

Network File System Version 4 Working Group  
Internet-Draft  
Intended status: Draft Standard  
Obsoletes: [1831](#)  
Expires: September 5, 2009

R. Thurlow  
Sun Microsystems

March 5, 2009

RPC: Remote Procedure Call Protocol Specification Version 2  
draft-ietf-nfsv4-rfc1831bis-13.txt

## Status of this Memo

This Internet-Draft is submitted to IETF in full conformance with the provisions of [BCP 78](#) and [BCP 79](#).

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

The list of current Internet-Drafts can be accessed at  
<http://www.ietf.org/lid-abstracts.html>

The list of Internet-Draft Shadow Directories can be accessed at  
<http://www.ietf.org/shadow.html>

This document will expire in July, 2009.

## Copyright Notice

Copyright (c) 2009 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to [BCP 78](#) and the IETF Trust's Legal Provisions Relating to IETF Documents (<http://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document.

---

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

## Abstract

This document describes the ONC (Open Network Computing) Remote Procedure Call (ONC RPC Version 2) protocol as it is currently deployed and accepted. This document obsoletes [[RFC1831](#)].

## Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [[RFC2119](#)].

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

## Table of Contents

|                         |  |                   |
|-------------------------|--|-------------------|
| <a href="#">1.</a>      | <a href="#">Introduction . . . . .</a>                                     | <a href="#">1</a> |
| <a href="#">2.</a>      | <a href="#">Changes since <a href="#">RFC 1831</a> . . . . .</a>           | <a href="#">1</a> |
| <a href="#">3.</a>      | <a href="#">Terminology . . . . .</a>                                      | <a href="#">1</a> |
| <a href="#">4.</a>      | <a href="#">The RPC Model . . . . .</a>                                    | <a href="#">1</a> |
| <a href="#">5.</a>      | <a href="#">Transports and Semantics . . . . .</a>                         | <a href="#">1</a> |
| <a href="#">6.</a>      | <a href="#">Binding and Rendezvous Independence . . . . .</a>              | <a href="#">1</a> |
| <a href="#">7.</a>      | <a href="#">Authentication . . . . .</a>                                   | <a href="#">1</a> |
| <a href="#">8.</a>      | <a href="#">RPC Protocol Requirements . . . . .</a>                        | <a href="#">1</a> |
| <a href="#">8.1.</a>    | <a href="#">RPC Programs and Procedures . . . . .</a>                      | <a href="#">1</a> |
| <a href="#">8.2.</a>    | <a href="#">Authentication, Integrity and Privacy . . . . .</a>            | <a href="#">1</a> |
| <a href="#">8.3.</a>    | <a href="#">Program Number Assignment . . . . .</a>                        | <a href="#">1</a> |
| <a href="#">8.4.</a>    | <a href="#">Other Uses of the RPC Protocol . . . . .</a>                   | <a href="#">1</a> |
| <a href="#">8.4.1.</a>  | <a href="#">Batching . . . . .</a>   | <a href="#">1</a> |
| <a href="#">8.4.2.</a>  | <a href="#">Broadcast Remote Procedure Calls . . . . .</a>                 | <a href="#">1</a> |
| <a href="#">9.</a>      | <a href="#">The RPC Message Protocol . . . . .</a>                         | <a href="#">1</a> |
| <a href="#">10.</a>     | <a href="#">Authentication Protocols . . . . .</a>                         | <a href="#">1</a> |
| <a href="#">10.1.</a>   | <a href="#">Null Authentication . . . . .</a>                              | <a href="#">1</a> |
| <a href="#">11.</a>     | <a href="#">Record Marking Standard . . . . .</a>                          | <a href="#">1</a> |
| <a href="#">12.</a>     | <a href="#">The RPC Language . . . . .</a>                                 | <a href="#">1</a> |
| <a href="#">12.1.</a>   | <a href="#">An Example Service Described in the RPC Language . . . . .</a> | <a href="#">1</a> |
| <a href="#">12.2.</a>   | <a href="#">The RPC Language Specification . . . . .</a>                   | <a href="#">1</a> |
| <a href="#">12.3.</a>   | <a href="#">Syntax Notes . . . . .</a>                                     | <a href="#">1</a> |
| <a href="#">13.</a>     | <a href="#">IANA Considerations . . . . .</a>                              | <a href="#">1</a> |
| <a href="#">13.1.</a>   | <a href="#">Numbering Requests to IANA . . . . .</a>                       | <a href="#">1</a> |
| <a href="#">13.2.</a>   | <a href="#">Protecting Past Assignments . . . . .</a>                      | <a href="#">1</a> |
| <a href="#">13.3.</a>   | <a href="#">RPC Number Assignment . . . . .</a>                            | <a href="#">1</a> |
| <a href="#">13.3.1.</a> | <a href="#">To be assigned by IANA . . . . .</a>                           | <a href="#">1</a> |
| <a href="#">13.3.2.</a> | <a href="#">Defined by local administrator . . . . .</a>                   | <a href="#">1</a> |
| <a href="#">13.3.3.</a> | <a href="#">Transient block . . . . .</a>                                  | <a href="#">1</a> |
| <a href="#">13.3.4.</a> | <a href="#">Reserved block . . . . .</a>                                   | <a href="#">1</a> |
| <a href="#">13.3.5.</a> | <a href="#">RPC Number Sub-Blocks . . . . .</a>                            | <a href="#">1</a> |
| <a href="#">13.4.</a>   | <a href="#">RPC Authentication Flavor Number Assignment . . . . .</a>      | <a href="#">1</a> |
| <a href="#">13.4.1.</a> | <a href="#">Assignment Policy . . . . .</a>                                | <a href="#">1</a> |
| <a href="#">13.4.2.</a> | <a href="#">Auth Flavors vs. Pseudo-flavors . . . . .</a>                  | <a href="#">1</a> |

|                         |   |                   |
|-------------------------|---|-------------------|
| <a href="#">13.5.</a>   | Authentication Status Number Assignment . . . . .                           | <a href="#">1</a> |
| <a href="#">13.5.1.</a> | Assignment Policy . . . . .   | <a href="#">1</a> |
| <a href="#">14.</a>     | Security Considerations . . . . .   | <a href="#">1</a> |
| <a href="#">15.</a>     | <a href="#">Appendix A</a> : System Authentication . . . . .                | <a href="#">1</a> |
| <a href="#">16.</a>     | <a href="#">Appendix B</a> : Requesting RPC-related numbers from IANA . . . | <a href="#">1</a> |
| <a href="#">17.</a>     | <a href="#">Appendix C</a> : Current number assignments . . . . .           | <a href="#">1</a> |
| <a href="#">18.</a>     | Normative References . . . . .  | <a href="#">1</a> |
| <a href="#">19.</a>     | Informative References . . . . .  | <a href="#">1</a> |
| <a href="#">20.</a>     | Author's Address . . . . .  | <a href="#">1</a> |

## [1.](#) Introduction

This document specifies version two of the message protocol used in ONC Remote Procedure Call (RPC). The message protocol is specified with the eXternal Data Representation (XDR) language [[RFC4506](#)]. This document assumes that the reader is familiar with XDR. It does not attempt to justify remote procedure calls systems or describe their use. The paper by Birrell and Nelson [[XRPC](#)] is recommended as an excellent background for the remote procedure call concept.

## [2.](#) Changes since [RFC 1831](#)

This document obsoletes [RFC 1831](#) as the authoritative document describing RPC, without introducing any over-the-wire protocol changes. The main changes from [RFC 1831](#) are:

- o Addition of an Appendix which describes how an implementor can request new RPC program numbers, authentication flavor numbers and authentication status numbers from IANA, rather than from Sun Microsystems
- o Addition of an "IANA Considerations" section which describes past number assignment policy and how IANA is intended to assign them in the future
- o Clarification of the RPC Language Specification to match current usage
- o Enhancement of the "Security Considerations" section to reflect

experience with strong security flavors

- o Specification of new authentication errors that are in common use in modern RPC implementations
- o Updates for the latest IETF intellectual property statements

### 3. Terminology

This document discusses clients, calls, servers, replies, services, programs, procedures, and versions. Each remote procedure call has two sides: an active client side that makes the call to a server, which sends back a reply. A network service is a collection of one or more remote programs. A remote program implements one or more remote procedures; the procedures, their parameters, and results are documented in the specific program's protocol specification. A server may support more than one version of a remote program in order to be compatible with changing protocols.

Thurlow

[draft-ietf-nfsv4-rfc1831bis-13.txt](#)

[Page 4]

---

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

For example, a network file service may be composed of two programs. One program may deal with high-level applications such as file system access control and locking. The other may deal with low-level file input and output and have procedures like "read" and "write". A client of the network file service would call the procedures associated with the two programs of the service on behalf of the client.

The terms client and server only apply to a particular transaction; a particular hardware entity (host) or software entity (process or program) could operate in both roles at different times. For example, a program that supplies remote execution service could also be a client of a network file service.

### 4. The RPC Model

The ONC RPC protocol is based on the remote procedure call model, which is similar to the local procedure call model. In the local case, the caller places arguments to a procedure in some well-specified location (such as a register window). It then transfers control to the procedure, and eventually regains control. At that point, the results of the procedure are extracted from the well-

specified location, and the caller continues execution.

The remote procedure call model is similar. One thread of control logically winds through two processes: the caller's process, and a server's process. The caller process first sends a call message to the server process and waits (blocks) for a reply message. The call message includes the procedure's parameters, and the reply message includes the procedure's results. Once the reply message is received, the results of the procedure are extracted, and caller's execution is resumed.

On the server side, a process is dormant awaiting the arrival of a call message. When one arrives, the server process extracts the procedure's parameters, computes the results, sends a reply message, and then awaits the next call message.

In this model, only one of the two processes is active at any given time. However, this model is only given as an example. The ONC RPC protocol makes no restrictions on the concurrency model implemented, and others are possible. For example, an implementation may choose to have RPC calls be asynchronous, so that the client may do useful work while waiting for the reply from the server. Another possibility is to have the server create a separate task to process an incoming call, so that the original server can be free to receive other requests.

There are a few important ways in which remote procedure calls differ from local procedure calls:

- o Error handling: failures of the remote server or network must be handled when using remote procedure calls.
- o Global variables and side-effects: since the server does not have access to the client's address space, hidden arguments cannot be passed as global variables or returned as side effects.
- o Performance: remote procedures usually operate one or more orders of magnitude slower than local procedure calls.
- o Authentication: since remote procedure calls can be transported

over unsecured networks, authentication may be necessary. Authentication prevents one entity from masquerading as some other entity.

The conclusion is that even though there are tools to automatically generate client and server libraries for a given service, protocols must still be designed carefully.

## 5. Transports and Semantics

The RPC protocol can be implemented on several different transport protocols. The scope of the definition of the RPC protocol excludes how a message is passed from one process to another, and includes only the specification and interpretation of messages. However, the application may wish to obtain information about (and perhaps control over) the transport layer through an interface not specified in this document. For example, the transport protocol may impose a restriction on the maximum size of RPC messages, or it may be stream-oriented like TCP [[RFC793](#)] with no size limit. The client and server must agree on their transport protocol choices.

It is important to point out that RPC does not try to implement any kind of reliability and that the application may need to be aware of the type of transport protocol underneath RPC. If it knows it is running on top of a reliable transport such as TCP, then most of the work is already done for it. On the other hand, if it is running on top of an unreliable transport such as UDP [[RFC768](#)], it must implement its own time-out, retransmission, and duplicate detection policies as the RPC protocol does not provide these services.

Because of transport independence, the RPC protocol does not attach specific semantics to the remote procedures or their execution requirements. Semantics can be inferred from (but should be

explicitly specified by) the underlying transport protocol. For example, consider RPC running on top of an unreliable transport such as UDP. If an application retransmits RPC call messages after time-outs, and does not receive a reply, it cannot infer anything about the number of times the procedure was executed. If it does receive a reply, then it can infer that the procedure was executed at least once.

A server may wish to remember previously granted requests from a client and not regrant them in order to insure some degree of execute-at-most-once semantics. A server can do this by taking advantage of the transaction ID that is packaged with every RPC message. The main use of this transaction ID is by the client RPC entity in matching replies to calls. However, a client application may choose to reuse its previous transaction ID when retransmitting a call. The server may choose to remember this ID after executing a call and not execute calls with the same ID in order to achieve some degree of execute-at-most-once semantics. The server is not allowed to examine this ID in any other way except as a test for equality.

On the other hand, if using a "reliable" transport such as TCP, the application can infer from a reply message that the procedure was executed exactly once, but if it receives no reply message, it cannot assume that the remote procedure was not executed. Note that even if a connection-oriented protocol like TCP is used, an application still needs time-outs and reconnection to handle server crashes.

There are other possibilities for transports besides datagram- or connection-oriented protocols. For example, a request-reply protocol such as [\[VMTP\]](#) is perhaps a natural transport for RPC. ONC RPC currently uses both TCP and UDP transport protocols. [Section 10](#) (Record Marking Standard) describes the mechanism employed by ONC RPC to utilize a connection-oriented, stream-oriented transport such as TCP. The mechanism by which future transports having different structural characteristics should be used to transfer ONC RPC messages should be specified by means of a standards-track RFC, once such additional transports are defined.

## [6.](#) Binding and Rendezvous Independence

The act of binding a particular client to a particular service and transport parameters is NOT part of this RPC protocol specification. This important and necessary function is left up to some higher-level software.

Implementors could think of the RPC protocol as the jump-subroutine instruction ("JSR") of a network; the loader (binder) makes JSR useful, and the loader itself uses JSR to accomplish its task.

Likewise, the binding software makes RPC useful, possibly using RPC



to accomplish this task.

## [7.](#) Authentication

The RPC protocol provides the fields necessary for a client to identify itself to a service, and vice-versa, in each call and reply message. Security and access control mechanisms can be built on top of this message authentication. Several different authentication protocols can be supported. A field in the RPC header indicates which protocol is being used. More information on specific authentication protocols is in [section 8.2](#): "Authentication, Integrity and Privacy".

## [8.](#) RPC Protocol Requirements

The RPC protocol must provide for the following:

- o Unique specification of a procedure to be called.
- o Provisions for matching response messages to request messages.
- o Provisions for authenticating the caller to service and vice-versa.

Besides these requirements, features that detect the following are worth supporting because of protocol roll-over errors, implementation bugs, user error, and network administration:

- o RPC protocol mismatches.
- o Remote program protocol version mismatches.
- o Protocol errors (such as misspecification of a procedure's parameters).
- o Reasons why remote authentication failed.
- o Any other reasons why the desired procedure was not called.

### [8.1.](#) RPC Programs and Procedures

The RPC call message has three unsigned integer fields -- remote program number, remote program version number, and remote procedure number -- which uniquely identify the procedure to be called. Program numbers are administered by a central authority (IANA). Once implementors have a program number, they can implement their remote

program; the first implementation would most likely have the version number 1 but MUST NOT be the number zero. Because most new protocols evolve, a version field of the call message identifies which version of the protocol the caller is using. Version numbers enable support of both old and new protocols through the same server process.

The procedure number identifies the procedure to be called. These numbers are documented in the specific program's protocol specification. For example, a file service's protocol specification may state that its procedure number 5 is "read" and procedure number 12 is "write".

Just as remote program protocols may change over several versions, the actual RPC message protocol could also change. Therefore, the call message also has in it the RPC version number, which is always equal to two for the version of RPC described here.

The reply message to a request message has enough information to distinguish the following error conditions:

- o The remote implementation of RPC does not support protocol version 2. The lowest and highest supported RPC version numbers are returned.
- o The remote program is not available on the remote system.
- o The remote program does not support the requested version number. The lowest and highest supported remote program version numbers are returned.
- o The requested procedure number does not exist. (This is usually a client side protocol or programming error.)
- o The parameters to the remote procedure appear to be garbage from the server's point of view. (Again, this is usually caused by a disagreement about the protocol between client and service.)

## [8.2.](#) Authentication, Integrity and Privacy

Provisions for authentication of caller to service and vice-versa are provided as a part of the RPC protocol. The call message has two authentication fields, the credential and verifier. The reply message has one authentication field, the response verifier. The RPC protocol specification defines all three fields to be the following opaque type (in the eXternal Data Representation (XDR) language

```
enum auth_flavor {
    AUTH_NONE      = 0,
    AUTH_SYS       = 1,
    AUTH_SHORT     = 2,
    AUTH_DH        = 3,
    RPCSEC_GSS     = 6
    /* and more to be defined */
};

struct opaque_auth {
    auth_flavor flavor;
    opaque body<400>;
};
```

In other words, any "opaque\_auth" structure is an "auth\_flavor" enumeration followed by up to 400 bytes which are opaque to (uninterpreted by) the RPC protocol implementation.

The interpretation and semantics of the data contained within the authentication fields is specified by individual, independent authentication protocol specifications.

If authentication parameters were rejected, the reply message contains information stating why they were rejected.

As demonstrated by RPCSEC\_GSS, it is possible for an "auth\_flavor" to also support integrity and privacy.

### [8.3.](#) Program Number Assignment

Program numbers are given out in groups according to the following chart:

|                         |   |
|-------------------------|---|
| 0x00000000              | Reserved  |
| 0x00000001 - 0x1fffffff | To be assigned by IANA  |
| 0x20000000 - 0x3fffffff | Defined by local administrator<br>(some blocks assigned here) |
| 0x40000000 - 0x5fffffff | Transient   |
| 0x60000000 - 0x7fffffff | Reserved  |

|                         |                        |
|-------------------------|------------------------|
| 0x7f000000 - 0x7fffffff | Assignment outstanding |
| 0x80000000 - 0xffffffff | Reserved               |

The first group is a range of numbers administered by IANA and should be identical for all sites. The second range is for applications peculiar to a particular site. This range is intended primarily for debugging new programs. When a site develops an application that might be of general interest, that application should be given an assigned number in the first range. Application developers may apply

Thurlow

[draft-ietf-nfsv4-rfc1831bis-13.txt](#)

[Page 10]

---

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

for blocks of RPC program numbers in the first range by methods described in [Appendix B](#). The third group is for applications that generate program numbers dynamically. The final groups are reserved for future use, and should not be used.

#### [8.4.](#) Other Uses of the RPC Protocol

The intended use of this protocol is for calling remote procedures. Normally, each call message is matched with a reply message. However, the protocol itself is a message-passing protocol with which other (non-procedure call) protocols can be implemented.

##### [8.4.1.](#) Batching

Batching is useful when a client wishes to send an arbitrarily large sequence of call messages to a server. Batching typically uses reliable byte stream protocols (like TCP) for its transport. In the case of batching, the client never waits for a reply from the server, and the server does not send replies to batch calls. A sequence of batch calls is usually terminated by a legitimate remote procedure call operation in order to flush the pipeline and get positive acknowledgement.

##### [8.4.2.](#) Broadcast Remote Procedure Calls

In broadcast protocols, the client sends a broadcast call to the network and waits for numerous replies. This requires the use of packet-based protocols (like UDP) as its transport protocol. Servers that support broadcast protocols usually respond only when the call is successfully processed and are silent in the face of errors, but this varies with the application.

The principles of broadcast RPC also apply to multicasting – an RPC request can be sent to a multicast address.

## 9. The RPC Message Protocol

This section defines the RPC message protocol in the XDR data description language [[RFC4506](#)].

```
enum msg_type {
    CALL    = 0,
    REPLY    = 1
};
```

A reply to a call message can take on two forms: The message was either accepted or rejected.

```
enum reply_stat {
    MSG_ACCEPTED = 0,
    MSG_DENIED   = 1
};
```

Given that a call message was accepted, the following is the status of an attempt to call a remote procedure.

```
enum accept_stat {
    SUCCESS          = 0, /* RPC executed successfully */
    PROG_UNAVAIL     = 1, /* remote hasn't exported program */
    PROG_MISMATCH    = 2, /* remote can't support version # */
    PROC_UNAVAIL     = 3, /* program can't support procedure */
    GARBAGE_ARGS     = 4, /* procedure can't decode params */
    SYSTEM_ERR       = 5  /* e.g. memory allocation failure */
};
```

Reasons why a call message was rejected:

```
enum reject_stat {
    RPC_MISMATCH = 0, /* RPC version number != 2 */
    AUTH_ERROR   = 1  /* remote can't authenticate caller */
};
```

Why authentication failed:

```

enum auth_stat {
    AUTH_OK          = 0, /* success */
    /*
     * failed at remote end
     */
    AUTH_BADCRED      = 1, /* bad credential (seal broken) */
    AUTH_REJECTEDCRED = 2, /* client must begin new session */
    AUTH_BADVERF      = 3, /* bad verifier (seal broken) */
    AUTH_REJECTEDVERF = 4, /* verifier expired or replayed */
    AUTH_TOOWEAK      = 5, /* rejected for security reasons */
    /*
     * failed locally
     */
    AUTH_INVALIDRESP  = 6, /* bogus response verifier */
    AUTH_FAILED       = 7, /* reason unknown */
    /*
     * AUTH_KERB errors; deprecated. See [RFC2695]
     */
    AUTH_KERB_GENERIC = 8, /* kerberos generic error */
    AUTH_TIMEEXPIRE   = 9, /* time of credential expired */
    AUTH_TKT_FILE     = 10, /* problem with ticket file */
    AUTH_DECODE       = 11, /* can't decode authenticator */

```

```

    AUTH_NET_ADDR = 12, /* wrong net address in ticket */
    /*
     * RPCSEC_GSS GSS related errors
     */
    RPCSEC_GSS_CREDPROBLEM = 13, /* no credentials for user */
    RPCSEC_GSS_CTXPROBLEM = 14 /* problem with context */
};

```

As new authentication mechanisms are added, there may be a need for more status codes to support them. IANA will hand out new auth\_stat numbers on a simple first-come, first-served basis as defined in the "IANA Considerations" and [Appendix B](#).

The RPC message:

All messages start with a transaction identifier, xid, followed by a two-armed discriminated union. The union's discriminant is a msg\_type which switches to one of the two types of the message. The

xid of a REPLY message always matches that of the initiating CALL message. NB: The xid field is only used for clients matching reply messages with call messages or for servers detecting retransmissions; the service side cannot treat this id as any type of sequence number.

```
struct rpc_msg {
    unsigned int xid;
    union switch (msg_type mtype) {
        case CALL:
            call_body cbody;
        case REPLY:
            reply_body rbody;
        } body;
    };
};
```

Body of an RPC call:

In version 2 of the RPC protocol specification, rpcvers MUST be equal to 2. The fields prog, vers, and proc specify the remote program, its version number, and the procedure within the remote program to be called. After these fields are two authentication parameters: cred (authentication credential) and verf (authentication verifier). The two authentication parameters are followed by the parameters to the remote procedure, which are specified by the specific program protocol.

The purpose of the authentication verifier is to validate the authentication credential. Note that these two items are historically separate, but are always used together as one logical

entity.

```
struct call_body {
    unsigned int rpcvers;          /* must be equal to two (2) */
    unsigned int prog;
    unsigned int vers;
    unsigned int proc;
    opaque_auth cred;
    opaque_auth verf;
    /* procedure specific parameters start here */
};
```

Body of a reply to an RPC call:

```
union reply_body switch (reply_stat stat) {
case MSG_ACCEPTED:
    accepted_reply areply;
case MSG_DENIED:
    rejected_reply rreply;
} reply;
```

Reply to an RPC call that was accepted by the server:

There could be an error even though the call was accepted. The first field is an authentication verifier that the server generates in order to validate itself to the client. It is followed by a union whose discriminant is an enum accept\_stat. The SUCCESS arm of the union is protocol specific. The PROG\_UNAVAIL, PROC\_UNAVAIL, GARBAGE\_ARGS, and SYSTEM\_ERR arms of the union are void. The PROG\_MISMATCH arm specifies the lowest and highest version numbers of the remote program supported by the server.

```
struct accepted_reply {
    opaque_auth verf;
    union switch (accept_stat stat) {
    case SUCCESS:
        opaque results[0];
        /*
         * procedure-specific results start here
         */
    case PROG_MISMATCH:
        struct {
            unsigned int low;
            unsigned int high;
        } mismatch_info;
    default:
        /*
         * Void. Cases include PROG_UNAVAIL, PROC_UNAVAIL,
```

```
        * GARBAGE_ARGS, and SYSTEM_ERR.
        */
        void;
    } reply_data;
```



```
};
```

Reply to an RPC call that was rejected by the server:

The call can be rejected for two reasons: either the server is not running a compatible version of the RPC protocol (RPC\_MISMATCH), or the server rejects the identity of the caller (AUTH\_ERROR). In case of an RPC version mismatch, the server returns the lowest and highest supported RPC version numbers. In case of invalid authentication, failure status is returned.

```
union rejected_reply switch (reject_stat stat) {
case RPC_MISMATCH:
    struct {
        unsigned int low;
        unsigned int high;
    } mismatch_info;
case AUTH_ERROR:
    auth_stat stat;
};
```

## 10. Authentication Protocols

As previously stated, authentication parameters are opaque, but open-ended to the rest of the RPC protocol. This section defines two standard "flavors" of authentication. Implementors are free to invent new authentication types, with the same rules of flavor number assignment as there is for program number assignment. The "flavor" of a credential or verifier refers to the value of the "flavor" field in the opaque\_auth structure. Flavor numbers, like RPC program numbers, are also administered centrally, and developers may assign new flavor numbers by methods described in [Appendix B](#). Credentials and verifiers are represented as variable length opaque data (the "body" field in the opaque\_auth structure).

In this document, two flavors of authentication are described. Of these, Null authentication (described in the next subsection) is mandatory - it MUST be available in all implementations. System authentication (AUTH\_SYS) is described in [Appendix A](#). Implementors MAY include AUTH\_SYS in their implementations to support existing applications. See "Security Considerations" for information about other, more secure, authentication flavors.

### [10.1.](#) Null Authentication

Often calls must be made where the client does not care about its identity or the server does not care who the client is. In this case, the flavor of the RPC message's credential, verifier, and reply verifier is "AUTH\_NONE". Opaque data associated with "AUTH\_NONE" is undefined. It is recommended that the length of the opaque data be zero.

## [11.](#) Record Marking Standard

When RPC messages are passed on top of a byte stream transport protocol (like TCP), it is necessary to delimit one message from another in order to detect and possibly recover from protocol errors. This is called record marking (RM). One RPC message fits into one RM record.

A record is composed of one or more record fragments. A record fragment is a four-byte header followed by 0 to  $(2^{*}31) - 1$  bytes of fragment data. The bytes encode an unsigned binary number; as with XDR integers, the byte order is from highest to lowest. The number encodes two values -- a boolean which indicates whether the fragment is the last fragment of the record (bit value 1 implies the fragment is the last fragment) and a 31-bit unsigned binary value which is the length in bytes of the fragment's data. The boolean value is the highest-order bit of the header; the length is the 31 low-order bits. (Note that this record specification is NOT in XDR standard form!)

## [12.](#) The RPC Language

Just as there was a need to describe the XDR data-types in a formal language, there is also need to describe the procedures that operate on these XDR data-types in a formal language as well. The RPC Language is an extension to the XDR language, with the addition of "program", "procedure", and "version" declarations. The keywords "program" and "version" are reserved in the RPC Language, and implementations of XDR compilers MAY reserve these keywords even when provided pure XDR, non-RPC, descriptions. The following example is used to describe the essence of the language.

### [12.1.](#) An Example Service Described in the RPC Language

Here is an example of the specification of a simple ping program.

```
program PING_PROG {  
    /*  
    * Latest and greatest version
```

\*/

```
version PING_VERS_PINGBACK {
    void
    PINGPROC_NULL(void) = 0;
    /*
     * Ping the client, return the round-trip time
     * (in microseconds). Returns -1 if the operation
     * timed out.
     */
    int
    PINGPROC_PINGBACK(void) = 1;
} = 2;

/*
 * Original version
 */
version PING_VERS_ORIG {
    void
    PINGPROC_NULL(void) = 0;
} = 1;
} = 1;

const PING_VERS = 2;      /* latest version */
```

The first version described is PING\_VERS\_PINGBACK with two procedures, PINGPROC\_NULL and PINGPROC\_PINGBACK. PINGPROC\_NULL takes no arguments and returns no results, but it is useful for computing round-trip times from the client to the server and back again. By convention, procedure 0 of any RPC protocol should have the same semantics, and never require any kind of authentication. The second procedure is used for the client to have the server do a reverse ping operation back to the client, and it returns the amount of time (in microseconds) that the operation used. The next version, PING\_VERS\_ORIG, is the original version of the protocol and it does not contain PINGPROC\_PINGBACK procedure. It is useful for compatibility with old client programs, and as this program matures it may be dropped from the protocol entirely.

## [12.2.](#) The RPC Language Specification

The RPC language is identical to the XDR language defined in [RFC](#)

[4506](#), except for the added definition of a "program-def" described below.

```
program-def:
  "program" identifier "{"
    version-def
    version-def *
  "}" "=" constant ";"
```

```
version-def:
  "version" identifier "{"
    procedure-def
    procedure-def *
  "}" "=" constant ";"

procedure-def:
  proc-return identifier "(" proc-firstarg
    ("," type-specifier)* ")" "=" constant ";"

proc-return: "void" | type-specifier

proc-firstarg: "void" | type-specifier
```

### [12.3.](#) Syntax Notes

- o The following keywords are added and cannot be used as identifiers: "program" and "version";
- o A version name cannot occur more than once within the scope of a program definition. Nor can a version number occur more than once within the scope of a program definition.
- o A procedure name cannot occur more than once within the scope of a version definition. Nor can a procedure number occur more than once within the scope of version definition.
- o Program identifiers are in the same name space as constant and type identifiers.
- o Only unsigned constants can be assigned to programs, versions

and procedures.

- o Current RPC language compilers do not generally support more than one type-specifier in procedure argument lists; the usual practice is to wrap arguments into a structure.

### 13. IANA Considerations

The assignment of RPC program numbers, authentication flavor numbers and authentication status numbers has in the past been performed by Sun Microsystems, Inc (Sun). This is inappropriate for an IETF standards-track protocol, as such work is done well by the Internet Assigned Numbers Authority (IANA). This document proposes the transfer of authority over RPC program numbers, authentication flavor

Thurlow

[draft-ietf-nfsv4-rfc1831bis-13.txt](#)

[Page 18]

---

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

numbers and authentication status numbers described here from Sun Microsystems, Inc. to IANA and proposes how IANA will maintain and assign these numbers. Users of RPC protocols will benefit by having an independent body responsible for these number assignments.

#### 13.1. Numbering Requests to IANA

[Appendix B](#) of this document describes the information to be sent to IANA to request one or more RPC numbers and the rules that apply. IANA should store the request for documentary purposes, and put the following information into the public registry:

- o The short description of purpose and use
- o The program number(s) assigned
- o The short identifier string(s)

#### 13.2. Protecting Past Assignments

Sun has made assignments in both number spaces since the original deployment of RPC. The assignments made by Sun Microsystems are still valid, and will be preserved. Sun will communicate all current assignments in both number spaces to IANA before final handoff of number assignment is done. Current program and auth number assignments are provided in [Appendix C](#). Current authentication

status numbers are listed in [Section 9](#) of this document in the "enum auth\_stat" definition.

### [13.3.](#) RPC Number Assignment

Future IANA practice should deal with the following partitioning of the 32-bit number space as listed in [Section 8.3](#). Detailed information for the administration of the partitioned blocks in [Section 8.3](#). is given below.

#### [13.3.1.](#) To be assigned by IANA

The first block will be administered by IANA, with previous assignments by Sun protected. Previous assignments were restricted to the range decimal 100000-399999 (0x000186a0 to 0x00061a7f), therefore IANA should begin assignments at decimal 400000. Individual numbers should be granted on a first-come, first-served basis, and blocks should be granted under rules related to the size of the block.

#### [13.3.2.](#) Defined by local administrator

The "Defined by local administrator" block is available for any local administrative domain to use, in a similar manner to IP address ranges reserved for private use. The expected use would be through the establishment of a local domain "authority" for assigning numbers from this range. This authority would establish any policies or procedures to be used within that local domain for use or assignment of RPC numbers from the range. The local domain should be sufficiently isolated that it would be unlikely that RPC applications developed by other local domains could communicate with the domain. This could result in RPC number contention, which would cause one of the applications to fail. In the absence of a local administrator, this block can be utilized in a "Private Use" manner per [\[RFC5226\]](#).

#### [13.3.3.](#) Transient block

The "Transient" block can be used by any RPC application on a "as available" basis. This range is intended for services that can

communicate a dynamically selected RPC program number to clients of the service. Any mechanism can be used to communicate the number. Examples include shared memory when the client and server are located on the same system, or a network message (either RPC or otherwise) that disseminates the selected number.

The transient block is not administered. An RPC service uses this range by selecting a number in the transient range and attempting to register that number with the local system's RPC bindery (see the `RPCBPROC_SET` or `PMAPPROC_SET` procedures in "Binding Protocols for ONC RPC", [[RFC1833](#)]). If successful, no other RPC service was using that number and the RPC Bindery has assigned that number to the requesting RPC application. The registration is valid until the RPC Bindery terminates, which normally would only happen if the system reboots causing all applications, including the RPC service using the transient number, to terminate. If the transient number registration fails, another RPC application is using the number and the requestor must select another number and try again. To avoid conflicts, the recommended method is to select a number randomly from the transient range.

#### [13.3.4.](#) Reserved block

The "Reserved" blocks are available for future use. RPC applications must not use numbers in these ranges unless their use is allowed by future action by the IESG.

#### [13.3.5.](#) RPC Number Sub-Blocks

RPC numbers are usually assigned for specific RPC services. Some applications, however, require multiple RPC numbers for a service. The most common example is an RPC service that needs to have multiple instances of the service active simultaneously at a specific site. RPC does not have an "instance identifier" in the protocol, so either a mechanism must be implemented to multiplex RPC requests amongst various instances of the service, or unique RPC numbers must be used by each instance.

In these cases, the RPC protocol used with the various numbers may be

different or the same. The numbers may be assigned dynamically by the application, or as part of a site-specific administrative decision. If possible, RPC services that dynamically assign RPC numbers should use the "Transient" RPC number block defined in [section 2](#). If not possible, RPC number sub-blocks may be requested.

Assignment of RPC Number Sub-Blocks is controlled by the size of the sub-block being requested. "Specification Required" and "IESG Approval" are used as defined by [\[RFC5226\] Section 4.1](#).

| Size of sub-block      | Assignment Method       | Authority |
|------------------------|-------------------------|-----------|
| -----                  | -----                   | -----     |
| Up to 100 numbers      | First Come First Served | IANA      |
| Up to 1000 numbers     | Specification Required  | IANA      |
| More than 1000 numbers | IESG Approval required  | IESG      |

Note: sub-blocks can be any size. The limits given above are maximums and smaller size sub-blocks are allowed.

Sub-blocks sized up to 100 numbers may be assigned by IANA on a First Come First Served basis. The RPC Service Description included in the range must include an indication of how the sub-block is managed. At a minimum, the statement should indicate whether the sub-block is used with a single RPC protocol or multiple RPC protocols, and whether the numbers are dynamically assigned or statically (through administrative action) assigned.

Sub-blocks of up to 1000 numbers must be documented in detail. The documentation must describe the RPC protocol or protocols that are to be used in the range. It must also describe how the numbers within the sub-block are to be assigned or used.

Sub-blocks sized over 1000 numbers must be documented as described above, and the assignment must be approved by the IESG. It is expected that this will be rare.

In order to avoid multiple requests of large blocks of numbers the following rule is proposed.

Requests up to and including 100 RPC numbers are handled via the First Come First Served assignment method. This 100 number



threshold applies to the total number of RPC numbers assigned to an individual or entity. For example, if an individual or entity first requests say 70 numbers, and then later requests 40 numbers, then the request for the 40 numbers will be assigned via the Specification Required method. As long as the total number of numbers assigned does not exceed 1000, IANA is free to waive the Specification Required assignment for incremental requests of less than 100 numbers.

If an individual or entity has under 1000 numbers and later requests an additional set of numbers such that the individual or entity would be granted over 1000 numbers, then the additional request will require IESG Approval.

#### [13.4.](#) RPC Authentication Flavor Number Assignment

The second number space is the authentication mechanism identifier, or "flavor", number. This number is used to distinguish between various authentication mechanisms which can be optionally used with an RPC message. An authentication identifier is used in the "flavor" field of the "opaque\_auth" structure.

##### [13.4.1.](#) Assignment Policy

[Appendix B](#) of this document describes the information to be sent to IANA to request one or more RPC auth numbers and the rules that apply. IANA should store the request for documentary purposes, and put the following information into the public registry:

- o The short identifier string(s)
- o The auth number(s) assigned
- o The short description of purpose and use

##### [13.4.2.](#) Auth Flavors vs. Pseudo-flavors

Recent progress in RPC security has moved away from new auth flavors as used by AUTH\_DH [[DH](#)], and focused on using the existing RPCSEC\_GSS [[RFC2203](#)] flavor and inventing novel GSS-API mechanisms which can be used with it. Even though RPCSEC\_GSS is an assigned authentication flavor, use of a new RPCSEC\_GSS mechanism with NFS ([[RFC1094](#)] [[RFC1813](#)] and [[RFC3530](#)]) will require the registration of 'pseudo-

flavors' which are used to negotiate security mechanisms in an unambiguous way, as defined by [[RFC2623](#)]. Existing pseudo-flavors have been granted in the decimal range 390000-390255. New pseudo-flavor requests should be granted by IANA within this block on a First Come First Served basis.

For non-pseudo-flavor requests, IANA should begin granting RPC authentication flavor numbers at 400000 on a First Come First Served basis to avoid conflicts with currently granted numbers.

For authentication flavors or RPCSEC\_GSS mechanisms to be used on the Internet, it is strongly advised that an informational or standards-track RFC be published describing the authentication mechanism behaviour and parameters.

### [13.5.](#) Authentication Status Number Assignment

The final number space is the authentication status or "auth\_stat" values which describe the nature of a problem found during an attempt to authenticate or validate authentication. The complete initial list of these values is found in [Section 9](#) of this document, in the "auth\_stat" enum listing. It is expected that it will be rare to add values, but that a small number of new values may be added from time to time as new authentication flavors introduce new possibilities. Numbers should be granted on a First Come First Served basis to avoid conflicts with currently granted numbers.

#### [13.5.1.](#) Assignment Policy

[Appendix B](#) of this document describes the information to be sent to IANA to request one or more auth\_stat values and the rules that apply. IANA should store the request for documentary purposes, and put the following information into the public registry:

- o The short identifier string(s)
- o The auth\_stat number(s) assigned
- o The short description of purpose and use

## [14.](#) Security Considerations

AUTH\_SYS as described in [Appendix A](#) is known to be insecure due to the lack of a verifier to permit the credential to be validated. AUTH\_SYS SHOULD NOT be used for services which permit clients to modify data. AUTH\_SYS MUST NOT be specified as RECOMMENDED or REQUIRED for any standards-track RPC service.

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

AUTH\_DH as mentioned in sections [8.2](#) and [13.4.2](#) is considered obsolete and insecure; see [[RFC2695](#)]. AUTH\_SYS SHOULD NOT be used for services which permit clients to modify data. AUTH\_DH MUST NOT be specified as RECOMMENDED or REQUIRED for any standards-track RPC service.

[RFC2203] defines a new security flavor, RPCSEC\_GSS, which permits GSS-API [[RFC2743](#)] mechanisms to be used for securing RPC. All non-trivial RPC programs developed in the future should implement RPCSEC\_GSS-based security appropriately. [[RFC2623](#)] describes how this was done for a widely deployed RPC program.

Standards-track RPC services MUST mandate support for RPCSEC\_GSS, and MUST mandate support for an authentication pseudo-flavor with appropriate levels of security, depending on the need for simple authentication, integrity a.k.a. non-repudiation, or data privacy.

## [15. Appendix A: System Authentication](#)

The client may wish to identify itself, for example, as it is identified on a UNIX(tm) system. The flavor of the client credential is "AUTH\_SYS". The opaque data constituting the credential encodes the following structure:

```
struct authsys_parms {
    unsigned int stamp;
    string machinename<255>;
    unsigned int uid;
    unsigned int gid;
    unsigned int gids<16>;
};
```

The "stamp" is an arbitrary ID which the caller machine may generate. The "machinename" is the name of the caller's machine (like "krypton"). The "uid" is the caller's effective user ID. The "gid" is the caller's effective group ID. The "gids" is a counted array of groups which contain the caller as a member. The verifier accompanying the credential should have "AUTH\_NONE" flavor value (defined above). Note this credential is only unique within a particular domain of machine names, uids, and gids.

The flavor value of the verifier received in the reply message from the server may be "AUTH\_NONE" or "AUTH\_SHORT". In the case of "AUTH\_SHORT", the bytes of the reply verifier's string encode an opaque structure. This new opaque structure may now be passed to the server instead of the original "AUTH\_SYS" flavor credential. The server may keep a cache which maps shorthand opaque structures

(passed back by way of an "AUTH\_SHORT" style reply verifier) to the original credentials of the caller. The caller can save network bandwidth and server cpu cycles by using the shorthand credential.

The server may flush the shorthand opaque structure at any time. If this happens, the remote procedure call message will be rejected due to an authentication error. The reason for the failure will be "AUTH\_REJECTEDCRED". At this point, the client may wish to try the original "AUTH\_SYS" style of credential.

It should be noted that use of this flavor of authentication does not guarantee any security for the users or providers of a service, in itself. The authentication provided by this scheme can be considered legitimate only when applications using this scheme and the network can be secured externally, and privileged transport addresses are used for the communicating end-points (an example of this is the use of privileged TCP/UDP ports in Unix systems - note that not all systems enforce privileged transport address mechanisms).

#### 16. Appendix B: Requesting RPC-related numbers from IANA

RPC program numbers, authentication flavor numbers and authentication status numbers which must be unique across all networks are assigned by the Internet Assigned Number Authority. To apply for a single number or a block of numbers, electronic mail must be sent to IANA <iana@iana.org> with the following information:

- o The type of number(s) (program number or authentication flavor number or authentication status number) sought
- o How many numbers are sought
- o The name of person or company which will use the number
- o An "identifier string" which associates the number with a

service

- o Email address of the contact person for the service which will be using the number.
- o A short description of the purpose and use of the number
- o If an authentication flavor number is sought, and the number will be a 'pseudo-flavor' intended for use with RPCSEC\_GSS and NFS, mappings analogous to those in [Section 4.2 of \[RFC2623\]](#) are required.

Specific numbers cannot be requested. Numbers are assigned on a

First Come First Served basis.

For all RPC authentication flavor and authentication status numbers to be used on the Internet, it is strongly advised that an informational or standards-track RFC be published describing the authentication mechanism behaviour and parameters.

#### [17. Appendix C](#): Current number assignments

|   |                          |  |
|---|--------------------------|--|
| # |                          |  |
| # | Sun-assigned RPC numbers |  |
| # |                          |  |
| # | Description/Owner        | RPC Program Number                      Short Name |
| # | -----                    | -----  |
|   | portmapper               | 100000      pmapprog portmap rpcbind               |
|   | remote stats             | 100001      rstatprog                              |
|   | remote users             | 100002      rusersprog                             |
|   | nfs                      | 100003      nfs                                    |
|   | yellow pages (NIS)       | 100004      ypprog ypserv                          |
|   | mount demon              | 100005      mountprog                              |
|   | remote dbx               | 100006      dbxprog                                |
|   | yp binder (NIS)          | 100007      ypbindprog ypbind                      |
|   | shutdown msg             | 100008      wall                                   |
|   | yppasswd server          | 100009      yppasswdprog yppasswdd                 |
|   | ether stats              | 100010      etherstatprog                          |
|   | disk quotas              | 100011      rquota                                 |
|   | spray packets            | 100012      spray                                  |
|   | 3270 mapper              | 100013      ibm3270prog                            |

|                         |        |                       |
|-------------------------|--------|-----------------------|
| RJE mapper              | 100014 | ibmrjeprog            |
| selection service       | 100015 | selnsvcprog           |
| remote database access  | 100016 | rdatabaseprog         |
| remote execution        | 100017 | rexec                 |
| Alice Office Automation | 100018 | aliceprog             |
| scheduling service      | 100019 | schedprog             |
| local lock manager      | 100020 | lockprog llockmgr     |
| network lock manager    | 100021 | netlockprog nlockmgr  |
| x.25 inr protocol       | 100022 | x25prog               |
| status monitor 1        | 100023 | statmon1              |
| status monitor 2        | 100024 | statmon2              |
| selection library       | 100025 | selnlibprog           |
| boot parameters service | 100026 | bootparam             |
| mazewars game           | 100027 | mazeprog              |
| yp update (NIS)         | 100028 | ypupdateprog ypupdate |
| key server              | 100029 | keyserveprog          |
| secure login            | 100030 | securecmdprog         |
| nfs net forwarder init  | 100031 | netfwdiprog           |
| nfs net forwarder trans | 100032 | netfwdtprog           |
| sunlink MAP             | 100033 | sunlinkmap            |

|                                   |        |                        |
|-----------------------------------|--------|------------------------|
| network monitor                   | 100034 | netmonprog             |
| lightweight database              | 100035 | dbaseprog              |
| password authorization            | 100036 | pwdauthprog            |
| translucent file svc              | 100037 | tfsprog                |
| nse server                        | 100038 | nseprog                |
| nse activate daemon               | 100039 | nse_activate_prog      |
| sunview help                      | 100040 | sunview_help_prog      |
| pnf install                       | 100041 | pnf_prog               |
| ip addr allocator                 | 100042 | ipaddr_alloc_prog      |
| show filehandle                   | 100043 | filehandle             |
| MVS NFS mount                     | 100044 | mvsnfsprog             |
| remote user file operations       | 100045 | rem_fileop_user_prog   |
| batched ypupdate                  | 100046 | batch_ypupdateprog     |
| network execution mgr             | 100047 | nem_prog               |
| raytrace/mandelbrot remote daemon | 100048 | raytrace_rd_prog       |
| raytrace/mandelbrot local daemon  | 100049 | raytrace_ld_prog       |
| remote group file operations      | 100050 | rem_fileop_group_prog  |
| remote system file operations     | 100051 | rem_fileop_system_prog |
| remote system role operations     | 100052 | rem_system_role_prog   |
| gpd lego fb simulator             | 100053 | [unknown]              |
| gpd simulator interface           | 100054 | [unknown]              |

|                                    |        |                    |
|------------------------------------|--------|--------------------|
| ioadmd                             | 100055 | ioadmd             |
| filemerge                          | 100056 | filemerge_prog     |
| Name Binding Program               | 100057 | namebind_prog      |
| sunlink NJE                        | 100058 | njeprog            |
| MVSNFS get attribute service       | 100059 | mvsattrprog        |
| SunAccess/SunLink resource manager | 100060 | rmgrprog           |
| UID allocation service             | 100061 | uidallocprog       |
| license broker                     | 100062 | lbserverprog       |
| NETlicense client binder           | 100063 | lbbinderprog       |
| GID allocation service             | 100064 | gidallocprog       |
| SunIsam                            | 100065 | sunisamprog        |
| Remote Debug Server                | 100066 | rdbsrvprog         |
| Network Directory Daemon           | 100067 | [unknown]          |
| Network Calendar Program           | 100068 | cmsd cm            |
| ypxfrd                             | 100069 | ypxfrd             |
| rpc.timed                          | 100070 | timedprog          |
| bugtraqd                           | 100071 | bugtraqd           |
|                                    | 100072 | [unknown]          |
| Connectathon Billboard - NFS       | 100073 | [unknown]          |
| Connectathon Billboard - X         | 100074 | [unknown]          |
| Sun tool for scheduling rooms      | 100075 | schedroom          |
| Authentication Negotiation         | 100076 | authnegotiate_prog |
| Database manipulation              | 100077 | attribute_prog     |
| Kerberos authentication daemon     | 100078 | kerbprog           |
| Internal testing product (no name) | 100079 | [unknown]          |
| Sun Consulting Special             | 100080 | autodump_prog      |
| Event protocol                     | 100081 | event_svc          |

|                                   |        |                       |
|-----------------------------------|--------|-----------------------|
| bugtraq_qd                        | 100082 | bugtraq_qd            |
| ToolTalk and Link Service Project | 100083 | database service      |
| Consulting Services               | 100084 | [unknown]             |
| Consulting Services               | 100085 | [unknown]             |
| Consulting Services               | 100086 | [unknown]             |
| Jupiter Administration            | 100087 | adm_agent admin       |
|                                   | 100088 | [unknown]             |
|                                   | 100089 | [unknown]             |
| Dual Disk support                 | 100090 | libdsd/dsd            |
| DocViewer 1.1                     | 100091 | [unknown]             |
| ToolTalk                          | 100092 | remote_activation_svc |
| Consulting Services               | 100093 | host_checking         |
| SNA peer-to-peer                  | 100094 | [unknown]             |
| Roger Riggs                       | 100095 | searchit              |

|                                     |        |                          |
|-------------------------------------|--------|--------------------------|
| Robert Allen                        | 100096 | mesgtool                 |
| SNA                                 | 100097 | [unknown]                |
| SISU                                | 100098 | networked version of CS5 |
| NFS Automount File System           | 100099 | autofs                   |
|                                     | 100100 | msgboard                 |
| event dispatching agent [eventd]    | 100101 | netmgt_eventd_prog       |
| statistics/event logger [netlogd]   | 100102 | netmgt_netlogd_prog      |
| topology display manager [topology] | 100103 | netmgt_topology_prog     |
| syncstat agent [syncstatd]          | 100104 | netmgt_syncstatd_prog    |
| ip packet stats agent [ippktd]      | 100105 | netmgt_ippktd_prog       |
| netmgt config agent [configd]       | 100106 | netmgt_configd_prog      |
| restat agent [restatd]              | 100107 | netmgt_restatd_prog      |
| lpq agent [lprstatd]                | 100108 | netmgt_lprstatd_prog     |
| netmgt activity agent [mgtlogd]     | 100109 | netmgt_mgtlogd_prog      |
| proxy DECnet NCP agent [proxydni]   | 100110 | netmgt_proxydni_prog     |
| topology mapper agent [mapperd]     | 100111 | netmgt_mapperd_prog      |
| netstat agent [netstatd]            | 100112 | netmgt_netstatd_prog     |
| sample netmgt agent [sampled]       | 100113 | netmgt_sampled_prog      |
| X.25 statistics agent [vcstatd]     | 100114 | netmgt_vcstatd_prog      |
| Frame Relay                         | 100128 | [unknown]                |
| PPP agent                           | 100129 | [unknown]                |
| localhad                            | 100130 | rpc.localhad             |
| layers2                             | 100131 | na.layers2               |
| token ring agent                    | 100132 | na.tr                    |
| related to lockd and statd          | 100133 | nsm_addr                 |
| Kerberos project                    | 100134 | kwarn                    |
| etherif2                            | 100135 | na.etherif2              |
| hostmem2                            | 100136 | na.hostmem2              |
| iostat2                             | 100137 | na.iostat2               |
| snmpv2                              | 100138 | na.snmpv2                |
| Cooperative Console                 | 100139 | cc_sender                |
| na.cpusat                           | 100140 | na.cpusat                |
| Sun Cluster SC3.0                   | 100141 | rgmd_receptionist        |
|                                     | 100142 | fed                      |

|                            |        |   |
|----------------------------|--------|---|
| Network Storage            | 100143 | rdc                                       |
| Sun Cluster products       | 100144 | nafo                                      |
| SunCluster 3.0             | 100145 | scadmd                                    |
| ASN.1                      | 100146 | amiserv                                   |
|                            | 100147 | amiaux # BER and DER<br>encode and decode |
| Delegate Management Server | 100148 | dm  |



|                                   |                 |                         |
|-----------------------------------|-----------------|-------------------------|
|                                   | 100149          | rkstat                  |
|                                   | 100150          | ocfserv                 |
|                                   | 100151          | sccheckd                |
|                                   | 100152          | autoclientd             |
|                                   | 100153          | sunvts                  |
|                                   | 100154          | ssmond                  |
|                                   | 100155          | smserverd               |
|                                   | 100156          | test1                   |
|                                   | 100157          | test2                   |
|                                   | 100158          | test3                   |
|                                   | 100159          | test4                   |
|                                   | 100160          | test5                   |
|                                   | 100161          | test6                   |
|                                   | 100162          | test7                   |
|                                   | 100163          | test8                   |
|                                   | 100164          | test9                   |
|                                   | 100165          | test10                  |
|                                   | 100166          | nfsmapid                |
|                                   | 100167          | SUN_WBEM_C_CIMON_HANDLE |
|                                   | 100168          | sacmmd                  |
|                                   | 100169          | fmd_adm                 |
|                                   | 100170          | fmd_api                 |
|                                   | 100171          | [unknown]               |
|                                   | 100172          | idmapd                  |
| <a href="#">[available]</a>       | 100173 - 100174 |                         |
| snmptrap                          | 100175          | na.snmptrap             |
| <a href="#">[available]</a>       | 100176-100199   |                         |
| <br>                              |                 |                         |
| <a href="#">[available]</a>       | 100200          |                         |
| MVS/NFS Memory usage stats server | 100201          | [unknown]               |
| Netapp                            | 100202-100207   |                         |
| <a href="#">[available]</a>       | 100208-100210   |                         |
| 8.0 SunLink SNA RJE               | 100211          | [unknown]               |
| 8.0 SunLink SNA RJE               | 100212          | [unknown]               |
|                                   | 100213          | ShowMe                  |
|                                   | 100214          | [unknown]               |
|                                   | 100215          | [unknown]               |
| AUTH_RSA Key service              | 100216          | keyrsa                  |
| SunSelect PC license service      | 100217          | [unknown]               |
| WWCS (Corporate)                  | 100218          | sunsolve                |
|                                   | 100219          | cstatd                  |

|                               |               |                             |
|-------------------------------|---------------|-----------------------------|
| X/Open Federated Naming       | 100220        | xfn_server_prog             |
| Kodak Color Management System | 100221        | kcs_network_io kcs          |
| HA-DBMS                       | 100222        | ha_dbms_serv                |
|                               | 100223-100225 | [unknown]                   |
|                               | 100226        | hafaultd                    |
| NFS ACL Service               | 100227        | nfs_acl                     |
| distributed lock manager      | 100228        | dlmd                        |
|                               | 100229        | metad                       |
|                               | 100230        | metamhd                     |
|                               | 100231        | nfsauth                     |
|                               | 100232        | sadmin                      |
|                               | 100233        | ufsd                        |
|                               | 100234        | grpserve                    |
|                               | 100235        | cachefs                     |
|                               | 100236        | msmprog Media_Server        |
|                               | 100237        | ihnmed                      |
|                               | 100238        | ihnnetd                     |
|                               | 100239        | ihsecured                   |
|                               | 100240        | ihclassmgrd                 |
|                               | 100241        | ihrepositoryd               |
|                               | 100242        | metamedd rpc.metamedd       |
|                               | 100243        | contentmanager cm           |
|                               | 100244        | symon                       |
|                               | 100245        | pld genesil                 |
|                               | 100246        | ctid                        |
|                               |               | cluster_transport_interface |
|                               | 100247        | ccd                         |
|                               |               | cluster_configuration_db    |
|                               | 100248        | pmfd                        |
|                               | 100249        | dmi2_client                 |
|                               | 100250        | mfs_admin                   |
|                               | 100251        | ndshared_unlink             |
|                               | 100252        | ndshared_touch              |
|                               | 100253        | ndshared_slink              |
|                               | 100254        | cbs control_board_server    |
|                               | 100255        | skiserv                     |
|                               | 100256        | nfsxa nfsxattr              |
|                               | 100257        | ndshared_disable            |
|                               | 100258        | ndshared_enable             |
|                               | 100259        | sms_account_admin           |
|                               | 100260        | sms_modem_admin             |
|                               | 100261        | sms_r_login                 |
|                               | 100262        | sms_r_subaccount_mgt        |
|                               | 100263        | sms_service_admin           |
|                               | 100264        | session_admin               |
|                               | 100265        | canci_ancs_program          |
|                               | 100266        | canci_sms_program           |
|                               | 100267        | msmp                        |

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

|                                  |                 |                   |
|----------------------------------|-----------------|-------------------|
|                                  | 100268          | halck             |
|                                  | 100269          | halogmsg          |
|                                  | 100270          | nfs_id_map        |
|                                  | 100271          | ncall             |
|                                  | 100272          | hmip              |
|                                  | 100273          | repl_mig          |
|                                  | 100274          | repl_mig_cb       |
| NIS+                             | 100300          | nisplus           |
| NIS+                             | 100301          | nis_cachemgr      |
| NIS+ call back protocol          | 100302          | [unknown]         |
| NIS+ Password Update Daemon      | 100303          | nispaswdd         |
| FNS context update in NIS        | 100304          | fnsypd            |
|                                  | 100305          | [unknown]         |
|                                  | 100306          | [unknown]         |
|                                  | 100307          | [unknown]         |
|                                  | 100308          | [unknown]         |
|                                  | 100309          | [unknown]         |
| <a href="#">[available]</a>      | 100310 - 100398 |                   |
| nfscksum                         | 100399          | nfscksum          |
| network utilization agent        | 100400          | netmgt_netu_prog  |
| network rpc ping agent           | 100401          | netmgt_rping_prog |
|                                  | 100402          | na.shell          |
| picsprint                        | 100403          | na.picslp         |
|                                  | 100404          | traps             |
|                                  | 100405 - 100409 | [unknown]         |
|                                  | 100410          | jdsagent          |
|                                  | 100411          | na.haconfig       |
|                                  | 100412          | na.halhost        |
|                                  | 100413          | na.hadtsrvc       |
|                                  | 100414          | na.hamdstat       |
|                                  | 100415          | na.neoadmin       |
|                                  | 100416          | ex1048prog        |
|                                  | 100417          | rdmaconfig        |
| IETF NFSv4 Working Group - FedFS | 100418 - 100421 |                   |
|                                  | 100422          | mdcommd           |
|                                  | 100423          | kiprop krb5_iprop |
|                                  | 100424          | stsf              |
| <a href="#">[available]</a>      | 100425 - 100499 |                   |
| Sun Microsystems                 | 100500 - 100531 | [unknown]         |
|                                  | 100532          | ucmmstate         |
|                                  | 100533          | srcmd             |
| <a href="#">[available]</a>      | 100534 - 100999 |                   |
| nse link daemon                  | 101002          | nselinktool       |

|                             |                 |            |
|-----------------------------|-----------------|------------|
| nse link application        | 101003          | nselinkapp |
| <a href="#">[available]</a> | 101004 - 101900 |            |
|                             | 101901          | [unknown]  |
| <a href="#">[available]</a> | 101902 - 101999 |            |
| AssetLite                   | 102000          | [unknown]  |

Thurlow

[draft-ietf-nfsv4-rfc1831bis-13.txt](#)

[Page 31]

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

|                                  |                 |                       |
|----------------------------------|-----------------|-----------------------|
| PagerTool                        | 102001          | [unknown]             |
| Discover                         | 102002          | [unknown]             |
| <a href="#">[available]</a>      | 102003 - 105000 |                       |
| ShowMe                           | 105001          | sharedapp             |
| Registry                         | 105002          | REGISTRY_PROG         |
| Print-server                     | 105003          | print-server          |
| Proto-server                     | 105004          | proto-server          |
| Notification-server              | 105005          | notification-server   |
| Transfer-agent-server            | 105006          | transfer-agent-server |
| <a href="#">[available]</a>      | 105007 - 110000 |                       |
|                                  | 110001          | tsolrpcb              |
|                                  | 110002          | tsolpeerinfo          |
|                                  | 110003          | tsolboot              |
|                                  | 120001          | cmip na.cmip          |
|                                  | 120002          | na.osidiscover        |
|                                  | 120003          | cmiptrap              |
| <a href="#">[available]</a>      | 120004 - 120099 |                       |
|                                  | 120100          | eserver               |
|                                  | 120101          | repserver             |
|                                  | 120102          | swserver              |
|                                  | 120103          | dmd                   |
|                                  | 120104          | ca                    |
| <a href="#">[available]</a>      | 120105 - 120125 |                       |
|                                  | 120126          | nf_fddi               |
|                                  | 120127          | nf_fddismt7_2         |
| <a href="#">[available]</a>      | 120128 - 150000 |                       |
| pc passwd authorization          | 150001          | pcnfsdprog            |
| TOPS name mapping                | 150002          | [unknown]             |
| TOPS external attribute storage  | 150003          | [unknown]             |
| TOPS hierarchical file system    | 150004          | [unknown]             |
| TOPS NFS transparency extensions | 150005          | [unknown]             |
| PC NFS License                   | 150006          | pcnfslicense          |
| RDA                              | 150007          | rdaprogram            |
| WabiServer                       | 150008          | wsprog                |
| WabiServer                       | 150009          | wsrlprog              |
| <a href="#">[available]</a>      | 150010 - 160000 |                       |

[[available](#)]

|                 |              |
|-----------------|--------------|
| 160001          | nihon-cm     |
| 160002          | nihon-ce     |
| 160003 - 170099 |              |
| 170100          | domf_daemon0 |
| 170101          | domf_daemon1 |
| 170102          | domf_daemon2 |
| 170103          | domf_daemon3 |
| 170104          | domf_daemon4 |
| 170105          | domf_daemon5 |
| 170106 - 179999 |              |
| 180000          | cecprog      |
| 180001          | cecsysprog   |

[[available](#)]

|        |                      |
|--------|----------------------|
| 180002 | cec2cecprog          |
| 180003 | cesprog              |
| 180004 | ces2cesprog          |
| 180005 | cet2cetprog          |
| 180006 | cet2cetdoneprog      |
| 180007 | cetcomprog           |
| 180008 | cetsysprog           |
| 180009 | cghapresenceprog     |
| 180010 | cgdmsyncprog         |
| 180011 | cgdmcnscliprog       |
| 180012 | cgdmcrscscliprog     |
| 180013 | cgdmcrcssvcproG      |
| 180014 | chmprog              |
| 180015 | chmsysprog           |
| 180016 | crcsapiproG          |
| 180017 | ckptmprog            |
| 180018 | crimcomponentprog    |
| 180019 | crimqueryprog        |
| 180020 | crimsecondaryprog    |
| 180021 | crimservicesprog     |
| 180022 | crimsyscomponentprog |
| 180023 | crimsysservicesprog  |
| 180024 | csmagtapiprog        |
| 180025 | csmagtcallbackprog   |
| 180026 | csmreplicaproG       |
| 180027 | csmsrvprog           |
| 180028 | cssccltprog          |
| 180029 | csscsvrprog          |
| 180030 | csscopresultprog     |

[[available](#)]

180031 - 199999  
200000 pyramid\_nfs  
200001 pyramid\_reserved  
200002 cadds\_image  
200003 stellar\_name\_prog  
200004 [unknown]  
200005 [unknown]  
200006 pacl  
200007 lookupids  
200008 ax\_statd\_prog  
200009 ax\_statd2\_prog  
200010 edm  
200011 dtedirwd  
200012 [unknown]  
200013 [unknown]  
200014 [unknown]  
200015 [unknown]  
200016 easerpcd  
200017 rlxnfs

Thurlow

[draft-ietf-nfsv4-rfc1831bis-13.txt](#)

[Page 33]

---

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

[[available](#)]

200018 sascuidprog  
200019 knfsd  
200020 ftnfsd ftnfsd\_program  
200021 ftsyncd ftsyncd\_program  
200022 ftstatd ftstatd\_program  
200023 exportmap  
200024 nfs\_metadata  
200025 - 200200  
200201 ecoad  
200202 eamon  
200203 ecolic  
200204 cs\_printstatus\_svr  
200205 ecodisc  
200206 - 300000  
300001 adt\_rflockprog  
300002 columbine1  
300003 system33\_prog  
300004 frame\_prog1  
300005 uimxprog  
300006 rvd  
300007 entombing daemon  
300008 account mgmt system

[[available](#)]

|        |                        |
|--------|------------------------|
| 300009 | frame_prog2            |
| 300010 | beeper access          |
| 300011 | dptuprog               |
| 300012 | mx-bcp                 |
| 300013 | instrument-file-access |
| 300014 | file-system-statistics |
| 300015 | unify-database-server  |
| 300016 | tmd_msg                |
| 300017 | [unknown]              |
| 300018 | [unknown]              |
| 300019 | automounter access     |
| 300020 | lock server            |
| 300021 | [unknown]              |
| 300022 | office-automation-1    |
| 300023 | office-automation-2    |
| 300024 | office-automation-3    |
| 300025 | office-automation-4    |
| 300026 | office-automation-5    |
| 300027 | office-automation-6    |
| 300028 | office-automation-7    |
| 300029 | local-data-manager     |
| 300030 | chide                  |
| 300031 | csi_program            |
| 300032 | [unknown]              |
| 300033 | online-help            |
| 300034 | case-tool              |

|        |                          |
|--------|--------------------------|
| 300035 | delta                    |
| 300036 | rgi                      |
| 300037 | instrument-config-server |
| 300038 | [unknown]                |
| 300039 | [unknown]                |
| 300040 | dtia-rpc-server          |
| 300041 | cms                      |
| 300042 | viewer                   |
| 300043 | aqm                      |
| 300044 | exclaim                  |
| 300045 | masterplan               |
| 300046 | fig_tool                 |
| 300047 | [unknown]                |
| 300048 | [unknown]                |
| 300049 | [unknown]                |

|        |                     |
|--------|---------------------|
| 300050 | remote-lock-manager |
| 300051 | [unknown]           |
| 300052 | gdebug              |
| 300053 | ldebug              |
| 300054 | rscanner            |
| 300055 | [unknown]           |
| 300056 | [unknown]           |
| 300057 | [unknown]           |
| 300058 | [unknown]           |
| 300059 | [unknown]           |
| 300060 | [unknown]           |
| 300061 | [unknown]           |
| 300062 | [unknown]           |
| 300063 | [unknown]           |
| 300064 | [unknown]           |
| 300065 | [unknown]           |
| 300066 | nSERVER             |
| 300067 | [unknown]           |
| 300068 | [unknown]           |
| 300069 | [unknown]           |
| 300070 | [unknown]           |
| 300071 | BioStation          |
| 300072 | [unknown]           |
| 300073 | NetProb             |
| 300074 | Logging             |
| 300075 | Logging             |
| 300076 | [unknown]           |
| 300077 | [unknown]           |
| 300078 | [unknown]           |
| 300079 | [unknown]           |
| 300080 | [unknown]           |
| 300081 | [unknown]           |
| 300082 | sw_twin             |

|        |                  |
|--------|------------------|
| 300083 | remote_get_login |
| 300084 | odcprog          |
| 300085 | [unknown]        |
| 300086 | [unknown]        |
| 300087 | [unknown]        |
| 300088 | [unknown]        |
| 300089 | [unknown]        |
| 300090 | [unknown]        |



|        |                       |
|--------|-----------------------|
| 300091 | smartdoc              |
| 300092 | superping             |
| 300093 | distributed-chembench |
| 300094 | uacman/alfil-uacman   |
| 300095 | ait_rcagent_prog      |
| 300096 | ait_rcagent_appl_prog |
| 300097 | smart                 |
| 300098 | ecoprogram            |
| 300099 | leonardo              |
| 300100 | [unknown]             |
| 300101 | [unknown]             |
| 300102 | [unknown]             |
| 300103 | [unknown]             |
| 300104 | [unknown]             |
| 300105 | [unknown]             |
| 300106 | [unknown]             |
| 300107 | [unknown]             |
| 300108 | wingz                 |
| 300109 | teidan                |
| 300110 | [unknown]             |
| 300111 | [unknown]             |
| 300112 | [unknown]             |
| 300113 | [unknown]             |
| 300114 | [unknown]             |
| 300115 | [unknown]             |
| 300116 | cadc_fhlockprog       |
| 300117 | highscan              |
| 300118 | [unknown]             |
| 300119 | [unknown]             |
| 300120 | [unknown]             |
| 300121 | opennavigator         |
| 300122 | aarpcxfer             |
| 300123 | [unknown]             |
| 300124 | [unknown]             |
| 300125 | [unknown]             |
| 300126 | groggs                |
| 300127 | licsrv                |
| 300128 | issdemon              |
| 300129 | [unknown]             |
| 300130 | maximize              |

|        |            |
|--------|------------|
| 300131 | cgm_server |
|--------|------------|

|        |                       |
|--------|-----------------------|
| 300132 | [unknown]             |
| 300133 | agent_rpc             |
| 300134 | docmaker              |
| 300135 | docmaker              |
| 300136 | [unknown]             |
| 300137 | [unknown]             |
| 300138 | [unknown]             |
| 300139 | iesx                  |
| 300140 | [unknown]             |
| 300141 | [unknown]             |
| 300142 | [unknown]             |
| 300143 | [unknown]             |
| 300144 | smart-mbs             |
| 300145 | [unknown]             |
| 300146 | [unknown]             |
| 300147 | docimage              |
| 300148 | [unknown]             |
| 300149 | dmc-interface         |
| 300150 | [unknown]             |
| 300151 | jss                   |
| 300152 | [unknown]             |
| 300153 | arimage               |
| 300154 | xdb-workbench         |
| 300155 | frontdesk             |
| 300156 | dmc                   |
| 300157 | expressight-6000      |
| 300158 | graph service program |
| 300159 | [unknown]             |
| 300160 | [unknown]             |
| 300161 | [unknown]             |
| 300162 | [unknown]             |
| 300163 | [unknown]             |
| 300164 | [unknown]             |
| 300165 | [unknown]             |
| 300166 | [unknown]             |
| 300167 | [unknown]             |
| 300168 | [unknown]             |
| 300169 | [unknown]             |
| 300170 | [unknown]             |
| 300171 | [unknown]             |
| 300172 | [unknown]             |
| 300173 | [unknown]             |
| 300174 | [unknown]             |
| 300175 | [unknown]             |
| 300176 | rlpr                  |
| 300177 | nx_hostdprog          |
| 300178 | netuser-x             |

---

|        |                        |
|--------|------------------------|
| 300179 | rmntprog               |
| 300180 | [unknown]              |
| 300181 | mipe                   |
| 300182 | [unknown]              |
| 300183 | collectorprog          |
| 300184 | uslookup_PROG          |
| 300185 | viewstation            |
| 300186 | iate                   |
| 300187 | [unknown]              |
| 300188 | [unknown]              |
| 300189 | [unknown]              |
| 300190 | imsvtprog              |
| 300191 | [unknown]              |
| 300192 | [unknown]              |
| 300193 | [unknown]              |
| 300194 | pmdb                   |
| 300195 | pmda                   |
| 300196 | [unknown]              |
| 300197 | [unknown]              |
| 300198 | trend_idbd             |
| 300199 | rres                   |
| 300200 | sd.masterd             |
| 300201 | sd.executiond          |
| 300202 | sd.listend             |
| 300203 | sd.reserve1            |
| 300204 | sd.reserve2            |
| 300205 | msbd                   |
| 300206 | stagedprog             |
| 300207 | mountprog              |
| 300208 | watchdprog             |
| 300209 | pms                    |
| 300210 | [unknown]              |
| 300211 | session_server_program |
| 300212 | session_program        |
| 300213 | debug_serverprog       |
| 300214 | [unknown]              |
| 300215 | [unknown]              |
| 300216 | paceprog               |
| 300217 | [unknown]              |
| 300218 | mbus                   |
| 300219 | aframes2ps             |
| 300220 | npартprog              |
| 300221 | cm1server              |
| 300222 | cm1bridge              |
| 300223 | sailfrogfaxprog        |
| 300224 | sailfrogphoneprog      |

|        |                       |
|--------|-----------------------|
| 300225 | sailfrogvmailprog     |
| 300226 | wserviceprog arcstorm |

|        |                   |
|--------|-------------------|
| 300227 | hld               |
| 300228 | alive             |
| 300229 | radsp             |
| 300230 | radavx            |
| 300231 | radview           |
| 300232 | rsys_prog         |
| 300233 | rsys_prog         |
| 300234 | fm_rpc_prog       |
| 300235 | aries             |
| 300236 | uapman            |
| 300237 | ddman             |
| 300238 | top               |
| 300239 | [unknown]         |
| 300240 | trendlink         |
| 300241 | licenseprog       |
| 300242 | statuslicenseprog |
| 300243 | oema_rmpf_svc     |
| 300244 | oema_smpf_svc     |
| 300245 | oema_rmsg_svc     |
| 300246 | grapes-sd         |
| 300247 | ds_master         |
| 300248 | ds_transfer       |
| 300249 | ds_logger         |
| 300250 | ds_query          |
| 300251 | [unknown]         |
| 300252 | [unknown]         |
| 300253 | nsd_prog          |
| 300254 | browser           |
| 300255 | epoch             |
| 300256 | floorplanner      |
| 300257 | reach             |
| 300258 | tactic            |
| 300259 | cachescientific1  |
| 300260 | cachescientific2  |
| 300261 | desksrc_prog      |
| 300262 | photo3d1          |
| 300263 | photo3d2          |
| 300264 | [unknown]         |
| 300265 | soundmgr          |

|        |                                    |
|--------|------------------------------------|
| 300266 | s6k                                |
| 300267 | aims_referenced_<br>text_processor |
| 300268 | xess                               |
| 300269 | ds_queue                           |
| 300270 | [unknown]                          |
| 300271 | orionscanplus                      |
| 300272 | openlink-xx                        |
| 300273 | kbmsprog                           |

|        |                       |
|--------|-----------------------|
| 300274 | [unknown]             |
| 300275 | futuresource          |
| 300276 | the_xprt              |
| 300277 | cmg_srvprog           |
| 300278 | [unknown]             |
| 300279 | [unknown]             |
| 300280 | front                 |
| 300281 | [unknown]             |
| 300282 | [unknown]             |
| 300283 | [unknown]             |
| 300284 | conmanprog            |
| 300285 | jincv2                |
| 300286 | isls                  |
| 300287 | systemstatprog        |
| 300288 | fxpsprog              |
| 300289 | callpath              |
| 300290 | axess                 |
| 300291 | armor_rpcd            |
| 300292 | armor_dictionary_rpcd |
| 300293 | armor_miscd           |
| 300294 | filetransfer_prog     |
| 300295 | bl_swda               |
| 300296 | bl_hwda               |
| 300297 | [unknown]             |
| 300298 | [unknown]             |
| 300299 | [unknown]             |
| 300300 | filemon               |
| 300301 | acunetprog            |
| 300302 | rbuild                |
| 300303 | assistprog            |
| 300304 | tog                   |
| 300305 | [unknown]             |

|        |                      |
|--------|----------------------|
| 300306 | sns7000              |
| 300307 | igprog               |
| 300308 | tgprog               |
| 300309 | plc                  |
| 300310 | pxman pxlsprog       |
| 300311 | hde_server hdeserver |
| 300312 | tsslicenseprog       |
| 300313 | rpc.explorerd        |
| 300314 | chrd                 |
| 300315 | tbisam               |
| 300316 | tbis                 |
| 300317 | adsprog              |
| 300318 | sponsorprog          |
| 300319 | querycmprog          |
| 300320 | [unknown]            |
| 300321 | [unknown]            |

|        |                        |
|--------|------------------------|
| 300322 | mobill                 |
| 300323 | sld                    |
|        | service_locator_daemon |
| 300324 | linkprog               |
| 300325 | codexdaemonprog        |
| 300326 | drprog                 |
| 300327 | ressys_commands        |
| 300328 | stamp                  |
| 300329 | matlab                 |
| 300330 | sched1d                |
| 300331 | upcprog                |
| 300332 | xferbkch               |
| 300333 | xfer                   |
| 300334 | qbthd                  |
| 300335 | qbabort                |
| 300336 | lsd                    |
| 300337 | geomgrd                |
| 300338 | generic_fts            |
| 300339 | ft_ack                 |
| 300340 | lymb                   |
| 300341 | vantage                |
| 300342 | cltstd clooptstdprog   |
| 300343 | clui clui_prog         |
| 300344 | testerd tstdprog       |
| 300345 | extsim                 |

|        |                          |
|--------|--------------------------|
| 300346 | cmd_dispatch maxm_ems    |
| 300347 | callpath_receive_program |
| 300348 | x3270prog                |
| 300349 | sbc_lag                  |
| 300350 | sbc_frsta                |
| 300351 | sbc_frs                  |
| 300352 | atommgr                  |
| 300353 | geostrat                 |
| 300354 | dbvialu6.2               |
| 300355 | [unknown]                |
| 300356 | fxncprog                 |
| 300357 | infopolic                |
| 300358 | [unknown]                |
| 300359 | aagns                    |
| 300360 | aagms                    |
| 300361 | [unknown]                |
| 300362 | clariion_mgr             |
| 300363 | setcimrpc                |
| 300364 | virtual_protocol_adapter |
| 300365 | unibart                  |
| 300366 | uniarch                  |
| 300367 | unifile                  |
| 300368 | unisrex                  |

|        |                       |
|--------|-----------------------|
| 300369 | uniscmd               |
| 300370 | rsc                   |
| 300371 | set                   |
| 300372 | desaf-ws/key          |
| 300373 | reelddb               |
| 300374 | nl                    |
| 300375 | rmd                   |
| 300376 | agcd                  |
| 300377 | rsynd                 |
| 300378 | rcnlib                |
| 300379 | rcnlib_attach         |
| 300380 | evergreen_mgmt_agent  |
| 300381 | fx104prog             |
| 300382 | rui                   |
|        | remote_user_interface |
| 300383 | ovomd                 |
| 300384 | [unknown]             |
| 300385 | [unknown]             |

|               |                               |
|---------------|-------------------------------|
| 300386        | system_server                 |
| 300387        | pipecs cs_pipeprog<br>ppktrpc |
| 300388        | uv-net univision              |
| 300389        | auexe                         |
| 300390        | audip                         |
| 300391        | mqi                           |
| 300392        | eva                           |
| 300393        | eeei_reserved_1               |
| 300394        | eeei_reserved_2               |
| 300395        | eeei_reserved_3               |
| 300396        | eeei_reserved_4               |
| 300397        | eeei_reserved_5               |
| 300398        | eeei_reserved_6               |
| 300399        | eeei_reserved_7               |
| 300400        | eeei_reserved_8               |
| 300401        | cpnlm                         |
| 300402        | wg_idms_manager               |
| 300403        | timequota                     |
| 300404        | spiff                         |
| 300405-300414 | ov_oem_svc                    |
| 300415        | ov_msg_ctlg_svc               |
| 300416        | ov_advt_reg_svc               |
| 300417-300424 | showkron                      |
| 300425        | daatd                         |
| 300426        | swiftnet                      |
| 300427        | ovomdel                       |
| 300428        | ovomreq                       |
| 300429        | msg_dispatcher                |
| 300430        | pcshare server                |

|        |              |
|--------|--------------|
| 300431 | rcvs         |
| 300432 | fdfserver    |
| 300433 | bssd         |
| 300434 | drdd         |
| 300435 | mif_gutsprog |
| 300436 | mif_guiprog  |
| 300437 | twolfd       |
| 300438 | twscd        |
| 300439 | nwsbumv      |
| 300440 | dgux_mgr     |
| 300441 | pfxd         |



|               |                       |
|---------------|-----------------------|
| 300442        | tds                   |
| 300443        | ovomadmind            |
| 300444        | ovomgate              |
| 300445        | omadmind              |
| 300446        | nps                   |
| 300447        | npd                   |
| 300448        | tsa                   |
| 300449        | cdaimc                |
| 300450-300452 |                       |
| 300453        | ckt_implementation    |
| 300454        | mda-tactical          |
| 300455-300458 |                       |
| 300459        | attrun                |
| 300460        | RoadRunner            |
| 300461        | nas                   |
| 300462        | undelede              |
| 300463        | ovacadd               |
| 300464        | tbdesmai              |
| 300465        | arguslm               |
| 300466        | dmd                   |
| 300467        | drd                   |
| 300468        | fm_help               |
| 300469        | ftransrpc_prog        |
| 300470        | finrisk               |
| 300471        | dg_pc_idisched        |
| 300472        | dg_pc_idiserv         |
| 300473        | apd                   |
| 300474        | ap_sspd               |
| 300475        | callpatheventrecorder |
| 300476        | flc                   |
| 300477        | dg_osm                |
| 300478        | dspnamed              |
| 300479        | iqddsrv               |
| 300480        | iqjobsrv              |
| 300481        | tacosxx               |
| 300482        | wheeldbmg             |
| 300483        | cnxmgr_nm_prog        |

|        |                 |
|--------|-----------------|
| 300484 | cnxmgr_cfg_prog |
| 300485 | 3dsmapper       |
| 300486 | ids             |
| 300487 | imagine_rpc_svc |

|        |                         |
|--------|-------------------------|
| 300488 | lfn                     |
| 300489 | salesnet                |
| 300490 | defaxo                  |
| 300491 | dbqtsd                  |
| 300492 | kms                     |
| 300493 | rpc.iced                |
| 300494 | calc2s                  |
| 300495 | ptoidprog               |
| 300496 | docsls                  |
| 300497 | new                     |
| 300498 | collagebdg              |
| 300499 | ars_server              |
| 300500 | ars_client              |
| 300501 | vr_catalog              |
| 300502 | vr_tdb                  |
| 300503 | ama                     |
| 300504 | evama                   |
| 300505 | conama                  |
| 300506 | service_process         |
| 300507 | reuse_proxy             |
| 300508 | mars_ctrl               |
| 300509 | mars_db                 |
| 300510 | mars_com                |
| 300511 | mars_admch              |
| 300512 | tbpipcip                |
| 300513 | top_acs_svc             |
| 300514 | inout_svc               |
| 300515 | csoft_wp                |
| 300516 | mcfs                    |
| 300517 | eventprog               |
| 300518 | dg_pc_idimsg            |
| 300519 | dg_pc_idiaux            |
| 300520 | atsr_gc                 |
| 300521 | alarm alarm_prog        |
| 300522 | fts_prog                |
| 300523 | dcs_prog                |
| 300524 | ihb_prog                |
| 300525 | [unknown]               |
| 300526 | [unknown]               |
| 300527 | clu_info_prog           |
| 300528 | rmfm                    |
| 300529 | c2sdocd                 |
| 300530 | interahelp              |
| 300531 | callpathasynmsgshandler |

|        |                          |
|--------|--------------------------|
| 300532 | optix_arc                |
| 300533 | optix_ts                 |
| 300534 | optix_wf                 |
| 300535 | maxopenc                 |
| 300536 | cev cev_server           |
| 300537 | sitewideprog             |
| 300538 | drs                      |
| 300539 | drsdm                    |
| 300540 | dasgate                  |
| 300541 | dcdbd                    |
| 300542 | dcpsd                    |
| 300543 | supportlink_prog         |
| 300544 | broker                   |
| 300545 | listner                  |
| 300546 | multiaccess              |
| 300547 | spai_interface           |
| 300548 | spai_adaption            |
| 300549 | chimera_ci               |
|        | chimera_clientinterface  |
| 300550 | chimera_pi               |
|        | chimera_processinvoker   |
| 300551 | teamware_fl              |
|        | teamware_foundationlevel |
| 300552 | teamware_sl              |
|        | teamware_systemlevel     |
| 300553 | teamware_ui              |
|        | teamware_userinterface   |
| 300554 | lprm                     |
| 300555 | mpsprog                  |
|        | Mensuration_Proxy_Server |
| 300556 | mo_symdis                |
| 300557 | retsideprog              |
| 300558 | slp                      |
| 300559 | slm-api                  |
| 300560 | im_rpc teamconference    |
| 300561 | license_prog license     |
| 300562 | stuple stuple_prog       |
| 300563 | upasswd_prog             |
| 300564 | gentranmentorsecurity    |
| 300565 | gentranmentorprovider    |
| 300566 | latitued                 |
|        | latitude_license_server  |
| 300567 | gentranmentorreq1        |
| 300568 | gentranmentorreq2        |
| 300569 | gentranmentorreq3        |
| 300570 | rj_server                |
| 300571 | gws-rdb                  |

|        |                              |
|--------|------------------------------|
| 300573 | gws-spm                      |
| 300574 | vwcalcd                      |
| 300575 | vworad                       |
| 300576 | vwsybd                       |
| 300577 | vwave                        |
| 300578 | online_assistant             |
| 300579 | internet_assistant           |
| 300580 | spawnd                       |
| 300581 | procmgrg                     |
| 300582 | cfgdbd                       |
| 300583 | logutild                     |
| 300584 | ibis                         |
| 300585 | ibisau                       |
| 300586 | aapi                         |
| 300587 | rstrt                        |
| 300588 | hbeat                        |
| 300589 | pcspu                        |
| 300590 | empress                      |
| 300591 | sched_server                 |
|        | LiveScheduler                |
| 300592 | path_server                  |
|        | LiveScheduler                |
| 300593 | c2sdmd                       |
| 300594 | c2scf                        |
| 300595 | btsas                        |
| 300596 | sdtas                        |
| 300597 | appie                        |
| 300598 | dmi                          |
| 300599 | p                            |
|        | panther software corp daemon |
| 300600 | sisd                         |
| 300601 | cpwebserver                  |
| 300602 | wwcommo                      |
| 300603 | mx-mie                       |
| 300604 | mx-mie-debug                 |
| 300605 | idmn                         |
| 300606 | ssrv                         |
| 300607 | vpnserv                      |
| 300608 | samserv                      |
| 300609 | sams_server                  |

|        |              |
|--------|--------------|
| 300610 | chrysalis    |
| 300611 | ddm          |
| 300612 | ddm-is       |
| 300613 | mx-bcp-debug |
| 300614 | upmrd        |
| 300615 | upmdsd       |
| 300616 | res          |
| 300617 | colortron    |

|        |                      |
|--------|----------------------|
| 300618 | zrs                  |
| 300619 | afpsrv               |
| 300620 | apxft                |
| 300621 | nrp                  |
| 300622 | hpid                 |
| 300623 | mailwatch            |
| 300624 | fos bc_fcrb_receiver |
| 300625 | cs_sysadmin_svr      |
| 300626 | cs_controller_svr    |
| 300627 | nokia_nms_eai        |
| 300628 | dbg                  |
| 300629 | remex                |
| 300630 | cs_bind              |
| 300631 | idm                  |
| 300632 | prpasswd             |
| 300633 | iw-pw                |
| 300634 | starrb               |
| 300635 | Impress_Server       |
| 300636 | colorstar            |
| 300637 | gwugui               |
| 300638 | gwsgui               |
| 300639 | dai_command_proxy    |
| 300640 | dai_alarm_server     |
| 300641 | dai_fui_proxy        |
| 300642 | spai_command_proxy   |
| 300643 | spai_alarm_server    |
| 300644 | iris                 |
| 300645 | hcxttp               |
| 300646 | updatedb rsched      |
| 300647 | urnd urn             |
| 300648 | iqwpsrv              |
| 300649 | dskutild             |
| 300650 | online               |

|        |                  |
|--------|------------------|
| 300651 | nlserv           |
| 300652 | acsm             |
| 300653 | dg_clar_sormsg   |
| 300654 | wwpollerrpc      |
| 300655 | wwmodelrpc       |
| 300656 | nsprofd          |
| 300657 | nsdistd          |
| 300658 | recollect        |
| 300659 | lssexecd lss_res |
| 300660 | lssagend lss_rea |
| 300661 | cdinfo           |
| 300662 | sninsr_addon     |
| 300663 | mm-sap           |
| 300664 | ks               |
| 300665 | psched           |

|        |                     |
|--------|---------------------|
| 300666 | tekdvfs             |
| 300667 | storxll             |
| 300668 | nisse               |
| 300669 | lbadvise            |
| 300670 | atcinstaller        |
| 300671 | atntstarter         |
| 300672 | NetML               |
| 300673 | tdmesmge            |
| 300674 | tdmesmgd            |
| 300675 | tdmesmgt            |
| 300676 | olm                 |
| 300677 | mediamanagement     |
| 300678 | rdbprog fieldowsrv  |
| 300679 | rpwdprog rpwd       |
| 300680 | sapi-trace          |
| 300681 | sapi-master-daemon  |
| 300682 | omdcuprog om-dcu    |
| 300683 | wwprocmon           |
| 300684 | tndidprog           |
| 300685 | rkey_setsecretprog  |
| 300686 | asdu_server_prog    |
| 300687 | pwrctrl             |
| 300688 | siunixd             |
| 300689 | wmapi               |
| 300690 | cross_reference_ole |
| 300691 | rtc                 |

|        |                        |
|--------|------------------------|
| 300692 | disp                   |
| 300693 | sql_compilation_agent  |
| 300694 | tnsysprog              |
| 300695 | ius-sapimd             |
| 300696 | apteam-dx              |
| 300697 | rmsrpc                 |
| 300698 | seismic_system         |
| 300699 | remote                 |
| 300700 | ttl_ts_event nokia_nms |
| 300701 | fxrs                   |
| 300702 | onlicense              |
| 300703 | vxkey                  |
| 300704 | dinis                  |
| 300705 | sched2d schedule-2     |
| 300706 | sched3d schedule-3     |
| 300707 | sched4d schedule-4     |
| 300708 | sched5d schedule-5     |
| 300709 | sched6d schedule-6     |
| 300710 | sched7d schedule-7     |
| 300711 | sched8d schedule-8     |
| 300712 | sched9d schedule-9     |
| 300713 | adtsqry                |

|        |            |
|--------|------------|
| 300714 | adserv     |
| 300715 | adrep serv |
| 300716 | [unknown]  |
| 300717 | caad       |
| 300718 | caau i     |
| 300719 | cescda     |
| 300720 | vcapiadmin |
| 300721 | vcapi20    |
| 300722 | tcfs       |
| 300723 | csed       |
| 300724 | nothand    |
| 300725 | hacb       |
| 300726 | nfauth     |
| 300727 | imlm       |
| 300728 | bestcomm   |
| 300729 | lprpasswd  |
| 300730 | rprpasswd  |
| 300731 | proplstd   |
| 300732 | mikomomc   |

|        |                     |
|--------|---------------------|
| 300733 | arepa-cas           |
| 300734 | [unknown]           |
| 300735 | [unknown]           |
| 300736 | ando_ts             |
| 300737 | intermezzo          |
| 300738 | ftel-sdh-request    |
| 300739 | ftel-sdh-response   |
| 300740 | [unknown]           |
| 300741 | [unknown]           |
| 300742 | [unknown]           |
| 300743 | [unknown]           |
| 300744 | [unknown]           |
| 300745 | vrc_abb             |
| 300746 | vrc_comau           |
| 300747 | vrc_fanuc           |
| 300748 | vrc_kuka            |
| 300749 | vrc_reis            |
| 300750 | hp_sv6d             |
| 300751 | correntmgr01        |
| 300752 | correntike          |
| 300753 | [unknown]           |
| 300754 | [unknown]           |
| 300755 | intransa_location   |
| 300756 | intransa_management |
| 300757 | intransa_federation |
| 300758 | portprot            |
| 300759 | ipmiprot            |
| 300760 | aceapi              |
| 300761 | f6000pss            |

|        |                |
|--------|----------------|
| 300762 | vsmapi_program |
| 300763 | ubertuple      |
| 300764 | ctconcrpcif    |
| 300765 | mfuadmin       |
| 300766 | aiols          |
| 300767 | dsmrootd       |
| 300768 | htdl           |
| 300769 | caba           |
| 300770 | vrc_cosimir    |
| 300771 | cmhelmd        |
| 300772 | polynsm        |
| 300773 | [unknown]      |



|                             |                 |                  |
|-----------------------------|-----------------|------------------|
|                             | 300774          | [unknown]        |
|                             | 300775          | [unknown]        |
|                             | 300776          | [unknown]        |
|                             | 300777          | [unknown]        |
|                             | 300778          | [unknown]        |
|                             | 300779          | [unknown]        |
|                             | 300780          | [unknown]        |
|                             | 300781          | dsmrecall        |
|                             | 300782          | [unknown]        |
|                             | 300783          | [unknown]        |
|                             | 300784          | twrgcontrol      |
|                             | 300785          | twrled           |
|                             | 300786          | twrcfgdb         |
| BMC software                | 300787-300886   |                  |
| <a href="#">[available]</a> | 300887 - 300999 |                  |
| Sun Microsystems            | 301000-302000   | [ 2000 numbers ] |
| <a href="#">[available]</a> | 302001-349999   |                  |
| American Airlines           | 350000 - 350999 |                  |
| Acucobol Inc.               | 351000 - 351099 |                  |
| The Bristol Group           | 351100 - 351249 |                  |
| Amteva Technologies         | 351250 - 351349 |                  |
|                             | 351350          | wfmMgmtApp       |
|                             | 351351          | wfmMgmtDataSrv   |
|                             | 351352          | wfmMgmtFut1      |
|                             | 351353          | wfmMgmtFut1      |
|                             | 351354          | wfmAPM           |
|                             | 351355          | wfmIAMgr         |
|                             | 351356          | wfmECMgr         |
|                             | 351357          | wfmLookOut       |
|                             | 351358          | wfmAgentFut1     |
|                             | 351359          | wfmAgentFut2     |
| <a href="#">[available]</a> | 351360 - 351406 |                  |
| Sterling Software ITD       | 351407          | csed             |
|                             | 351360          | sched10d         |
|                             | 351361          | sched11d         |
|                             | 351362          | sched12d         |

|        |          |
|--------|----------|
| 351363 | sched13d |
| 351364 | sched14d |
| 351365 | sched15d |
| 351366 | sched16d |
| 351367 | sched17d |

|        |                |
|--------|----------------|
| 351368 | sched18d       |
| 351369 | sched19d       |
| 351370 | sched20d       |
| 351371 | sched21d       |
| 351372 | sched22d       |
| 351373 | sched23d       |
| 351374 | sched24d       |
| 351375 | sched25d       |
| 351376 | sched26d       |
| 351377 | sched27d       |
| 351378 | sched28d       |
| 351379 | sched29d       |
| 351380 | sched30d       |
| 351381 | sched31d       |
| 351382 | sched32d       |
| 351383 | sched33d       |
| 351384 | sched34d       |
| 351385 | sched35d       |
| 351386 | sched36d       |
| 351387 | sched37d       |
| 351388 | sched38d       |
| 351389 | sched39d       |
| 351390 | consoleserver  |
| 351391 | scheduleserver |
| 351392 | RDELIVER       |
| 351393 | REVENTPROG     |
| 351394 | RSENDEVENTPROG |
| 351395 | snapp          |
| 351396 | snapad         |
| 351397 | sdsoodb        |
| 351398 | sdsmain        |
| 351399 | sdssrv         |
| 351400 | sdscInt        |
| 351401 | sdsreg         |
| 351402 | fsbatch        |
| 351403 | fsmonitor      |
| 351404 | fsdisp         |
| 351405 | fsession       |
| 351406 | fslog          |
| 351407 | svdpappserv    |
| 351408 | gns            |
| 351409 | [unkonwn]      |
| 351410 | [unkonwn]      |

|        |                 |
|--------|-----------------|
| 351411 | [unkonwn]       |
| 351412 | axi             |
| 351413 | rpcxfr          |
| 351414 | slm             |
| 351415 | smbpasswdd      |
| 351416 | tbdbserv        |
| 351417 | tbprojserv      |
| 351418 | genericserver   |
| 351419 | dynarc_ds       |
| 351420 | dnscmdr         |
| 351421 | ipcmdr          |
| 351422 | faild           |
| 351423 | failmon         |
| 351424 | faildebug       |
| 351425 | [unknown]       |
| 351426 | [unknown]       |
| 351427 | siemens_srs     |
| 351428 | bsproxy         |
| 351429 | ifsrpc          |
| 351430 | CesPvcSm        |
| 351431 | FrPvcSm         |
| 351432 | AtmPvcSm        |
| 351433 | radius          |
| 351434 | auditor         |
| 351435 | sft             |
| 351436 | voicemail       |
| 351437 | kis             |
| 351438 | SOFTSERV_NOTIFY |
| 351439 | dynarpc         |
| 351440 | hc              |
| 351441 | iopas           |
| 351442 | iopcs           |
| 351443 | iopss           |
| 351444 | spcnfs          |
| 351445 | spcvss          |
| 351446 | matilda_sms     |
| 351447 | matilda_brs     |
| 351448 | matilda_dbs     |
| 351449 | matilda_sps     |
| 351450 | matilda_svs     |
| 351451 | matilda_sds     |
| 351452 | matilda_vvs     |
| 351453 | matilda_stats   |
| 351454 | xtrade          |
| 351455 | mapsvr          |
| 351456 | hp_graphicsd    |
| 351457 | berkeley_db     |
|        | berkeley_db_svc |

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

|                             |                 |                     |
|-----------------------------|-----------------|---------------------|
|                             | 351458          | io_server           |
|                             | 351459          | rpc.niod            |
|                             | 351460          | rpc.kill            |
|                             | 351461          | hmdisproxy          |
|                             | 351462          | smdisproxy          |
|                             | 351463          | avatard             |
|                             | 351464          | namu                |
|                             | 351465          | BMCsess             |
|                             | 351466          | FENS_Sport          |
|                             | 351467          | EM_CONFIG           |
|                             | 351468          | EM_CONFIG_RESP      |
|                             | 351469          | lodge_proof         |
|                             | 351470          | ARCserveIT-Queue    |
|                             | 351471          | ARCserveIT-Device   |
|                             | 351472          | ARCserveIT-Discover |
|                             | 351473          | ARCserveIT-Alert    |
|                             | 351474          | ARCserveIT-Database |
|                             | 351475          | scand1              |
|                             | 351476          | scand2              |
|                             | 351477          | scand3              |
|                             | 351478          | scand4              |
|                             | 351479          | scand5              |
|                             | 351480          | dscv                |
|                             | 351481          | cb_svc              |
|                             | 351482          | [unknown]           |
|                             | 351483          | iprobe              |
|                             | 351484          | omniconf            |
|                             | 351485          | isan                |
| BG Partners                 | 351486 - 351500 |                     |
|                             | 351501          | mond                |
|                             | 351502          | iqlremote           |
|                             | 351503          | iqlalarm            |
| <a href="#">[available]</a> | 351504 - 351599 |                     |
| Orion Multisystems          | 351600-351855   |                     |
| <a href="#">[available]</a> | 351856 - 351899 |                     |
| NSP lab                     | 351900 - 351999 |                     |
| <a href="#">[available]</a> | 351999 - 352232 |                     |
|                             | 352233          | asautostart         |
|                             | 352234          | asmediad1           |
|                             | 352235          | asmediad2           |
|                             | 352236          | asmediad3           |
|                             | 352237          | asmediad4           |

|        |            |
|--------|------------|
| 352238 | asmediad5  |
| 352239 | asmediad6  |
| 352240 | asmediad7  |
| 352241 | asmediad8  |
| 352242 | asmediad9  |
| 352243 | asmediad10 |

|        |            |
|--------|------------|
| 352244 | asmediad11 |
| 352245 | asmediad12 |
| 352246 | asmediad13 |
| 352247 | asmediad14 |
| 352248 | asmediad15 |
| 352249 | asmediad16 |
| 352250 | waruser    |
| 352251 | warlogd    |
| 352252 | warsvrmgr  |
| 352253 | warvfsysd  |
| 352254 | warftpd    |
| 352255 | warnfsd    |
| 352256 | bofproxyc0 |
| 352257 | bofproxys0 |
| 352258 | bofproxyc1 |
| 352259 | bofproxys1 |
| 352260 | bofproxyc2 |
| 352261 | bofproxys2 |
| 352262 | bofproxyc3 |
| 352263 | bofproxys3 |
| 352264 | bofproxyc4 |
| 352265 | bofproxys4 |
| 352266 | bofproxyc5 |
| 352267 | bofproxys5 |
| 352268 | bofproxyc6 |
| 352269 | bofproxys6 |
| 352270 | bofproxyc7 |
| 352271 | bofproxys7 |
| 352272 | bofproxyc8 |
| 352273 | bofproxys8 |
| 352274 | bofproxyc9 |
| 352275 | bofproxys9 |
| 352276 | bofproxycb |
| 352277 | bofproxysa |
| 352278 | bofproxycb |

|        |             |
|--------|-------------|
| 352279 | bofproxysb  |
| 352280 | bofproxycc  |
| 352281 | bofproxysc  |
| 352282 | bofproxycd  |
| 352283 | bofproxysd  |
| 352284 | bofproxyce  |
| 352285 | bofproxyse  |
| 352286 | bofproxycf  |
| 352287 | bofproxysf  |
| 352288 | bofproxypo0 |
| 352289 | bofproxypo1 |
| 352290 | bofproxypo2 |
| 352291 | bofproxypo3 |

[[available](#)]

|               |             |
|---------------|-------------|
| 352292        | bofproxypo4 |
| 352293-370000 |             |
| 370001        | [unknown]   |
| 370002        | [unknown]   |
| 370003        | [unknown]   |
| 370004        | [unknown]   |
| 370005        | [unknown]   |
| 370006        | [unknown]   |
| 370007        | [unknown]   |
| 370008        | [unknown]   |
| 370009        | [unknown]   |
| 370010        | [unknown]   |
| 370011        | [unknown]   |
| 370012        | [unknown]   |
| 370013        | [unknown]   |
| 370014        | [unknown]   |
| 370015        | [unknown]   |
| 370016        | [unknown]   |
| 370017        | [unknown]   |
| 370018        | [unknown]   |
| 370019        | [unknown]   |
| 370020        | [unknown]   |
| 370021        | [unknown]   |
| 370022        | [unknown]   |
| 370023        | [unknown]   |
| 370024        | [unknown]   |
| 370025        | [unknown]   |
| 370026        | [unknown]   |

[[available](#)]

|                 |                       |
|-----------------|-----------------------|
| 370027          | [unknown]             |
| 370028 - 379999 |                       |
| 380000          | opensna               |
| 380001          | probenet              |
| 380002          | [unknown]             |
| 380003          | license               |
| 380004          | na.3com-remote        |
| 380005          | na.ntp                |
| 380006          | probeutil             |
| 380007          | na.vlb                |
| 380008          | cds_mhs_agent         |
| 380009          | cds_x500_agent        |
| 380010          | cds_mailhub_agent     |
| 380011          | codex_6500_proxy      |
| 380012          | codex_6500_trapd      |
| 380013          | na.nm212              |
| 380014          | cds_mta_metrics_agent |
| 380015          | [unknown]             |
| 380016          | na.cable              |
| 380017          | codexcabletrap        |

Thurlow

[draft-ietf-nfsv4-rfc1831bis-13.txt](#)

[Page 55]

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

Swiss Re

|               |                             |
|---------------|-----------------------------|
| 380018-380028 |                             |
| 380029        | ncstat                      |
| 380030        | ncnfsstat                   |
| 380031        | ftams                       |
| 380032        | na.isotp                    |
| 380033        | na. <a href="#">rfc1006</a> |

[[available](#)]

Epoch Systems

Quickturn Systems

Team One Systems

General Electric CRD

TSIG NFS subcommittee

SoftLab ab

Legato Network Services

|                 |            |
|-----------------|------------|
| 380034 - 389999 |            |
| 390000 - 390049 |            |
| 390050 - 390065 |            |
| 390066 - 390075 |            |
| 390076 - 390085 |            |
| 390086 - 390089 |            |
| 390090 - 390099 |            |
| 390100 - 390115 |            |
| 390116          | cdsmonitor |
| 390117          | cdslock    |
| 390118          | cdslicense |
| 390119          | shm        |
| 390120          | rws        |
| 390121          | cdc        |
| 390122 - 390141 |            |

Data General

|                         |                 |
|-------------------------|-----------------|
| Perfect Byte            | 390142 - 390171 |
| JTS Computer Systems    | 390172 - 390181 |
| Parametric Technology   | 390182 - 390191 |
| Voxem                   | 390192 - 390199 |
| Effix Systems           | 390200 - 390299 |
| Motorola                | 390300 - 390309 |
| Mobile Data Intl.       | 390310 - 390325 |
| Physikalisches Institut | 390326 - 390330 |
| Ergon Informatik AG     | 390331 - 390340 |
| Analog Devices Inc.     | 390341 - 390348 |
| Interphase Corporation  | 390349 - 390358 |
| NeWsware                | 390359 - 390374 |
| Qualix Group            | 390375 - 390379 |
| Xerox Imaging Systems   | 390380 - 390389 |
| Noble Net               | 390390 - 390399 |
| Legato Network Services | 390400 - 390499 |
| Client Server Tech.     | 390500 - 390511 |
| Atria                   | 390512 - 390517 |
| GE NMR Instruments      | 390518 - 390525 |
| Harris Corp.            | 390526 - 390530 |
| Unisys                  | 390531 - 390562 |
| Aggregate Computing     | 390563 - 390572 |
| Interactive Data        | 390573 - 390580 |
| OKG AB                  | 390581 - 390589 |
| K2 Software             | 390591 - 390594 |
| Collier Jackson         | 390595 - 390599 |
| Remedy Corporation      | 390600 - 390699 |

|                         |                 |
|-------------------------|-----------------|
| Mentor Graphics         | 390700 - 390799 |
| AT&T Bell Labs (Lucent) | 390800 - 390899 |
| Xerox                   | 390900 - 390999 |
| Silicon Graphics        | 391000 - 391063 |
| Data General            | 391064 - 391095 |
| Computer Support Corp.  | 391096 - 391099 |
| Quorum Software Systems | 391100 - 391199 |
| InterLinear Technology  | 391200 - 391209 |
| Highland Software       | 391210 - 391229 |
| Boeing Comp. Svcs.      | 391230 - 391249 |
| IBM Sweden              | 391250 - 391259 |
| Signature Authority Svc | 391260 - 391271 |
| ZUMTOBEL Licht GmbH     | 391272 - 391283 |
| NOAA/ERL                | 391284 - 391299 |



|                          |                          |
|--------------------------|--------------------------|
| NCR Corp.                | 391300 - 391399          |
| FTP Software             | 391400 - 391409          |
| Cadre Technologies       | 391410 - 391433          |
| Visionware Ltd (UK)      | 391434 - 391439          |
| IBR-Partner AG           | 391440 - 391449          |
| CAP Programator AB       | 391450 - 391459          |
| Reichle+De-Massari AG    | 391460 - 391474          |
| Swiss Bank Corp (London) | 391475 - 391484          |
| Unisys Enterprise Svr    | 391485 - 391489          |
| Intel - Test Dev. Tech.  | 391490 - 391499          |
| Ampex                    | 391500 - 391755          |
|                          | 391756 naas-spare        |
|                          | 391757 naas-admin        |
|                          | 391758 isps              |
|                          | 391759 isps-admin        |
|                          | 391760 mars              |
|                          | 391761 mars-admin        |
|                          | 391762 attcis_spare0     |
|                          | 391763 attcis_spare1     |
|                          | 391764 mail-server       |
|                          | 391765 mail-server-spare |
|                          | 391766 attcis_spare2     |
|                          | 391767 attcis_spare3     |
|                          | 391768 attcis_spare4     |
|                          | 391769 attcis_spare5     |
|                          | 391770 attcis_spare6     |
|                          | 391771 attcis_spare7     |
| Integrated Systems, Inc. | 391772 - 391779          |
| Parametric Tech., Inc.   | 391780 - 391789          |
| Ericsson Telecom AB      | 391790 - 391799          |
| SLAC                     | 391800 - 391849          |
|                          | 391850 qhrdata           |
|                          | 391851 qhrbackup         |
|                          | 391852 minutedata        |

|        |             |
|--------|-------------|
| 391853 | prefecture  |
| 391854 | supc        |
| 391855 | suadminrw   |
| 391856 | suadminotas |
| 391857 | sumessage   |
| 391858 | sublock     |
| 391859 | sumotd      |

|                        |                           |
|------------------------|---------------------------|
| staffware dev. (uk)    | 391860 - 391869           |
| Staffware Dev. (UK)    | 391870 - 391879           |
|                        | 391880 namesrvr           |
|                        | 391881 disksrvr           |
|                        | 391882 tapesrvr           |
|                        | 391883 migsrvr            |
|                        | 391884 pdmsrvr            |
|                        | 391885 pvrsrvr            |
|                        | 391886 repacksrvr         |
|                        | 391887 [unknown]          |
| Convex Computer Corp.  | 391888 - 391951           |
|                        | 391952 lookoutsrv         |
|                        | 391953 lookoutagnt        |
|                        | 391954 lookoutprxy        |
|                        | 391955 lookoutsntp        |
|                        | 391956 lookoutrmon        |
|                        | 391957 lookoutfut1        |
|                        | 391958 lookoutfut2        |
| windward               | 391959 - 391967           |
|                        | 391968 sra_legato         |
|                        | 391969 sra_legato_imgsrvr |
|                        | 391970 sra_legato_0       |
|                        | 391971 sra_legato_1       |
|                        | 391972 sra_legato_2       |
|                        | 391973 sra_legato_3       |
|                        | 391974 sra_legato_4       |
|                        | 391975 sra_legato_5       |
|                        | 391976 sra_legato_6       |
|                        | 391977 sra_legato_7       |
|                        | 391978 sra_legato_8       |
|                        | 391979 sra_legato_9       |
| Brooktree Corp.        | 391980 - 391989           |
| Cadence Design Systems | 391990 - 391999           |
| J. Frank & Associates  | 392000 - 392999           |
| Cooperative Solutions  | 393000 - 393999           |
| Xerox Corp.            | 394000 - 395023           |
|                        | 395024 odbc_sqlretriever  |
| 3M                     | 395025 - 395091           |
| Digital Zone Intl.     | 395092 - 395099           |
| Software Professionals | 395100 - 395159           |
| Del Mar Solutions      | 395160 - 395164           |

|                             |                 |               |
|-----------------------------|-----------------|---------------|
|                             | 395165          | ife-es        |
|                             | 395166          | ife-resmgr    |
|                             | 395167          | ife-aes       |
|                             | 395168          | ife-bite      |
|                             | 395169          | ife-loader    |
|                             | 395170          | ife-satcom    |
|                             | 395171          | ife-seat      |
|                             | 395172          | ife-dbmgr     |
|                             | 395173          | ife-testmgr   |
|                             | 395174          | atrium_server |
|                             | 395175          | ase_director  |
|                             | 395176          | ase_agent     |
|                             | 395177          | ase_hsm       |
|                             | 395178          | ase_mgr       |
|                             | 395179          | ase_sim       |
| Hewlett-Packard             | 395180 - 395194 |               |
| XES, Inc.                   | 395195 - 395199 |               |
| Unitech Products            | 395200 - 395249 |               |
| TransSys                    | 395250 - 395505 |               |
| Unisys Govt Systems         | 395506 - 395519 |               |
| Bellcore                    | 395520 - 395529 |               |
| IBM                         | 395530 - 395561 |               |
| AT&T Network Services       | 395562 - 395571 |               |
| Data General                | 395572 - 395577 |               |
| Swiss Bank Corp             | 395578 - 395597 |               |
| Swiss Bank Corp             | 395598 - 395637 |               |
| Novell                      | 395638 - 395643 |               |
| Computer Associates         | 395644 - 395650 |               |
| Omneon Video Networks       | 395651 - 395656 |               |
| <a href="#">[available]</a> | 395657 - 395908 |               |
| UK Post Office              | 395909 - 395924 |               |
| AEROSPATIALE                | 395925 - 395944 |               |
| Result d.o.o.               | 395945 - 395964 |               |
| DataTools, Inc.             | 395965 - 395980 |               |
| CADIS, Inc.                 | 395981 - 395990 |               |
| Cummings Group, Inc.        | 395991 - 395994 |               |
| Cadre Technologies          | 395995 - 395999 |               |
| American Airlines           | 396000 - 396999 |               |
| Ericsson Telecom TM Div     | 397000 - 398023 |               |
| IBM                         | 398024 - 398028 |               |
| Toshiba OME Works           | 398029 - 398033 |               |
| TUSC Computer Systems       | 398034 - 398289 |               |
| AT&T                        | 398290 - 398320 |               |
| Ontario Hydro               | 398321 - 398346 |               |
| Micrion Corporation         | 398347 - 398364 |               |
| <a href="#">[available]</a> | 398365 - 398591 |               |
| Pegasystems, Inc.           | 398592 - 399616 |               |
| Spectra Securities Soft     | 399617 - 399850 |               |

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

```
QualCom                                399851 - 399866
[available]                            399867 - 399884
Altris Software Ltd.                  399885 - 399899
ISO/IEC WG11                          399900 - 399919
Parametric Technology                 399920 - 399949
Dolby Laboratories                    399950 - 399981
[available]                            399982 - 399991
Xerox PARC                           399992 - 399999
#
Next Inc.                             200100000 - 200199999
Netwise (RPCtool)                     200200000
Concurrent Computer Corp              200200001 - 200200007
AIM Technology                        200300000 - 200399999
TGV                                   200400000 - 200499999
#
# Sun-assigned authentication flavor numbers
#
AUTH_NONE          0          /* no authentication, see RFC 1831 */
                        /* a.k.a. AUTH_NULL */
AUTH_SYS           1          /* unix style (uid+gids), RFC 1831 */
                        /* a.k.a. AUTH_UNIX */
AUTH_SHORT         2          /* short hand unix style, RFC 1831 */
AUTH_DH            3          /* des style (encrypted timestamp) */
                        /* a.k.a. AUTH_DES, see RFC 2695 */
AUTH_KERB          4          /* kerberos auth, see RFC 2695 */
AUTH_RSA           5          /* RSA authentication */
RPCSEC_GSS         6          /* GSS-based RPC security for auth,
                                integrity and privacy, RPC 5403 */

AUTH_NW            30001      NETWARE
AUTH_SEC           200000     TSIG NFS subcommittee
AUTH_ESV           200004     SVr4 ES

AUTH_NQNFS         300000     Univ. of Guelph - Not Quite NFS
AUTH_GSSAPI        300001     OpenVision <john.linn@ov.com>
AUTH_ILU_UGEN      300002     Xerox <janssen@parc.xerox.com>
                                - ILU Unsecured Generic Identity
#
# Small blocks are assigned out of the 39xxxx series of numbers
#
AUTH_SPNEGO        390000
                    390000 - 390255 NFS 'pseudo' flavors for RPCSEC_GSS
                    390003 - kerberos_v5 authentication, RFC 2623
```

390004 - kerberos\_v5 with data integrity, [RFC 2623](#)  
390005 - kerberos\_v5 with data privacy, [RFC 2623](#)  
  
200000000 reserved  
200100000 NeXT Inc.

## [18.](#) Normative References

[RFC4506]

Eisler, M., "XDR: External Data Representation Standard", [RFC 4506](#), May 2006

[RFC2203]

Eisler, M., Chiu, A., Ling, L., "RPCSEC\_GSS Protocol Specification", [RFC 2203](#), September 1997

## [19.](#) Informative References

[XRPC]

Birrell, A. D. & Nelson, B. J., "Implementing Remote Procedure Calls", XEROX CSL-83-7, October 1983.

[VMTP]

Cheriton, D., "VMTP: Versatile Message Transaction Protocol", Preliminary Version 0.3, Stanford University, January 1987.

[DH]

Diffie & Hellman, "New Directions in Cryptography", IEEE Transactions on Information Theory IT-22, November 1976.

[RFC768]

Postel, J., "User Datagram Protocol", STD 6, [RFC 768](#), USC/Information Sciences Institute, August 1980.

[RFC793]

Postel, J., "Transmission Control Protocol - DARPA Internet Program Protocol Specification", STD 7, [RFC 793](#), USC/Information Sciences Institute, September 1981.

[RFC1094]

Sun Microsystems, Inc., "NFS: Network File System Protocol Specification", [RFC 1094](#), March 1989.

[RFC1813]

ThurLOW

[draft-ietf-nfsv4-rfc1813bis-13.txt](#)

[Page 61]

---

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

Callaghan, B., Pawlowski, B., Staubach, P., "NFS Version 3 Protocol Specification", [RFC 1813](#), June 1995.

[RFC1831]

R. Srinivasan, "RPC: Remote Procedure Call Protocol Specification Version 2", [RFC 1831](#), August 1995.

[RFC1833]

R. Srinivasan, "Binding Protocols for ONC RPC Version 2", [RFC 1833](#), August 1995.

[RFC2119]

Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [RFC 2119](#), March 1997

[RFC2623]

Eisler, M., "NFS Version 2 and Version 3 Security Issues and the NFS Protocol's Use of RPCSEC\_GSS and Kerberos V5", [RFC 2623](#), June 1999.

[RFC2695]

Chiu, A., "Authentication Mechanisms for ONC RPC", [RFC 2695](#), September 1999.

[RFC2743]

Linn. J., "Generic Security Service Application Program Interface Version 2, Update 1", [RFC 2743](#), January 2000.

[RFC3530]

Shepler, S., Callaghan, B., Robinson, D., Thurlow, R., Beame, C., Eisler, M., Noveck, D., "Network File System (NFS) version 4 Protocol", [RFC 3530](#), April 2003.

[RFC5226]

Narten, T. and Alvestrand, H., "Guidelines for Writing an IANA Considerations Section in RFCs", [RFC 5226](#), May 2008.

Thurlow

[draft-ietf-nfsv4-rfc1831bis-13.txt](#)

[Page 62]

---

Internet Draft Remote Procedure Call Protocol Version 2

March 2009

## [20.](#) Author's Address

Address comments related to this memorandum to:

[nfsv4@ietf.org](mailto:nfsv4@ietf.org)

Robert Thurlow  
Sun Microsystems, Inc.  
500 Eldorado Boulevard, UBRM05-171  
Broomfield, CO 80021

Phone: 877-718-3419  
E-mail: [robert.thurlow@sun.com](mailto:robert.thurlow@sun.com)

