Nimrod

A New Routing and Addressing Architecture for the Internet

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Perfection is finally attained not when there is no longer anything to add, but when there is no longer anything to take away.

– A. de St. Exupery, "Wind, Sand and Stars"

One ring to rule them all, one ring to find them, one ring to bring them all, and in the darkness bind them.

– J. R. R. Tolkien, "The Fellowship of the Ring"

What is Nimrod about?

Nimrod is a routing *architecture*, not a routing *protocol*; done by a *system architect*, not an algorithmic expert.

In other words, don't expect to see:

- New path-finding ("routing") algorithms
- New abstraction algorithms

Expect rather to see:

- Ideas on what the overall *functionality* of "routing" ought to be
- Ideas on how "routing" ought to *interact* with the rest of the internetwork layer
- Ideas on how to organize the *internals* of the "routing" functionality

Internet Evolution

Internet Evolutionary Needs

The Internet was not designed to grow to its current size *or importance*. The Internet desperately needs several things:

- A new addressing architecture
- Recognition and explicit naming of some new fundamental abstractions
- A much improved routing architecture
- A resource allocation architecture
- A security architecture
- Accounting

Routing and Addressing Architectures

An addressing architecture includes:

- A system of naming networks, interfaces, topology aggregates, etc

A *routing architecture* is *not* a simply a *protocol*, i.e. a set of packet formats, and instructions on how to process them. Rather, it considers the entire question of how the network organizes the handling of user traffic.

A routing architecture includes:

- A way of exchanging information as to where these named things are
- A way of computing and selecting paths between sets of communicating entities
- A way of causing traffic to take these paths

Examples and Non-Examples of Routing Architectures

Routing protocols:

- BGP is a routing protocol
- iBGP is a routing protocol
- OSPF is a routing protocol
- RIP is a routing protocol

Routing architectures:

- Nimrod is a routing architecture
- The entire collection of BGP, etc, along with the specifications for how they interact, is a routing architecture (albeit an incredibly poorly organized and lashed-together one, not to mention one without many desirable capabilities)

Architectural Discussion Fundamentals

Confusion in Terminology and Concepts

I am far from thinking that nomenclature is a remedy for every defect in art or science: still I cannot but feel that confusion of terms generally springs from, and always leads to, confusion of ideas.

– John Louis Petit, "Architectural Studies in France", 1854

Much of the confusion in discussion of routing results from varying meanings for terms, *particularly "address"*. This happened, in part, because the set of fundamental objects recognized was not rich enough.

Thus, difficulties have arisen when solutions to various problems demanded that objects which were previously hidden "inside" or "behind" other objects be recognized as separate entities.

Names and Objects

We must also separate out the *name* for a thing from the *object*, the thing *itself*, to which those names *refer*. We must also separate out the *form* of the name for a thing from the *generic concept* of a name for the thing.

One of more possible names or types of names can exist for each object, and different names may or may not have structure. The structure is there to help something else do its job.

Objects

- Interface:
  - A place to which a producer or consumer of packets connects to the network; a "network attachment point"
  - The place towards which the system of routers directs packets
- Network:
  - A collection of interfaces which have some useful relationship:
    * Any interface can send directly to any other without going through a router
    * A topology aggregate
- Route or Path:
  - A path from one place in the network to another

Objects, Continued

- Host:
  - An actual machine which is the source or destination of traffic, through some interface
- Router:
  - A device which is interconnecting various elements of the network, and forwarding traffic
- Node:
  - A host or router
  - In Nimrod technical terminology, an element of a Nimrod map (which is represented as a *graph*, with *nodes* and *arcs*)

Names

- Address:
  - A structured name for a network interface or topology aggregate:
    - The structure is used by the routing to help it scale
    - Topologically related items *have* to be given related addresses
  - Topologically related addresses also:
    - Allow the number of "destinations" tracked by the routing to be minimized
    - Allow quick location of the named interface on a map
    - Provide a representation for topology distribution process
    - Provide a framework for the abstraction process
- DNS names:
  - A structured human usable name for a host, etc
  - The structure is used to facilitate the distribution and lookup

New Terminology and Concepts

A new routing architecture should add a new object, and a new naming space for them, to the packet layer: the *endpoint*.

An endpoint is:

- Approximately, the entity at one end of a TCP connection
- A "fate-sharing" region
- An "end-end" entity
- Can be hosts, mobile processes, etc...