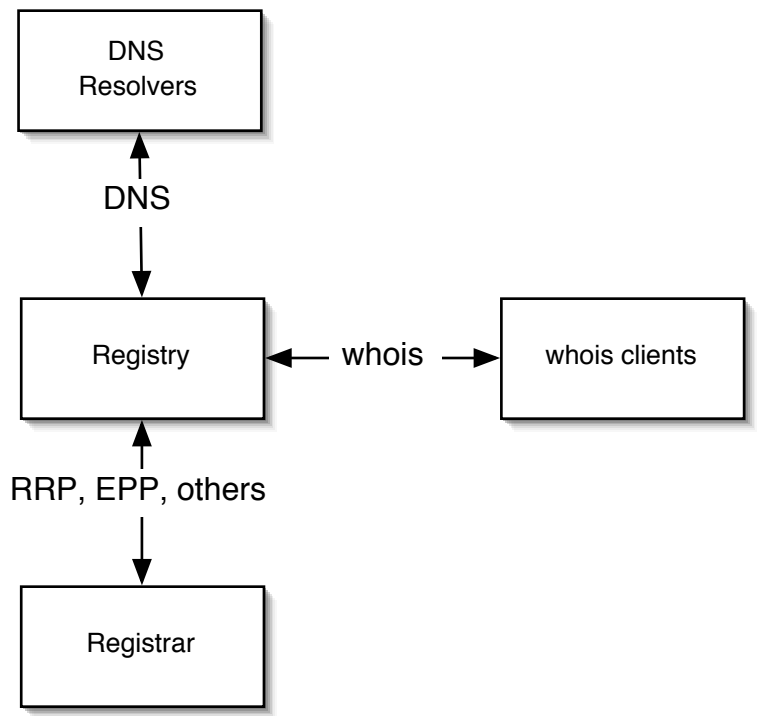
- Registries only interact with Registrars
- For any particular domain, a Registrant only interacts with one Registrar
- That Registrar is said to "sponsor" the domain
  - registry "transfer" transaction

Thick vs. Thin

- Some shared-registry systems distribute much of the registry metadata to registrars, rather than maintaining it centrally
  - "thin" registry (COM, NET)
- Other shared-registry systems keep all the metadata central
  - "thick" registry (INFO, NZ, CA, etc)

Interaction with Others

Contact with Others



whois

- Mechanism for retrieving metadata from registry
  - RFC 954 (”nicname”)
    - no data format specified
    - much of the specification describes a query/retrieval strategy that has never been implemented
    - transport protocol is poorly specified
- Every registry’s whois output looks different

whois.crsnic.net

```
Whois Server Version 1.3

Domain names in the .com and .net domains can now be registered
with many different competing registrars. Go to http://www.internic.net
for detailed information.

   Domain Name: VIX.COM
   Registrar: NETWORK SOLUTIONS, INC.
   Whois Server: whois.networksolutions.com
   Referral URL: http://www.networksolutions.com
   Name Server: NS1.GNAC.COM
   Name Server: NS-EXT.VIX.COM
   Status: ACTIVE
   Updated Date: 05-nov-2001
   Creation Date: 20-jun-1995
   Expiration Date: 19-jun-2003


>>> Last update of whois database: Wed, 19 Feb 2003 05:39:55 EST <<<

The Registry database contains ONLY .COM, .NET, .EDU domains and
Registrars.
```

whois.srs.net.nz

```
% New Zealand Domain Name Registry Limited
% Users confirm on submission their agreement to all published Terms
%
version: 0.95
query_datetime: 2003-02-20T02:33:39+13:00
domain_name: patho.gen.nz
query_status: 200 Active
domain_dateregistered: 1997-06-30T00:00:00+12:00
domain_datebilleduntil: 2003-06-30T00:00:00+12:00
domain_datelastmodified: 2003-02-03T17:03:30+13:00
domain_delegaterequested: yes
%
registrar_name: Domainz
registrar_address1: Private Bag 1810
registrar_city: Wellington
registrar_country: NZ (NEW ZEALAND)
registrar_phone: +64 4 918-1740
registrar_fax: +64 4 918-1719
registrar_email: 4service@domainz.net.nz
%
registrant_contact_name: Joe Abley
registrant_contact_address1: 10805 Old River Road
registrant_contact_address2: Rural Route 3
registrant_contact_city: Ontario
registrant_contact_province: Komoka
registrant_contact_postalcode: N0L 1R0
registrant_contact_country: CA (CANADA)
registrant_contact_phone: +1 519 641 3738
registrant_contact_email: jabley@automagic.org
%

[etc, etc, etc]
```

Thick vs. Thin

- Thick registries return all the registry metadata from one place, in one query (e.g. that NZ example)
- Thin registries return a minimal set of data, usually with a referral to a registrar's whois server (e.g. that COM example)
  - if you are lucky, the registrar's whois server might actually work today

More Whois

- RIRs are registries too
  - IP addresses, ASNs, domains
    - Route Policy (RIPE-181, RPSL)
      - Merit's IRR
  - whois.apnic.net, whois.ripe.net, whois.arin.net, whois.lacnic.net
  - whois.ra.net

Registry-Registrar Interaction

- Registry-Registrar interaction does not need to be user-friendly
  - user-friendliness is nominally the registrar's business
- Technical, business-to-business protocols designed for bulk transactions

Registry-Registrar Protocol (RRP)

- RFC 2832
- draft-hollenbeck-rfc2832bis-03.txt
- Used between Verisign Registry and accredited Registrars
  - thin registry
  - somewhat single-purpose, inextensible
- Interactive, session-oriented stream protocol carried out over SSL

Extensible Provisioning Protocol (EPP)

- IETF standards-track protocol
- Active working group (provreg)
  - (very peculiar and erratic wg chair)
- Based on the exchange of XML documents
- Can use a variety of transport protocols (BEEP, TCP over SSL, potentially others)
- Extensible

DNS

- Let's not get so wrapped up in the fun and excitement of registry operations that we forget why we're here:
  - registries publish zones to master servers
  - master servers' data is replicated to slave servers
  - resolvers are referred to authoritative servers, and from there can be referred to registrants' nameservers

Registry Policy

Reserved Names

- Some registries place restrictions on what names can be registered
  - “offensive names”
  - names which might cause confusion

Grace Periods

- Registrant mis-types a domain name when registering it, and wants the error to be corrected
- Payment of an invoice is delayed for a couple of days, and a domain is deleted
- Some registries operate grace periods to accommodate these kinds of issues
  - sometimes it's easier and cheaper to be flexible than to punish people for making mistakes

Renewals

- Some registries automatically renew names unless they have been explicitly cancelled
- Multi-year renewals

Manual Authorisation

- Lost password
- Administrator e-mail address change
- Administrator no longer works at the company
- Mergers, acquisitions

Registrar Accreditation

- Technical readiness
- certification testing
- Financial, other criteria
- seek to avoid spontaneous combustion of registrars
- ensure that registrar's customer relationship covers all required legal aspects

The Extensible Provisioning Protocol (EPP)

Base Protocol

- draft-ietf-provreg-epp-08.txt
- Provides a mechanism for manipulating generic objects
  - does not specify what those objects are
  - does not specify the transport protocol
- Provides some generic session management primitives

Base Transactions

- “check” – determine whether an object exists
- “info” – retrieve information about an object
- “create”, “delete”, “update”
- “renew”
- “transfer”

Session-Control Primitives

- “login”, “logout”
- “hello”, “greeting”

Buzzword-Compliance

- XML
- Stateful protocol with atomic commands
- Extensible via XML namespaces

Object Mappings

- Domain Object Mapping
- Host Object Mapping
- Contact Object Mapping

Domain Mapping

- draft-ietf-provreg-epp-domain-06.txt
- Provides an extension to the base object for dealing with domain objects

Domain Objects

- References to various contact objects (registrant, admin, tech, billing contacts)
- References to various host objects (nameservers, for delegation)
- Various dates (renewal, last modified, created)
- Various status flags
- Authorisation Information

Host Mapping

- draft-ietf-provreg-epp-host-06.txt
- Provides an extension to the base object for dealing with host objects

Host Objects

- Hostnames
- Addresses (IPv4, IPv6)
- Various status flags
- Authorisation Information

About Hosts and Domains

- The host object/domain object abstraction is based on the Verisign registry
  - other registries don't always handle things that way
- Host and domain records have a carefully-specified relationship

Contact Mapping

- draft-ietf-provreg-epp-contact-06.txt
- Provides an extension to the base object for dealing with contact objects

Contact Objects

- Names
- Postal Addresses
- E-mail addresses
- Phone, Fax numbers
- Authorisation Information

Transport over TCP

- draft-ietf-provreg-epp-tcp-06.txt
- Defines a well-known port, specifies encryption and wire encoding of XML request and response documents

IETF Clues

- Provisioning Registry Protocol (provreg) working group
- All the internet-drafts mentioned are current, and are nearing publication as standards-track RFCs
- http://www.ietf.org/html.charters/provreg-charter.html
  - mailing list info, archives
  - drafts, milestones, etc
  - open to anybody who is interested

EPP Examples

Client Request

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<epp xmlns="urn:ietf:params:xml:ns:epp-1.0"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="urn:ietf:params:xml:ns:epp-1.0
     epp-1.0.xsd">
  <hello/>
</epp>
```

Server Response

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<epp xmlns="urn:ietf:params:xml:ns:epp-1.0"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="urn:ietf:params:xml:ns:epp-1.0
     epp-1.0.xsd">
  <greeting>
    <svID>Example EPP server epp.example.com</svID>
    <svDate>2000-06-08T22:00:00.0Z</svDate>
    <svcMenu>
      <version>1.0</version>
      <lang>en</lang>
      <lang>fr</lang>
      <objURI>urn:ietf:params:xml:ns:obj1</objURI>
      <objURI>urn:ietf:params:xml:ns:obj2</objURI>
      <objURI>urn:ietf:params:xml:ns:obj3</objURI>
      <svcExtension>
        <extURI>http://custom/obj1ext-1.0</extURI>
      </svcExtension>
    </svcMenu>
    <dcp>
      <access><all/></access>
      <statement>
        <purpose><admin/><prov/></purpose>
        <recipient><ours/><public/></recipient>
        <retention><stated/></retention>
      </statement>
    </dcp>
  </greeting>
</epp>
```

Example

- We want to register two domains with the BILL registry:
  - where-is.bill (flag.ep.net, dot.ep.net)
  - platypus.bill (duck.platypus.bill, bill.platypus.bill)
- Let's see what host and domain transactions would be required

where-is.bill – hosts

- We need to add the host objects to the registry before we can add a domain object which refers to them
- So, let's add host objects for flag.ep.net and dot.ep.net

Create flag.ep.net

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<epp xmlns="urn:ietf:params:xml:ns:epp-1.0"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="urn:ietf:params:xml:ns:epp-1.0
     epp-1.0.xsd">
  <command>
    <create>
      <host:create
       xmlns:host="urn:ietf:params:xml:ns:host-1.0"
       xsi:schemaLocation="urn:ietf:params:xml:ns:host-1.0
       host-1.0.xsd">
        <host:name>flag.ep.net</host:name>
        <host:addr ip="v4">198.32.4.13</host:addr>
        <host:addr ip="v4">61.8.9.254</host:addr>
        <host:addr ip="v6">3ffe:805::2d0:b7ff:fee8:c4d9</host:addr>
      </host:create>
    </create>
    <clTRID>ABC-12345</clTRID>
  </command>
</epp>
```

Create dot.ep.net

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<epp xmlns="urn:ietf:params:xml:ns:epp-1.0"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="urn:ietf:params:xml:ns:epp-1.0
     epp-1.0.xsd">
  <command>
    <create>
      <host:create
       xmlns:host="urn:ietf:params:xml:ns:host-1.0"
       xsi:schemaLocation="urn:ietf:params:xml:ns:host-1.0
       host-1.0.xsd">
        <host:name>flag.ep.net</host:name>
        <host:addr ip="v4">198.32.2.10</host:addr>
        <host:addr ip="v4">61.8.9.254</host:addr>
        <host:addr ip="v6">3ffe:0:1:0:230:48ff:fe22:6a29</host:addr>
        <host:addr ip=”v6”>2001:478:6:0:230:48ff:fe22:6a29</host:addr>
      </host:create>
    </create>
    <clTRID>ABC-12345</clTRID>
  </command>
</epp>
```

Create where-is.bill

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<epp xmlns="urn:ietf:params:xml:ns:epp-1.0"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="urn:ietf:params:xml:ns:epp-1.0
     epp-1.0.xsd">
  <command>
    <create>
      <domain:create
       xmlns:domain="urn:ietf:params:xml:ns:domain-1.0"
       xsi:schemaLocation="urn:ietf:params:xml:ns:domain-1.0
       domain-1.0.xsd">
        <domain:name>where-is.bill</domain:name>
        <domain:period unit="y">2</domain:period>
        <domain:ns>flag.ep.net</domain:ns>
        <domain:ns>dot.ep.net</domain:ns>
        <domain:registrant>bm1234</domain:registrant>
        <domain:contact type="admin">bm1234</domain:contact>
        <domain:contact type="tech">bm1234</domain:contact>
        <domain:authInfo>
          <domain:pw>!!ferrets!!</domain:pw>
        </domain:authInfo>
      </domain:create>
    </create>
    <clTRID>ABC-12345</clTRID>
  </command>
</epp>
```

platypus.bill – hosts

- Nameservers for platypus.bill are duck.platypus.bill, and bill.platypus.bill
- We are not allowed to add those hosts until their superordinate domain has been added
- The superordinate domain is platypus.bill
- We need the hosts to exist before the domain can be properly created
- Help!

Create platypus.bill

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<epp xmlns="urn:ietf:params:xml:ns:epp-1.0"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="urn:ietf:params:xml:ns:epp-1.0
     epp-1.0.xsd">
  <command>
    <create>
      <domain:create
       xmlns:domain="urn:ietf:params:xml:ns:domain-1.0"
       xsi:schemaLocation="urn:ietf:params:xml:ns:domain-1.0
       domain-1.0.xsd">
        <domain:name>platypus.bill</domain:name>
        <domain:period unit="y">2</domain:period>
        <domain:registrant>bm1234</domain:registrant>
        <domain:contact type="admin">bm1234</domain:contact>
        <domain:contact type="tech">bm1234</domain:contact>
        <domain:authInfo>
          <domain:pw>!!ferrets!!</domain:pw>
        </domain:authInfo>
      </domain:create>
    </create>
    <clTRID>ABC-12345</clTRID>
  </command>
</epp>
```

Add duck.platypus.bill

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<epp xmlns="urn:ietf:params:xml:ns:epp-1.0"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="urn:ietf:params:xml:ns:epp-1.0
     epp-1.0.xsd">
  <command>
    <create>
      <host:create
       xmlns:host="urn:ietf:params:xml:ns:host-1.0"
       xsi:schemaLocation="urn:ietf:params:xml:ns:host-1.0
       host-1.0.xsd">
        <host:name>duck.platypus.bill</host:name>
        <host:addr ip="v4">192.168.78.1</host:addr>
      </host:create>
    </create>
    <clTRID>ABC-12345</clTRID>
  </command>
</epp>
```

Add bill.platypus.bill

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<epp xmlns="urn:ietf:params:xml:ns:epp-1.0"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="urn:ietf:params:xml:ns:epp-1.0
     epp-1.0.xsd">
  <command>
    <create>
      <host:create
       xmlns:host="urn:ietf:params:xml:ns:host-1.0"
       xsi:schemaLocation="urn:ietf:params:xml:ns:host-1.0
       host-1.0.xsd">
        <host:name>duck.platypus.bill</host:name>
        <host:addr ip="v4">192.168.87.1</host:addr>
      </host:create>
    </create>
    <clTRID>ABC-12345</clTRID>
  </command>
</epp>
```

Update platypus.bill

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<epp xmlns="urn:ietf:params:xml:ns:epp-1.0"
     xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
     xsi:schemaLocation="urn:ietf:params:xml:ns:epp-1.0
     epp-1.0.xsd">
  <command>
    <update>
      <domain:update
       xmlns:domain="urn:ietf:params:xml:ns:domain-1.0"
       xsi:schemaLocation="urn:ietf:params:xml:ns:domain-1.0
       domain-1.0.xsd">
        <domain:name>platypus.bill</domain:name>
        <domain:add>
          <domain:ns>duck.platypus.bill</domain:ns>
          <domain:ns>bill.platypus.bill</domain:ns>
        </domain:add>
      </domain:update>
    </update>
    <clTRID>ABC-12345</clTRID>
  </command>
</epp>
```

Additional!

- Attempting to add a host object that already exists will result in an error
- Registrars need to do a structured series of <host:check>, <host:create>, <domain:check>, <domain:create> and <domain:update> commands in order to create a domain
- It has been said that this is a little cumbersome

EPP Status

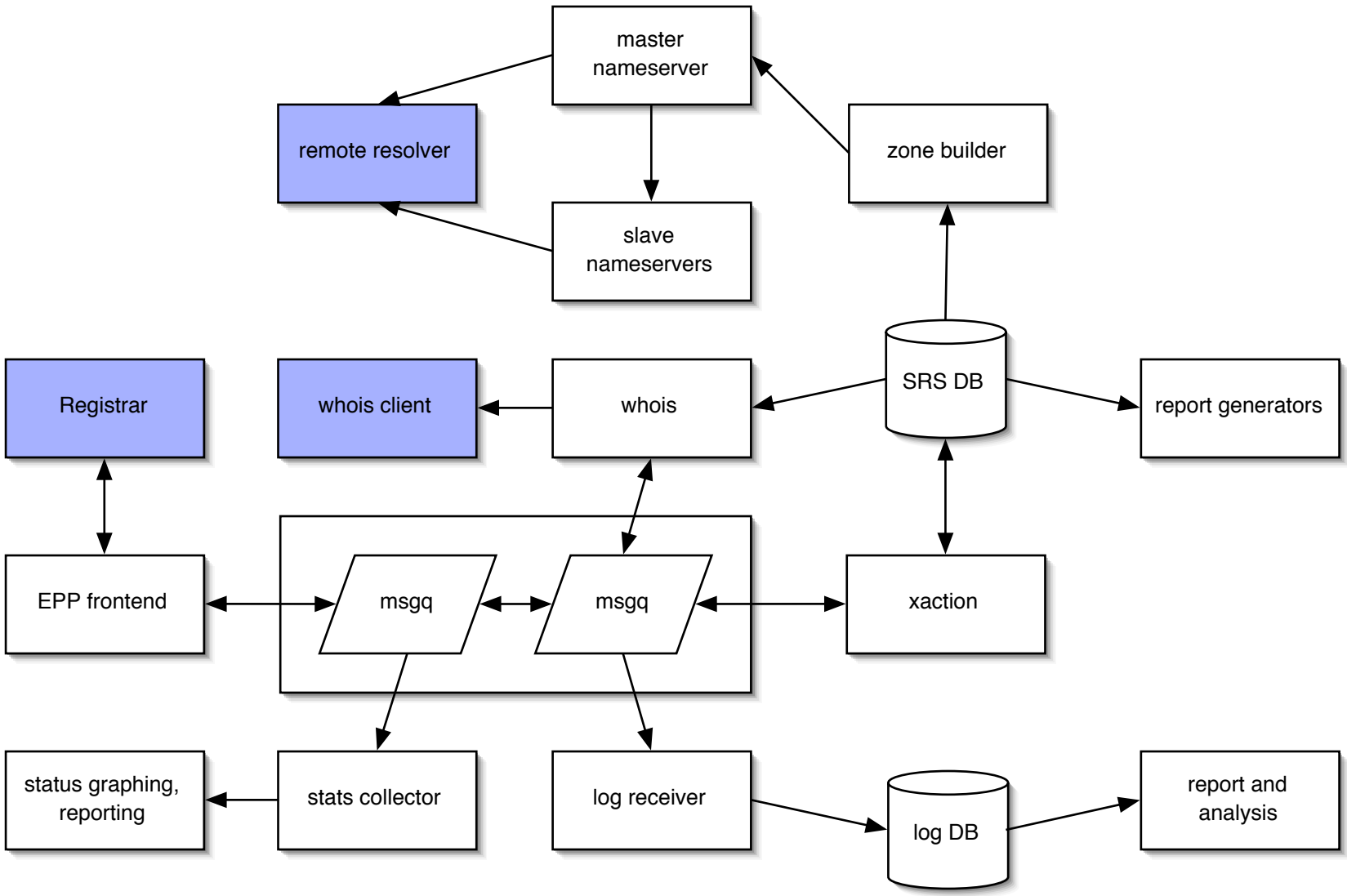
- A version of the EPP specification is currently before the IESG, waiting to be accepted as a draft standard
- Currently held up on a couple of issues, mainly relating to privacy
- Once Ed has beaten some consensus out of the whining throng in the provreg wg, implementation and interop can proceed

ISC OpenReg

OpenReg Goals

- Standards Compliance
- High Performance
  - originally implemented to run ORG
- Scaleable, Reliable
  - eliminate single points of failure
- Free Software (BSD-like licence)

Components


master nameserver
remote resolver
zone builder
slave nameservers
SRS DB
Registrar
whois client
whois
report generators
EPP frontend
msgq
msgq
xaction
status graphing, reporting
stats collector
log receiver
log DB
report and analysis

Component Distribution

- Multiple xaction components
- Multiple epp-frontend components
- Distribution of components across multiple machines
  - joined by a mesh of msgq processes
- Fail-over betwen xaction components

Logging, Statistics Gathering

- All components generate log messages and performance information
- Performance and logging data are sent over the msgbus
- Picked up by one or more statistics servers and log receivers

Status

- Two external organisations have been working with engineering snapshot releases since November
- Initial public code release is due approximately now
  - some issues came up in pre-release testing

What Works?

- Session control (over TCP transport)
- Basic operations on domain, host and contact objects (create, delete, update, info, check)
- Domain renew
- Zone file creation
- Logging, statistics generation and collection
- whois

What Doesn't Work?

- Multi-host msgq (the API supports it, but the msgq daemons don't)
- Redundant xaction components
- Domain transfer

Future

- We have a number of external developers ready to start work on the code
- We plan to continue to dedicate developer resource to the project
- We are actively seeking funding, so that we can provide long-term development support to the project
- We will continue to give Ed a hard time

The End

http://www.isc.org/misc/netsa2003/registries.pdf

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