



Routing Arbiter for NSFNET and the NREN

Program Plan

31 March 1997 - 31 March 1998

Merit Network, Inc.

Merit Network, Inc., in close collaboration and cooperation with the University of Southern California, under Cooperative Agreement NCR 9321060, provides leadership for operations, routing engineering, and management and coordination for Routing Arbiter services for NSFNET and the NREN.

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Projects for Year Four

This report describes tasks to be undertaken by the Routing Arbiter project between March 31, 1997, and March 31, 1998. These activities are consistent with the Statement of Work submitted to NSF in April 1994, as part of the "Additional Supporting Documentation" for Merit's Routing Arbiter proposal, and reflect the July 1996 Review Panel's recommendations for refocusing the Routing Arbiter's responsibilities. At that time, NSF recommended that Merit continue to pursue the goals listed below, shift Route Server activities to the commercial marketplace, and pursue statistical research, tool development, and NANOG activities independently from the Routing Arbiter project.

The tasks to be accomplished in Year Four are as follows:

1. Merit will operate the Routing Arbiter Database (RADB) and provide a central repository for the Internet Routing Registry (IRR), which comprises the major registries available in the Internet. An important focus of this operational work will be efforts to improve the quality of data registered in the IRR.
2. Merit will develop tools that facilitate more effective use of the Internet Routing Registry.
3. Merit will help Internet Service Providers describe and register their routing policy in the IRR and participate in prototyping new "high-performance" Internet connections. Merit will also recruit providers who are not yet participating in the Internet Routing Registry, and attempt to persuade them to share global routing policies by registering in the IRR.
4. Merit will facilitate routing-related communication among representatives of the European and Asian networking communities, ISPs, vendors, and the Routing Arbiter project.

Routing Arbiter Database Activities

During Year Four of the project, Merit will continue to support the RADB and consult with end users. Specific enhancements to be made to RADB/Internet Routing Registry services are detailed below.

User Support

Merit will continue to provide ongoing e-mail and telephone consulting on the use of the Routing Arbiter Database, and to resolve routing registry problems for all users.

In an effort to improve the RADB user interface and enhance database performance, Merit will construct a series of user profiles by collecting statistical data on RADB usage patterns, query types, and command success and failure rates. The data will allow the

database support staff to pinpoint areas in which users encounter problems, and enhance the user interface accordingly.

The statistics to be collected include:

- The number of queries and commands issued daily and the distribution of commands over time. By determining whether queries are submitted evenly throughout the day, or spike or cluster at particular times, Merit can identify bottlenecks and take corrective action so service does not degrade to unacceptable levels.
- The frequency of each command and query issued and the number of user errors.
- The number of auto-dbm e-mail transactions machine-processed daily, including successes and failures over time.
- The number of queries initiated by RAToolSet programs vs. human clients.
- The average number of commands issued per connection.

Access to this data will greatly improve Merit's understanding of which components of the RADB software will benefit most from improvements in engineering design and interface management.

Accuracy of Database Records

Merit's database support team will continue to maintain credible routing information by taking steps to convince database maintainers—the end users authorized to make changes to RADB objects—to remove or correct inaccurate objects in the registry. Merit will also work with network operators and providers who are conducting audits of their RADB registrations, to ensure that stale or duplicated objects are identified and removed from the registry. In all situations, the database support team will offer to remove inaccurate records for the maintainers or operators, or provide them with objects in a form suitable for deletion.

Though a great deal of progress has been made in this area, much work remains to be done. New tools such as the Dynamic Routing Policy Analyzer, which pinpoints inaccurate data in the RADB, will be of substantial help in this effort.

Routing Policy System Language

Merit will play an important role in implementing the next-generation Routing Policy System Language, which will replace RIPE-181 (RFC 1786) as the language used to express routing policy in the RADB and other Internet Routing Registry databases. The new language is being developed by the IETF Routing Policy System Working Group, which is chaired by Cengiz Alaettinoglu of ISI and Daniel Karrenberg of the RIPE Network Coordination Centre.

Routing Policy System Language (RPSL) offers many powerful new capabilities, most notably the ability to express routing policy much more precisely than in RIPE-181. Because the new code base differs significantly from the existing RADB software, a major effort will be required on Merit's part to integrate, test, and support the new language. Much of Merit's work will involve modifying RAWhoisd and other tools to support the new syntax and operate on the new RPSL-style database records.

The overall plan for the conversion process has been drafted by David Kessens of ISI, with input from Gerald Winters, Alaettinoglu, Curtis Villamizar of ANS, Joachim Schmitz of the DFN Network Operation Center, Carol Orange of RIPE, and other participants in the RPS Working Group. (See "Routing Policy Specification Language (RPSL)," draft-ietf-rps-rpsl-00.txt.)

During Year Four of the RA project, Merit will perform the following tasks to prepare for the RIPE-181-to-RPSL conversion:

- Introduce into the production database the new "as-in" and "as-out" fields for the RPSL AS object. Because the new options are a superset of the RIPE-181 fields, the change should be transparent to users. Advanced users may choose to experiment with the new language and register RPSL-style AS objects in the database.
- Link RAWhoisd with the new RPSL database software.
- Test the new RAWhoisd/RPSL code on several platforms, including SunOS, Solaris, and DEC OSF/1.
- Work closely in conjunction with RIPE to merge RAwhoisd with the RIPE whois server. This effort will greatly facilitate Merit and RIPE's conversion to RPSL, simplify future efforts to incorporate RIPE enhancements into the RADB code, and RADB enhancements into the RIPE code. Combining the two servers will benefit users by providing a single, uniform interface for the Internet Routing Registry.
- Run the new RAWhoisd/RPSL code on a test port that will be widely publicized in the user community.

The group leading the conversion effort held a planning meeting at the Memphis IETF in April 1997, and determined that the IRR software should accept both RIPE-181 and RPSL objects for a period of time before the actual conversion. A banner message will be displayed for several months in all database e-mail to announce the conversion and point to further information on the Web.

Inter-Registry Operations

The Merit database support team will continue to improve consistency among the databases in the Internet Routing Registry, cooperating in this effort with users of both the RADB and other routing registries. Work will focus on eliminating duplicate objects and inconsistent policy registrations among registries. Merit will continue to work actively with the RIPE Network Coordination Centre to develop mechanisms to support and deploy real-time data exchange among the registries.

Dynamic Routing Policy Analysis

Merit will design a Web-based tool, called the Dynamic Routing Policy Analyzer (DRPA), which will compare policy registered in the IRR with policy actually being routed in the Internet. DRPA will display the route import and export lists for a particular Autonomous System, indicating which routes are registered in the IRR. Users can then compare these routes to those that are actually being exported to the Route Servers. Discrepancies can be noted and corrective actions taken to align dynamic policy with registered policy. The Route Servers can be reconfigured, or the registered policy adjusted to the desired specifications.

DRPA will also help network operators identify, analyze, and debug Internet routing problems. A generalized query interface will make it possible to answer questions such as “Am I seeing route X from peer Y?” or “Show me the list of AS's that are announcing route X.”

Critics of the Internet Routing Registry frequently assert that there is data in the registries that is stale and incorrect. This is indeed a serious problem—one that DRPA will address by providing quantitative indicators to show exactly how much information is out of date. By analyzing the route lists exported to the Route Servers and comparing them to policy registered in the IRR, DRPA will alert users of discrepancies and point to changes that can be made to correct stale information.

Enhanced Support for Route Server Configurations

The current Route Server configuration process relies heavily on RAWhoisd, the Routing Arbiter's whois server. Merit will implement a new configuration procedure using Trawhoisd, Merit's new, high-performance server, which is currently in beta test. Trawhoisd will speed up the configuration process exponentially—perhaps by a factor of 100. The server will also lighten the load placed on RAWhoisd, freeing up capacity that can be used by compute-intensive users and RAToolset programs querying the RADB.

Expanded Trawhoisd Support for RAToolSet

Experience has shown that there are two types of RAWhoisd users:

- One-command-and-exit users
- RAToolSet users

“One-command-and-exit” users are well served by the current implementation of RAWhoisd, despite its performance problems; their main concerns are convenience and ease of use, and they generally do not have stringent performance requirements. RAToolSet users, in contrast, often issue hundreds of RAWhoisd commands at a time, and thus require high levels of performance from RAWhoisd.

Many RAToolSet users are ISPs whose livelihood depends on providing Internet connectivity to customers, and who would benefit by having local administrative control of the Internet registries (to be able to run router configuration programs in the event of RA software or hardware failures or network outages). Trawhoisd, Merit’s distributed, high-speed query server, was designed with these users in mind. Trawhoisd offers local caching of the IRR and is nearly 100 times faster than RAWhoisd. Currently, however, Trawhoisd does not support the full RAWhoisd command set, but only the commands needed to run with RtConfig, RAToolSet’s router configuration tool.

Future releases of Trawhoisd will be designed jointly by Merit and ISI, giving ISI a hand in charting the future of the software. New commands, features, and functionality will be added so Trawhoisd supports the full RAToolSet, and is eventually folded into the RAToolSet distribution.

Multicast Support

Currently, the RADB can only be used to generate unicast router configurations. Merit will develop and implement a mechanism to support multicast routing information in the routing registry, and investigate the possibility of providing registration services to the MBone and 6bone communities.

ISP Assistance

The Merit RA staff will continue to encourage ISPs to register in the Internet Routing Registry, and provide coordination among all the registries to ensure consistent representation of routing policies. The support staff will continue to work one-on-one with users to explain registration procedures and answer specific questions about describing policy in the IRR.

Merit will also assist organizations with routing-related issues associated with the new, high-performance connections to the Internet, and with the routing for the meritorious applications supported by the high-speed links.

Routing-Related Communications

Merit will continue its routing-related communications activities during Year Four of the project, not only to encourage the use of RA services, but also to work towards creating a

cohesive networking environment for all participants in the post-NSFNET architecture. Close coordination with RIPE and ISI will play an important role in this effort, as these organizations must work closely together to ensure a smooth transition to the new Routing Policy Specification Language.

Routing Registry Advisory Group

Merit will continue its work with the Routing Registry Advisory group, which promotes much-needed communication among representatives of the European and Asian networking communities, ISPs, vendors, and the RA project. The mailing list rr-impl@merit.edu provides the vehicle for these discussions.

Team Interaction

Frequent interaction among the RA team and the RA management staff will continue through e-mail, teleconferences, and face-to-face meetings. At the second annual RA retreat, to be held at ISI on May 15-16, 1997, the staff will evaluate past efforts, plan future activities, and consider ways in which the Routing Arbiter can continue to provide high-quality research, operations, and engineering services to the global routing community.

Public Archives

The RA project will continue to maintain Web and FTP sites for distribution of routing research, documentation, tools, reports, and general information about the Routing Arbiter project and the U.S. networking infrastructure.

Budget for Year Four

Merit Routing Arbiter Staffing

Staffing levels for Year Four of the Routing Arbiter project are detailed below.

Management - Senior Personnel

Eric Aupperle, the President of Merit, continues to have overall responsibility for the Routing Arbiter project. Merit has posted a position for an Associate Director who will oversee technical and operational aspects of the project. (0.5 FTE)

Routing Arbiter Technical Development Staff

Merit's database staff provide ongoing e-mail and telephone consulting for users of the Routing Arbiter Database. The group performs system and application administration of the RADB, develops tools to query the RADB and to report on usage of the database, fixes bugs, and implements new objects and attributes in the RADB.

The database support team actively participates in the IETF Routing Policy System Working Group to facilitate the transition to the Routing Policy System Language, which will succeed the current RIPE-181 language definitions. This includes active collaboration with the RIPE Database Working Group. In addition, this group will continue to work towards improving the accuracy of data in the Internet Routing Registry. (4.25 FTE)

Administrative Support

Staffing levels for administrative support for Year four will be .75 FTE.

Equipment

The proposed budget for Year Four of the Routing Arbiter service includes:

1. One new server-class RADB server (\$16,400)

Merit needs to upgrade the existing RADB server to the next higher class machine in order to accommodate the increased load. The new machine includes an 8G external disk pack to accommodate the increased size of the RADB data set. The server also includes an FDDI card in order to facilitate a more direct (low latency) attachment to the MichNet egress point.

2. One external 8G external disk pack (\$2,500)

The current RADB machine, once upgraded with the additional external disk pack, will serve as a hot backup to the new RADB server-class machine.

3. Collaborative hardware (\$3,600)

To facilitate close collaboration with our ISI partners, Merit will install two video collaboration systems on staff workstations. Each system will comprise a video camera and video capture card. This technology, particularly important as Merit and ISI work together to implement the new RPSL standard, will allow ad hoc video conferencing and ease of access to our partners. ISI is already equipped with this technology.

4. On-call support technology (\$7,400)

Merit on-call staff require high-speed remote access to the deployed infrastructure from their residences. ISDN technology is rapidly becoming a cost-effective mechanism to achieve these goals. The Year Four budget includes a one-time installation fee of \$600, and a yearly access charge (\$1,800) for three on-call staff. In addition, the RADB project team will purchase a shared laptop computer for use in making presentations and to provide on-call support while away on trips.

The total equipment budget for Year Four of the Routing Arbiter project is \$29,900.

Staff Travel

The Routing Arbiter service requires frequent participation and presence at Internet working groups and conferences. The total proposed travel budget is \$71,505.

Travel Expenditures				
Domestic	# Staff	Frequency	Per Trip	Total
IETF	2	2	\$2,100	\$8,400
FARNET	1	4	1,680	6,720
NANOG	4	3	2,800	20,160
FEPG	2	2	1,680	6,720
Misc. Travel	2	4	2,240	13,440
Foreign Travel				
IETF	2	1	2,940	5,880
RIPE	1	3	2,520	7,560
INET	1	1	2,625	2,625

Materials and Supplies

This budget item includes office supplies, computing supplies and software, equipment maintenance contracts, freight, shipping and postage, telephone, pager, and cellular phone expenses. The amount of the request is based on our experience and anticipated requirements for the project. The amount budgeted in the second half of Year Three is \$23,400.

Publications and Document Dissemination

This budget item covers the costs of printing and publication of status reports and information about the project. The figure is \$5,880.

Subcontracts

This budget item covers the cost of a subcontract to the University of Michigan NOC to provide 24x7 monitoring of the RADB database machine. The amount budgeted for Year Four is \$24,000.

Indirect Costs

Merit Network, Inc. will continue to use the indirect cost rate for the University of Michigan, which is currently 52.5% modified total direct cost. Merit's indirect cost rate will track the University of Michigan's rate throughout the project.