

NFSv4
Internet-Draft
Intended status: Standards Track
Expires: January 13, 2011

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July 12, 2010

NFS Version 4 Protocol External Data Representation Standard (XDR)
Description
draft-ietf-nfsv4-rfc3530bis-dot-x-03.txt

Abstract

The Network File System (NFS) version 4 is a distributed filesystem protocol which owes heritage to NFS protocol version 2, RFC 1094, and version 3, RFC 1813. Unlike earlier versions, the NFS version 4 protocol supports traditional file access while integrating support for file locking and the mount protocol. In addition, support for strong security (and its negotiation), compound operations, client caching, and internationalization have been added. Of course, attention has been applied to making NFS version 4 operate well in an Internet environment.

This document, together with RFC 3530bis replaces RFC 3530 as the definition of the NFS version 4 protocol.

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 RFC 2119 [1].

Status of this Memo

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Table of Contents

1. XDR Description of NFSv4.0	3
2. Security Considerations	36
3. IANA Considerations	36
4. Normative References	36
Authors' Addresses	36

1. XDR Description of NFSv4.0

This document contains the XDR ([2]) description of NFSv4.0 protocol ([3]).

The XDR description is provided in this document in a way that makes it simple for the reader to extract into ready to compile form. The reader can feed this document in the following shell script to produce the machine readable XDR description of NFSv4.0:

```
#!/bin/sh
grep "^ *///" | sed 's?^ */// ??' | sed 's?^ *///$??'
```

I.e. if the above script is stored in a file called "extract.sh", and this document is in a file called "spec.txt", then the reader can do:

```
sh extract.sh < spec.txt > nfs4_prot.x
```

The effect of the script is to remove leading white space from each line, plus a sentinel sequence of "///".

The XDR description, with the sentinel sequence follows:

```
/// /*
/// * This file was machine generated for
/// * draft-ietf-nfsv4-rfc3530bis-
/// * Last updated Mon Jul 12 18:34:38 CDT 2010
/// */
/// /*
/// * Copyright (C) The IETF Trust (2009-2010)
/// * All Rights Reserved.
/// *
/// * Copyright (C) The Internet Society (1998-2010).
/// * All Rights Reserved.
/// */
///
/// /*
/// *      nfs4_prot.x
/// *
/// */
///
/// /*
/// * Basic typedefs for RFC 1832 data type definitions
/// */
/// /*
/// * typedef int          int32_t;
/// * typedef unsigned int uint32_t;
```

```

/// * typedef hyper                int64_t;
/// * typedef unsigned hyper       uint64_t;
/// */
///
/// /*
/// * Sizes
/// */
/// const NFS4_FHSIZE                = 128;
/// const NFS4_VERIFIER_SIZE        = 8;
/// const NFS4_OPAQUE_LIMIT         = 1024;
///
///
/// /*
/// * File types
/// */
/// enum nfs_ftype4 {
///     NFS4REG = 1,                /* Regular File */
///     NFS4DIR = 2,                /* Directory */
///     NFS4BLK = 3,                /* Special File - block device */
///     NFS4CHR = 4,                /* Special File - character device */
///     NFS4LNK = 5,                /* Symbolic Link */
///     NFS4SOCK = 6,               /* Special File - socket */
///     NFS4FIFO = 7,               /* Special File - fifo */
///     NFS4ATTRDIR
///         = 8,                    /* Attribute Directory */
///     NFS4NAMEDATTR
///         = 9,                    /* Named Attribute */
/// };
///
/// /*
/// * Error status
/// */
/// enum nfsstat4 {
///     NFS4_OK                       = 0,    /* everything is okay */
///     NFS4ERR_PERM                   = 1,    /* caller not privileged */
///     NFS4ERR_NOENT                   = 2,    /* no such file/directory */
///     NFS4ERR_IO                      = 5,    /* hard I/O error */
///     NFS4ERR_NXIO                    = 6,    /* no such device */
///     NFS4ERR_ACCESS                  = 13,   /* access denied */
///     NFS4ERR_EXIST                   = 17,   /* file already exists */
///     NFS4ERR_XDEV                    = 18,   /* different filesystems */
///     /* Unused/reserved */          = 19,   /* */
///     NFS4ERR_NOTDIR                  = 20,   /* should be a directory */
///     NFS4ERR_ISDIR                   = 21,   /* should not be directory */
///     NFS4ERR_INVALID                 = 22,   /* invalid argument */
///     NFS4ERR_FBIG                    = 27,   /* file exceeds server max */
///     NFS4ERR_NOOPC                   = 28,   /* no space on filesystem */

```

```

/// NFS4ERR_ROFS = 30, /* read-only filesystem */
/// NFS4ERR_MLINK = 31, /* too many hard links */
/// NFS4ERR_NAME_TOO_LONG = 63, /* name exceeds server max */
/// NFS4ERR_NOTEMPTY = 66, /* directory not empty */
/// NFS4ERR_DQUOT = 69, /* hard quota limit reached*/
/// NFS4ERR_STALE = 70, /* file no longer exists */
/// NFS4ERR_BADHANDLE = 10001, /* Illegal filehandle */
/// NFS4ERR_BAD_COOKIE = 10003, /* REaddir cookie is stale */
/// NFS4ERR_NOTSUPP = 10004, /* operation not supported */
/// NFS4ERR_TOOSMALL = 10005, /* response limit exceeded */
/// NFS4ERR_SERVERFAULT = 10006, /* undefined server error */
/// NFS4ERR_BADTYPE = 10007, /* type invalid for CREATE */
/// NFS4ERR_DELAY = 10008, /* file "busy" - retry */
/// NFS4ERR_SAME = 10009, /* nverify says attrs same */
/// NFS4ERR_DENIED = 10010, /* lock unavailable */
/// NFS4ERR_EXPIRED = 10011, /* lock lease expired */
/// NFS4ERR_LOCKED = 10012, /* I/O failed due to lock */
/// NFS4ERR_GRACE = 10013, /* in grace period */
/// NFS4ERR_FHEXPIRED = 10014, /* filehandle expired */
/// NFS4ERR_SHARE_DENIED = 10015, /* share reserve denied */
/// NFS4ERR_WRONGSEC = 10016, /* wrong security flavor */
/// NFS4ERR_CLID_INUSE = 10017, /* clientid in use */
/// NFS4ERR_RESOURCE = 10018, /* resource exhaustion */
/// NFS4ERR_MOVED = 10019, /* filesystem relocated */
/// NFS4ERR_NOFILEHANDLE = 10020, /* current FH is not set */
/// NFS4ERR_MINOR_VERS_MISMATCH = 10021, /* minor vers not supp */
/// NFS4ERR_STALE_CLIENTID = 10022, /* server has rebooted */
/// NFS4ERR_STALE_STATEID = 10023, /* server has rebooted */
/// NFS4ERR_OLD_STATEID = 10024, /* state is out of sync */
/// NFS4ERR_BAD_STATEID = 10025, /* incorrect stateid */
/// NFS4ERR_BAD_SEQID = 10026, /* request is out of seq. */
/// NFS4ERR_NOT_SAME = 10027, /* verify - attrs not same */
/// NFS4ERR_LOCK_RANGE = 10028, /* lock range not supported*/
/// NFS4ERR_SYMLINK = 10029, /* should be file/directory*/
/// NFS4ERR_RESTOREFH = 10030, /* no saved filehandle */
/// NFS4ERR_LEASE_MOVED = 10031, /* some filesystem moved */
/// NFS4ERR_ATTRNOTSUPP = 10032, /* recommended attr not sup*/
/// NFS4ERR_NO_GRACE = 10033, /* reclaim outside of grace*/
/// NFS4ERR_RECLAIM_BAD = 10034, /* reclaim error at server */
/// NFS4ERR_RECLAIM_CONFLICT = 10035, /* conflict on reclaim */
/// NFS4ERR_BADXDR = 10036, /* XDR decode failed */
/// NFS4ERR_LOCKS_HELD = 10037, /* file locks held at CLOSE*/
/// NFS4ERR_OPENMODE = 10038, /* conflict in OPEN and I/O*/
/// NFS4ERR_BADOWNER = 10039, /* owner translation bad */
/// NFS4ERR_BADCHAR = 10040, /* utf-8 char not supported*/
/// NFS4ERR_BADNAME = 10041, /* name not supported */
/// NFS4ERR_BAD_RANGE = 10042, /* lock range not supported*/
/// NFS4ERR_LOCK_NOTSUPP = 10043, /* no atomic up/downgrade */

```

```

/// NFS4ERR_OP_ILLEGAL      = 10044,/* undefined operation      */
/// NFS4ERR_DEADLOCK       = 10045,/* file locking deadlock   */
/// NFS4ERR_FILE_OPEN      = 10046,/* open file blocks op.    */
/// NFS4ERR_ADMIN_REVOKED  = 10047,/* lockowner state revoked */
/// NFS4ERR_CB_PATH_DOWN   = 10048 /* callback path down      */
/// };
///
/// /*
///  * Basic data types
///  */
/// typedef opaque          attrlist4<>;
/// typedef uint32_t       bitmap4<>;
/// typedef uint64_t       changeid4;
/// typedef uint64_t       clientid4;
/// typedef uint32_t       count4;
/// typedef uint64_t       length4;
/// typedef uint32_t       mode4;
/// typedef uint64_t       nfs_cookie4;
/// typedef opaque         nfs_fh4<NFS4_FHSIZE>;
/// typedef uint64_t       offset4;
/// typedef uint32_t       qop4;
/// typedef opaque         sec_oid4<>;
/// typedef uint32_t       seqid4;
/// typedef opaque         utf8string<>;
/// typedef utf8string     utf8_should;
/// typedef utf8string     utf8val_should;
/// typedef utf8string     utf8val_must;
/// typedef utf8string     ascii_must;
/// typedef utf8_should    comptag4;
/// typedef utf8val_should component4;
/// typedef utf8val_should linktext4;
/// typedef component4    pathname4<>;
/// typedef uint64_t       nfs_lockid4;
/// typedef opaque         verifier4[NFS4_VERIFIER_SIZE];
///
///
/// /*
///  * Timeval
///  */
/// struct nfstime4 {
///     int64_t          seconds;
///     uint32_t         nseconds;
/// };
///
/// enum time_how4 {
///     SET_TO_SERVER_TIME4 = 0,
///     SET_TO_CLIENT_TIME4 = 1
/// };

```

```
///
/// union settime4 switch (time_how4 set_it) {
///   case SET_TO_CLIENT_TIME4:
///     nfstime4      time;
///   default:
///     void;
/// };
///
///
///
/// /*
///  * File attribute definitions
///  */
///
/// /*
///  * FSID structure for major/minor
///  */
/// struct fsid4 {
///     uint64_t      major;
///     uint64_t      minor;
/// };
///
///
/// /*
///  * Filesystem locations attribute for relocation/migration
///  */
/// struct fs_location4 {
///     utf8val_must  server<>;
///     pathname4     rootpath;
/// };
///
/// struct fs_locations4 {
///     pathname4     fs_root;
///     fs_location4  locations<>;
/// };
///
///
/// /*
///  * Various Access Control Entry definitions
///  */
///
/// /*
///  * Mask that indicates which Access Control Entries
///  * are supported. Values for the fattr4_aclsupport attribute.
///  */
/// const ACL4_SUPPORT_ALLOW_ACL      = 0x00000001;
/// const ACL4_SUPPORT_DENY_ACL       = 0x00000002;
/// const ACL4_SUPPORT_AUDIT_ACL      = 0x00000004;
```



```
/// const ACL4_SUPPORT_ALARM_ACL      = 0x00000008;
///
///
/// typedef uint32_t          acetype4;
///
/// /*
///  * acetype4 values, others can be added as needed.
///  */
/// const ACE4_ACCESS_ALLOWED_ACE_TYPE      = 0x00000000;
/// const ACE4_ACCESS_DENIED_ACE_TYPE      = 0x00000001;
/// const ACE4_SYSTEM_AUDIT_ACE_TYPE      = 0x00000002;
/// const ACE4_SYSTEM_ALARM_ACE_TYPE      = 0x00000003;
///
///
/// /*
///  * ACE flag
///  */
/// typedef uint32_t aceflag4;
///
///
/// /*
///  * ACE flag values
///  */
/// const ACE4_FILE_INHERIT_ACE            = 0x00000001;
/// const ACE4_DIRECTORY_INHERIT_ACE      = 0x00000002;
/// const ACE4_NO_PROPAGATE_INHERIT_ACE    = 0x00000004;
/// const ACE4_INHERIT_ONLY_ACE           = 0x00000008;
/// const ACE4_SUCCESSFUL_ACCESS_ACE_FLAG  = 0x00000010;
/// const ACE4_FAILED_ACCESS_ACE_FLAG     = 0x00000020;
/// const ACE4_IDENTIFIER_GROUP           = 0x00000040;
///
///
///
/// /*
///  * ACE mask
///  */
/// typedef uint32_t          acemask4;
///
///
/// /*
///  * ACE mask values
///  */
/// const ACE4_READ_DATA                  = 0x00000001;
/// const ACE4_LIST_DIRECTORY              = 0x00000001;
/// const ACE4_WRITE_DATA                  = 0x00000002;
/// const ACE4_ADD_FILE                    = 0x00000002;
```

```
/// const ACE4_APPEND_DATA          = 0x00000004;
/// const ACE4_ADD_SUBDIRECTORY      = 0x00000004;
/// const ACE4_READ_NAMED_ATTRS     = 0x00000008;
/// const ACE4_WRITE_NAMED_ATTRS    = 0x00000010;
/// const ACE4_EXECUTE               = 0x00000020;
/// const ACE4_DELETE_CHILD         = 0x00000040;
/// const ACE4_READ_ATTRIBUTES       = 0x00000080;
/// const ACE4_WRITE_ATTRIBUTES      = 0x00000100;
///
/// const ACE4_DELETE               = 0x00010000;
/// const ACE4_READ_ACL             = 0x00020000;
/// const ACE4_WRITE_ACL            = 0x00040000;
/// const ACE4_WRITE_OWNER          = 0x00080000;
/// const ACE4_SYNCHRONIZE          = 0x00100000;
///
///
/// /*
///  * ACE4_GENERIC_READ -- defined as combination of
///  *   ACE4_READ_ACL |
///  *   ACE4_READ_DATA |
///  *   ACE4_READ_ATTRIBUTES |
///  *   ACE4_SYNCHRONIZE
///  */
///
/// const ACE4_GENERIC_READ = 0x00120081;
///
/// /*
///  * ACE4_GENERIC_WRITE -- defined as combination of
///  *   ACE4_READ_ACL |
///  *   ACE4_WRITE_DATA |
///  *   ACE4_WRITE_ATTRIBUTES |
///  *   ACE4_WRITE_ACL |
///  *   ACE4_APPEND_DATA |
///  *   ACE4_SYNCHRONIZE
///  */
///
/// const ACE4_GENERIC_WRITE = 0x00160106;
///
///
/// /*
///  * ACE4_GENERIC_EXECUTE -- defined as combination of
///  *   ACE4_READ_ACL
///  *   ACE4_READ_ATTRIBUTES
///  *   ACE4_EXECUTE
///  *   ACE4_SYNCHRONIZE
///  */
///
/// const ACE4_GENERIC_EXECUTE = 0x001200A0;
///
///
```

```
/// /*
///  * Access Control Entry definition
///  */
/// struct nfsace4 {
///     acetype4      type;
///     aceflag4      flag;
///     acemask4      access_mask;
///     utf8_must     who;
/// };
///
///
/// /*
///  * Field definitions for the fattr4_mode attribute
///  */
/// const MODE4_SUID = 0x800; /* set user id on execution */
/// const MODE4_SGID = 0x400; /* set group id on execution */
/// const MODE4_SVTX = 0x200; /* save text even after use */
/// const MODE4_RUSR = 0x100; /* read permission: owner */
/// const MODE4_WUSR = 0x080; /* write permission: owner */
/// const MODE4_XUSR = 0x040; /* execute permission: owner */
/// const MODE4_RGRP = 0x020; /* read permission: group */
/// const MODE4_WGRP = 0x010; /* write permission: group */
/// const MODE4_XGRP = 0x008; /* execute permission: group */
/// const MODE4_ROTH = 0x004; /* read permission: other */
/// const MODE4_WOTH = 0x002; /* write permission: other */
/// const MODE4_XOTH = 0x001; /* execute permission: other */
///
///
/// /*
///  * Special data/attribute associated with
///  * file types NF4BLK and NF4CHR.
///  */
/// struct specdata4 {
///     uint32_t specdata1; /* major device number */
///     uint32_t specdata2; /* minor device number */
/// };
///
///
/// /*
///  * Values for fattr4_fh_expire_type
///  */
/// const FH4_PERSISTENT = 0x00000000;
/// const FH4_NOEXPIRE_WITH_OPEN = 0x00000001;
/// const FH4_VOLATILE_ANY = 0x00000002;
/// const FH4_VOL_MIGRATION = 0x00000004;
/// const FH4_VOL_RENAME = 0x00000008;
///
///
```

```
/// typedef bitmap4          fattr4_supported_attrs;
/// typedef nfs_ftype4       fattr4_type;
/// typedef uint32_t         fattr4_fh_expire_type;
/// typedef changeid4       fattr4_change;
/// typedef uint64_t         fattr4_size;
/// typedef bool             fattr4_link_support;
/// typedef bool             fattr4_symlink_support;
/// typedef bool             fattr4_named_attr;
/// typedef fsid4           fattr4_fsid;
/// typedef bool             fattr4_unique_handles;
/// typedef uint32_t         fattr4_lease_time;
/// typedef nfsstat4         fattr4_rdattrib_error;
///
/// typedef nfsace4          fattr4_acl<>;
/// typedef uint32_t         fattr4_aclsupport;
/// typedef bool             fattr4_archive;
/// typedef bool             fattr4_cansettime;
/// typedef bool             fattr4_case_insensitive;
/// typedef bool             fattr4_case_preserving;
/// typedef bool             fattr4_chown_restricted;
/// typedef uint64_t         fattr4_fileid;
/// typedef uint64_t         fattr4_files_avail;
/// typedef nfs_fh4         fattr4_filehandle;
/// typedef uint64_t         fattr4_files_free;
/// typedef uint64_t         fattr4_files_total;
/// typedef fs_locations4   fattr4_fs_locations;
/// typedef bool             fattr4_hidden;
/// typedef bool             fattr4_homogeneous;
/// typedef uint64_t         fattr4_maxfilesize;
/// typedef uint32_t         fattr4_maxlink;
/// typedef uint32_t         fattr4_maxname;
/// typedef uint64_t         fattr4_maxread;
/// typedef uint64_t         fattr4_maxwrite;
/// typedef ascii_must       fattr4_mimetype;
/// typedef mode4            fattr4_mode;
/// typedef uint64_t         fattr4_mounted_on_fileid;
/// typedef bool             fattr4_no_trunc;
/// typedef uint32_t         fattr4_numlinks;
/// typedef utf8val_must     fattr4_owner;
/// typedef utf8val_must     fattr4_owner_group;
/// typedef uint64_t         fattr4_quota_avail_hard;
/// typedef uint64_t         fattr4_quota_avail_soft;
/// typedef uint64_t         fattr4_quota_used;
/// typedef specdata4        fattr4_rawdev;
/// typedef uint64_t         fattr4_space_avail;
/// typedef uint64_t         fattr4_space_free;
/// typedef uint64_t         fattr4_space_total;
/// typedef uint64_t         fattr4_space_used;
```

```
/// typedef bool                fattr4_system;
/// typedef nfstime4            fattr4_time_access;
/// typedef setttime4           fattr4_time_access_set;
/// typedef nfstime4            fattr4_time_backup;
/// typedef nfstime4            fattr4_time_create;
/// typedef nfstime4            fattr4_time_delta;
/// typedef nfstime4            fattr4_time_metadata;
/// typedef nfstime4            fattr4_time_modify;
/// typedef setttime4           fattr4_time_modify_set;
///
///
/// /*
///  * Mandatory Attributes
///  */
/// const FATTR4_SUPPORTED_ATTRS = 0;
/// const FATTR4_TYPE = 1;
/// const FATTR4_FH_EXPIRE_TYPE = 2;
/// const FATTR4_CHANGE = 3;
/// const FATTR4_SIZE = 4;
/// const FATTR4_LINK_SUPPORT = 5;
/// const FATTR4_SYMLINK_SUPPORT = 6;
/// const FATTR4_NAMED_ATTR = 7;
/// const FATTR4_FSID = 8;
/// const FATTR4_UNIQUE_HANDLES = 9;
/// const FATTR4_LEASE_TIME = 10;
/// const FATTR4_RDATTR_ERROR = 11;
/// const FATTR4_FILEHANDLE = 19;
///
/// /*
///  * Recommended Attributes
///  */
/// const FATTR4_ACL = 12;
/// const FATTR4_ACLSUPPORT = 13;
/// const FATTR4_ARCHIVE = 14;
/// const FATTR4_CANSETTIME = 15;
/// const FATTR4_CASE_INSENSITIVE = 16;
/// const FATTR4_CASE_PRESERVING = 17;
/// const FATTR4_CHOWN_RESTRICTED = 18;
/// const FATTR4_FILEID = 20;
/// const FATTR4_FILES_AVAIL = 21;
/// const FATTR4_FILES_FREE = 22;
/// const FATTR4_FILES_TOTAL = 23;
/// const FATTR4_FS_LOCATIONS = 24;
/// const FATTR4_HIDDEN = 25;
/// const FATTR4_HOMOGENEOUS = 26;
/// const FATTR4_MAXFILESIZE = 27;
/// const FATTR4_MAXLINK = 28;
/// const FATTR4_MAXNAME = 29;
```

```
/// const FATTR4_MAXREAD          = 30;
/// const FATTR4_MAXWRITE         = 31;
/// const FATTR4_MIMETYPE         = 32;
/// const FATTR4_MODE              = 33;
/// const FATTR4_NO_TRUNC          = 34;
/// const FATTR4_NUMLINKS         = 35;
/// const FATTR4_OWNER             = 36;
/// const FATTR4_OWNER_GROUP       = 37;
/// const FATTR4_QUOTA_AVAIL_HARD  = 38;
/// const FATTR4_QUOTA_AVAIL_SOFT  = 39;
/// const FATTR4_QUOTA_USED        = 40;
/// const FATTR4_RAWDEV            = 41;
/// const FATTR4_SPACE_AVAIL       = 42;
/// const FATTR4_SPACE_FREE        = 43;
/// const FATTR4_SPACE_TOTAL       = 44;
/// const FATTR4_SPACE_USED        = 45;
/// const FATTR4_SYSTEM            = 46;
/// const FATTR4_TIME_ACCESS       = 47;
/// const FATTR4_TIME_ACCESS_SET   = 48;
/// const FATTR4_TIME_BACKUP       = 49;
/// const FATTR4_TIME_CREATE       = 50;
/// const FATTR4_TIME_DELTA        = 51;
/// const FATTR4_TIME_METADATA     = 52;
/// const FATTR4_TIME_MODIFY       = 53;
/// const FATTR4_TIME_MODIFY_SET   = 54;
/// const FATTR4_MOUNTED_ON_FILEID = 55;
///
/// /*
///  * File attribute container
///  */
/// struct fattr4 {
///     bitmap4      attrmask;
///     attrlist4    attr_vals;
/// };
///
/// /*
///  * Change info for the client
///  */
/// struct change_info4 {
///     bool         atomic;
///     changeid4    before;
///     changeid4    after;
/// };
///
/// struct clientaddr4 {
///     /* see struct rpcb in RFC 1833 */
```

```

///      string r_netid<>;      /* network id */
///      string r_addr<>;      /* universal address */
/// };
///
/// /*
///  * Callback program info as provided by the client
///  */
/// struct cb_client4 {
///      unsigned int      cb_program;
///      clientaddr4      cb_location;
/// };
///
/// /*
///  * Stateid
///  */
/// struct stateid4 {
///      uint32_t          seqid;
///      opaque            other[12];
/// };
///
/// /*
///  * Client ID
///  */
/// struct nfs_client_id4 {
///      verifier4         verifier;
///      opaque            id<NFS4_OPAQUE_LIMIT>;
/// };
///
/// struct open_owner4 {
///      clientid4        clientid;
///      opaque            owner<NFS4_OPAQUE_LIMIT>;
/// };
///
/// struct lock_owner4 {
///      clientid4        clientid;
///      opaque            owner<NFS4_OPAQUE_LIMIT>;
/// };
///
/// enum nfs_lock_type4 {
///      READ_LT          = 1,
///      WRITE_LT         = 2,
///      READW_LT         = 3,      /* blocking read */
///      WRITEW_LT        = 4,      /* blocking write */

```

```
/// };
///
///
/// const ACCESS4_READ      = 0x00000001;
/// const ACCESS4_LOOKUP    = 0x00000002;
/// const ACCESS4_MODIFY    = 0x00000004;
/// const ACCESS4_EXTEND    = 0x00000008;
/// const ACCESS4_DELETE    = 0x00000010;
/// const ACCESS4_EXECUTE   = 0x00000020;
///
/// struct ACCESS4args {
///     /* CURRENT_FH: object */
///     uint32_t      access;
/// };
///
/// struct ACCESS4resok {
///     uint32_t      supported;
///     uint32_t      access;
/// };
///
/// union ACCESS4res switch (nfsstat4 status) {
///     case NFS4_OK:
///         ACCESS4resok  resok4;
///     default:
///         void;
/// };
///
/// struct CLOSE4args {
///     /* CURRENT_FH: object */
///     seqid4        seqid;
///     stateid4      open_stateid;
/// };
///
/// union CLOSE4res switch (nfsstat4 status) {
///     case NFS4_OK:
///         stateid4      open_stateid;
///     default:
///         void;
/// };
///
/// struct COMMIT4args {
///     /* CURRENT_FH: file */
///     offset4       offset;
///     count4        count;
/// };
///
/// struct COMMIT4resok {
///     verifier4     writeverf;
```



```

    /// };
    ///
    /// union COMMIT4res switch (nfsstat4 status) {
    ///   case NFS4_OK:
    ///     COMMIT4resok   resok4;
    ///   default:
    ///     void;
    /// };
    ///
    /// union createtype4 switch (nfs_ftype4 type) {
    ///   case NF4LNK:
    ///     linktext4 linkdata;
    ///   case NF4BLK:
    ///   case NF4CHR:
    ///     specdata4 devdata;
    ///   case NF4SOCK:
    ///   case NF4FIFO:
    ///   case NF4DIR:
    ///     void;
    ///   default:
    ///     void; /* server should return NFS4ERR_BADTYPE */
    /// };
    ///
    /// struct CREATE4args {
    ///   /* CURRENT_FH: directory for creation */
    ///   createtype4   objtype;
    ///   component4   objname;
    ///   fattr4       createattrs;
    /// };
    ///
    /// struct CREATE4resok {
    ///   change_info4  cinfo;
    ///   bitmap4       attrset; /* attributes set */
    /// };
    ///
    /// union CREATE4res switch (nfsstat4 status) {
    ///   case NFS4_OK:
    ///     CREATE4resok resok4;
    ///   default:
    ///     void;
    /// };
    ///
    /// struct DELEGPURGE4args {
    ///   clientid4     clientid;
    /// };
    ///
    /// struct DELEGPURGE4res {
    ///   nfsstat4      status;

```

```
/// };
///
/// struct DELEGRETURN4args {
///     /* CURRENT_FH: delegated file */
///     stateid4      deleg_stateid;
/// };
///
/// struct DELEGRETURN4res {
///     nfsstat4      status;
/// };
///
/// struct GETATTR4args {
///     /* CURRENT_FH: directory or file */
///     bitmap4       attr_request;
/// };
///
/// struct GETATTR4resok {
///     fattr4        obj_attributes;
/// };
///
/// union GETATTR4res switch (nfsstat4 status) {
///     case NFS4_OK:
///         GETATTR4resok  resok4;
///     default:
///         void;
/// };
///
/// struct GETFH4resok {
///     nfs_fh4       object;
/// };
///
/// union GETFH4res switch (nfsstat4 status) {
///     case NFS4_OK:
///         GETFH4resok    resok4;
///     default:
///         void;
/// };
///
/// struct LINK4args {
///     /* SAVED_FH: source object */
///     /* CURRENT_FH: target directory */
///     component4    newname;
/// };
///
/// struct LINK4resok {
///     change_info4  cinfo;
/// };
///
```

```
/// union LINK4res switch (nfsstat4 status) {
///   case NFS4_OK:
///     LINK4resok resok4;
///   default:
///     void;
/// };
///
/// /*
///  * For LOCK, transition from open_owner to new lock_owner
///  */
/// struct open_to_lock_owner4 {
///   seqid4      open_seqid;
///   stateid4    open_stateid;
///   seqid4      lock_seqid;
///   lock_owner4 lock_owner;
/// };
///
/// /*
///  * For LOCK, existing lock_owner continues to request file locks
///  */
/// struct exist_lock_owner4 {
///   stateid4    lock_stateid;
///   seqid4      lock_seqid;
/// };
///
/// union locker4 switch (bool new_lock_owner) {
///   case TRUE:
///     open_to_lock_owner4    open_owner;
///   case FALSE:
///     exist_lock_owner4      lock_owner;
/// };
///
/// /*
///  * LOCK/LOCKT/LOCKU: Record lock management
///  */
/// struct LOCK4args {
///   /* CURRENT_FH: file */
///   nfs_lock_type4 locktype;
///   bool           reclaim;
///   offset4        offset;
///   length4        length;
///   locker4        locker;
/// };
///
/// struct LOCK4denied {
///   offset4        offset;
///   length4        length;
///   nfs_lock_type4 locktype;
/// }
```

```
    ///         lock_owner4      owner;
    /// };
    ///
    /// struct LOCK4resok {
    ///         stateid4          lock_stateid;
    /// };
    ///
    /// union LOCK4res switch (nfsstat4 status) {
    ///     case NFS4_OK:
    ///         LOCK4resok      resok4;
    ///     case NFS4ERR_DENIED:
    ///         LOCK4denied     denied;
    ///     default:
    ///         void;
    /// };
    ///
    /// struct LOCKT4args {
    ///         /* CURRENT_FH: file */
    ///         nfs_lock_type4  locktype;
    ///         offset4        offset;
    ///         length4        length;
    ///         lock_owner4     owner;
    /// };
    ///
    /// union LOCKT4res switch (nfsstat4 status) {
    ///     case NFS4ERR_DENIED:
    ///         LOCK4denied     denied;
    ///     case NFS4_OK:
    ///         void;
    ///     default:
    ///         void;
    /// };
    ///
    /// struct LOCKU4args {
    ///         /* CURRENT_FH: file */
    ///         nfs_lock_type4  locktype;
    ///         seqid4          seqid;
    ///         stateid4        lock_stateid;
    ///         offset4        offset;
    ///         length4        length;
    /// };
    ///
    /// union LOCKU4res switch (nfsstat4 status) {
    ///     case NFS4_OK:
    ///         stateid4        lock_stateid;
    ///     default:
    ///         void;
    /// };
```

```
///  
/// struct LOOKUP4args {  
///     /* CURRENT_FH: directory */  
///     component4      objname;  
/// };  
///  
/// struct LOOKUP4res {  
///     /* CURRENT_FH: object */  
///     nfsstat4        status;  
/// };  
///  
/// struct LOOKUP4res {  
///     /* CURRENT_FH: directory */  
///     nfsstat4        status;  
/// };  
///  
/// struct NVERIFY4args {  
///     /* CURRENT_FH: object */  
///     fattr4          obj_attributes;  
/// };  
///  
/// struct NVERIFY4res {  
///     nfsstat4        status;  
/// };  
///  
/// const OPEN4_SHARE_ACCESS_READ    = 0x00000001;  
/// const OPEN4_SHARE_ACCESS_WRITE   = 0x00000002;  
/// const OPEN4_SHARE_ACCESS_BOTH    = 0x00000003;  
///  
/// const OPEN4_SHARE_DENY_NONE      = 0x00000000;  
/// const OPEN4_SHARE_DENY_READ      = 0x00000001;  
/// const OPEN4_SHARE_DENY_WRITE     = 0x00000002;  
/// const OPEN4_SHARE_DENY_BOTH      = 0x00000003;  
/// /*  
///  * Various definitions for OPEN  
///  */  
/// enum createmode4 {  
///     UNCHECKED4      = 0,  
///     GUARDED4        = 1,  
///     EXCLUSIVE4      = 2,  
/// };  
///  
/// union createhow4 switch (createmode4 mode) {  
///     case UNCHECKED4:  
///     case GUARDED4:  
///         fattr4          createattrs;  
///     case EXCLUSIVE4:  
///         verifier4       createverf;  
/// }
```

```
/// };
///
/// enum opentype4 {
///     OPEN4_NOCREATE = 0,
///     OPEN4_CREATE   = 1
/// };
///
/// union openflag4 switch (opentype4 opentype) {
///     case OPEN4_CREATE:
///         createhow4     how;
///     default:
///         void;
/// };
///
/// /* Next definitions used for OPEN delegation */
/// enum limit_by4 {
///     NFS_LIMIT_SIZE      = 1,
///     NFS_LIMIT_BLOCKS    = 2
///     /* others as needed */
/// };
///
/// struct nfs_modified_limit4 {
///     uint32_t            num_blocks;
///     uint32_t            bytes_per_block;
/// };
///
/// union nfs_space_limit4 switch (limit_by4 limitby) {
///     /* limit specified as file size */
///     case NFS_LIMIT_SIZE:
///         uint64_t        filesize;
///     /* limit specified by number of blocks */
///     case NFS_LIMIT_BLOCKS:
///         nfs_modified_limit4    mod_blocks;
/// };
///
/// enum open_delegation_type4 {
///     OPEN_DELEGATE_NONE    = 0,
///     OPEN_DELEGATE_READ    = 1,
///     OPEN_DELEGATE_WRITE   = 2
/// };
///
/// enum open_claim_type4 {
///     CLAIM_NULL            = 0,
///     CLAIM_PREVIOUS        = 1,
///     CLAIM_DELEGATE_CUR    = 2,
///     CLAIM_DELEGATE_PREV   = 3,
/// };
///
```

```
/// struct open_claim_delegate_cur4 {
///     stateid4      delegate_stateid;
///     component4    file;
/// };
///
/// union open_claim4 switch (open_claim_type4 claim) {
///     /*
///     * No special rights to file.
///     * Ordinary OPEN of the specified file.
///     */
///     case CLAIM_NULL:
///         /* CURRENT_FH: directory */
///         component4    file;
///     /*
///     * Right to the file established by an
///     * open previous to server reboot. File
///     * identified by filehandle obtained at
///     * that time rather than by name.
///     */
///     case CLAIM_PREVIOUS:
///         /* CURRENT_FH: file being reclaimed */
///         open_delegation_type4    delegate_type;
///     /*
///     * Right to file based on a delegation
///     * granted by the server. File is
///     * specified by name.
///     */
///     case CLAIM_DELEGATE_CUR:
///         /* CURRENT_FH: directory */
///         open_claim_delegate_cur4    delegate_cur_info;
///     /*
///     * Right to file based on a delegation
///     * granted to a previous boot instance
///     * of the client. File is specified by name.
///     */
///     case CLAIM_DELEGATE_PREV:
///         /* CURRENT_FH: directory */
///         component4    file_delegate_prev;
///     };
///
///     /*
///     * OPEN: Open a file, potentially receiving an open delegation
///     */
///     struct OPEN4args {
///         seqid4      seqid;
///         uint32_t    share_access;
```

```
///      uint32_t      share_deny;
///      open_owner4   owner;
///      openflag4     openhow;
///      open_claim4   claim;
/// };
///
/// struct open_read_delegation4 {
///     stateid4 stateid; /* Stateid for delegation*/
///     bool      recall; /* Pre-recalled flag for
///                       delegations obtained
///                       by reclaim (CLAIM_PREVIOUS) */
///
///     nfsace4 permissions; /* Defines users who don't
///                           need an ACCESS call to
///                           open for read */
/// };
///
/// struct open_write_delegation4 {
///     stateid4 stateid; /* Stateid for delegation */
///     bool      recall; /* Pre-recalled flag for
///                       delegations obtained
///                       by reclaim
///                       (CLAIM_PREVIOUS) */
///
///     nfs_space_limit4
///         space_limit; /* Defines condition that
///                       the client must check to
///                       determine whether the
///                       file needs to be flushed
///                       to the server on close. */
///
///     nfsace4 permissions; /* Defines users who don't
///                           need an ACCESS call as
///                           part of a delegated
///                           open. */
/// };
///
/// union open_delegation4
/// switch (open_delegation_type4 delegation_type) {
///     case OPEN_DELEGATE_NONE:
///         void;
///     case OPEN_DELEGATE_READ:
///         open_read_delegation4 read;
///     case OPEN_DELEGATE_WRITE:
///         open_write_delegation4 write;
/// };
///
/// /*
```



```

/// * Result flags
/// */
///
/// /* Client must confirm open */
/// const OPEN4_RESULT_CONFIRM      = 0x00000002;
/// /* Type of file locking behavior at the server */
/// const OPEN4_RESULT_LOCKTYPE_POSIX = 0x00000004;
///
/// struct OPEN4resok {
///     stateid4      stateid;      /* Stateid for open */
///     change_info4  cinfo;        /* Directory Change Info */
///     uint32_t      rflags;       /* Result flags */
///     bitmap4       attrset;      /* attribute set for create*/
///     open_delegation4 delegation; /* Info on any open
///                                   delegation */
/// };
///
/// union OPEN4res switch (nfsstat4 status) {
///     case NFS4_OK:
///         /* CURRENT_FH: opened file */
///         OPEN4resok      resok4;
///     default:
///         void;
/// };
///
/// struct OPENATTR4args {
///     /* CURRENT_FH: object */
///     bool      createdir;
/// };
///
/// struct OPENATTR4res {
///     /* CURRENT_FH: named attr directory */
///     nfsstat4      status;
/// };
///
/// struct OPEN_CONFIRM4args {
///     /* CURRENT_FH: opened file */
///     stateid4      open_stateid;
///     seqid4        seqid;
/// };
///
/// struct OPEN_CONFIRM4resok {
///     stateid4      open_stateid;
/// };
///
/// union OPEN_CONFIRM4res switch (nfsstat4 status) {
///     case NFS4_OK:
///         OPEN_CONFIRM4resok      resok4;

```

```
/// default:
///     void;
/// };
///
/// struct OPEN_DOWNGRADE4args {
///     /* CURRENT_FH: opened file */
///     stateid4      open_stateid;
///     seqid4        seqid;
///     uint32_t      share_access;
///     uint32_t      share_deny;
/// };
///
/// struct OPEN_DOWNGRADE4resok {
///     stateid4      open_stateid;
/// };
///
/// union OPEN_DOWNGRADE4res switch(nfsstat4 status) {
///     case NFS4_OK:
///         OPEN_DOWNGRADE4resok      resok4;
///     default:
///         void;
/// };
///
/// struct PUTFH4args {
///     nfs_fh4      object;
/// };
///
/// struct PUTFH4res {
///     /* CURRENT_FH: */
///     nfsstat4      status;
/// };
///
/// struct PUTPUBFH4res {
///     /* CURRENT_FH: public fh */
///     nfsstat4      status;
/// };
///
/// struct PUTROOTFH4res {
///     /* CURRENT_FH: root fh */
///     nfsstat4      status;
/// };
///
/// struct READ4args {
///     /* CURRENT_FH: file */
///     stateid4      stateid;
///     offset4       offset;
///     count4        count;
/// };
```

```
///
/// struct READ4resok {
///     bool          eof;
///     opaque        data<>;
/// };
///
/// union READ4res switch (nfsstat4 status) {
///     case NFS4_OK:
///         READ4resok    resok4;
///     default:
///         void;
/// };
///
/// struct READDIR4args {
///     /* CURRENT_FH: directory */
///     nfs_cookie4    cookie;
///     verifier4      cookieverf;
///     count4         dircount;
///     count4         maxcount;
///     bitmap4        attr_request;
/// };
///
/// struct entry4 {
///     nfs_cookie4    cookie;
///     component4     name;
///     fattr4         attrs;
///     entry4         *nextentry;
/// };
///
/// struct dirlist4 {
///     entry4         *entries;
///     bool          eof;
/// };
///
/// struct READDIR4resok {
///     verifier4      cookieverf;
///     dirlist4       reply;
/// };
///
///
/// union READDIR4res switch (nfsstat4 status) {
///     case NFS4_OK:
///         READDIR4resok    resok4;
///     default:
///         void;
/// };
///
///
```

```
/// struct READLINK4resok {
///     linktext4      link;
/// };
///
/// union READLINK4res switch (nfsstat4 status) {
///     case NFS4_OK:
///         READLINK4resok resok4;
///     default:
///         void;
/// };
///
/// struct REMOVE4args {
///     /* CURRENT_FH: directory */
///     component4      target;
/// };
///
/// struct REMOVE4resok {
///     change_info4    cinfo;
/// };
///
/// union REMOVE4res switch (nfsstat4 status) {
///     case NFS4_OK:
///         REMOVE4resok  resok4;
///     default:
///         void;
/// };
///
/// struct RENAME4args {
///     /* SAVED_FH: source directory */
///     component4      oldname;
///     /* CURRENT_FH: target directory */
///     component4      newname;
/// };
///
/// struct RENAME4resok {
///     change_info4    source_cinfo;
///     change_info4    target_cinfo;
/// };
///
/// union RENAME4res switch (nfsstat4 status) {
///     case NFS4_OK:
///         RENAME4resok  resok4;
///     default:
///         void;
/// };
///
/// struct RENEW4args {
///     clientid4       clientid;
```

```
/// };
///
/// struct RENEW4res {
///     nfsstat4      status;
/// };
///
/// struct RESTOREFH4res {
///     /* CURRENT_FH: value of saved fh */
///     nfsstat4      status;
/// };
///
/// struct SAVEFH4res {
///     /* SAVED_FH: value of current fh */
///     nfsstat4      status;
/// };
///
/// struct SECINFO4args {
///     /* CURRENT_FH: directory */
///     component4    name;
/// };
///
/// /*
///  * From RFC 2203
///  */
/// enum rpc_gss_svc_t {
///     RPC_GSS_SVC_NONE          = 1,
///     RPC_GSS_SVC_INTEGRITY     = 2,
///     RPC_GSS_SVC_PRIVACY       = 3
/// };
///
/// struct rpcsec_gss_info {
///     sec_oid4      oid;
///     qop4          qop;
///     rpc_gss_svc_t service;
/// };
///
/// /* RPCSEC_GSS has a value of '6' - See RFC 2203 */
/// union secinfo4 switch (uint32_t flavor) {
///     case RPCSEC_GSS:
///         rpcsec_gss_info      flavor_info;
///     default:
///         void;
/// };
///
/// typedef secinfo4 SECINFO4resok<>;
///
/// union SECINFO4res switch (nfsstat4 status) {
///     case NFS4_OK:
```

```

    ///          SECINFO4resok resok4;
    ///  default:
    ///          void;
    /// };
    ///
    /// struct SETATTR4args {
    ///          /* CURRENT_FH: target object */
    ///          stateid4      stateid;
    ///          fattr4        obj_attributes;
    /// };
    ///
    /// struct SETATTR4res {
    ///          nfsstat4      status;
    ///          bitmap4       attrsset;
    /// };
    ///
    /// struct SETCLIENTID4args {
    ///          nfs_client_id4 client;
    ///          cb_client4     callback;
    ///          uint32_t       callback_ident;
    /// };
    ///
    /// struct SETCLIENTID4resok {
    ///          clientid4      clientid;
    ///          verifier4      setclientid_confirm;
    /// };
    ///
    /// union SETCLIENTID4res switch (nfsstat4 status) {
    ///  case NFS4_OK:
    ///          SETCLIENTID4resok      resok4;
    ///  case NFS4ERR_CLID_INUSE:
    ///          clientaddr4      client_using;
    ///  default:
    ///          void;
    /// };
    ///
    /// struct SETCLIENTID_CONFIRM4args {
    ///          clientid4      clientid;
    ///          verifier4      setclientid_confirm;
    /// };
    ///
    /// struct SETCLIENTID_CONFIRM4res {
    ///          nfsstat4      status;
    /// };
    ///
    /// struct VERIFY4args {
    ///          /* CURRENT_FH: object */
    ///          fattr4        obj_attributes;

```

```

/// };
///
/// struct VERIFY4res {
///     nfsstat4      status;
/// };
///
/// enum stable_how4 {
///     UNSTABLE4      = 0,
///     DATA_SYNC4    = 1,
///     FILE_SYNC4     = 2
/// };
///
/// struct WRITE4args {
///     /* CURRENT_FH: file */
///     stateid4       stateid;
///     offset4        offset;
///     stable_how4    stable;
///     opaque         data<>;
/// };
///
/// struct WRITE4resok {
///     count4         count;
///     stable_how4    committed;
///     verifier4     writeverf;
/// };
///
/// union WRITE4res switch (nfsstat4 status) {
///     case NFS4_OK:
///         WRITE4resok   resok4;
///     default:
///         void;
/// };
///
/// struct RELEASE_LOCKOWNER4args {
///     lock_owner4    lock_owner;
/// };
///
/// struct RELEASE_LOCKOWNER4res {
///     nfsstat4      status;
/// };
///
/// struct ILLEGAL4res {
///     nfsstat4      status;
/// };
///
/// /*
///  * Operation arrays
///  */

```

```
///
/// enum nfs_opnum4 {
///   OP_ACCESS           = 3,
///   OP_CLOSE           = 4,
///   OP_COMMIT          = 5,
///   OP_CREATE          = 6,
///   OP_DELEGPURGE      = 7,
///   OP_DELEGRETURN     = 8,
///   OP_GETATTR         = 9,
///   OP_GETFH           = 10,
///   OP_LINK            = 11,
///   OP_LOCK            = 12,
///   OP_LOCKT           = 13,
///   OP_LOCKU           = 14,
///   OP_LOOKUP          = 15,
///   OP_LOOKUPP         = 16,
///   OP_NVERIFY         = 17,
///   OP_OPEN            = 18,
///   OP_OPENATTR        = 19,
///   OP_OPEN_CONFIRM    = 20,
///   OP_OPEN_DOWNGRADE = 21,
///   OP_PUTFH           = 22,
///   OP_PUTPUBFH        = 23,
///   OP_PUTROOTFH       = 24,
///   OP_READ            = 25,
///   OP_READDIR         = 26,
///   OP_READLINK        = 27,
///   OP_REMOVE          = 28,
///   OP_RENAME          = 29,
///   OP_RENEW           = 30,
///   OP_RESTOREFH       = 31,
///   OP_SAVEFH          = 32,
///   OP_SECINFO         = 33,
///   OP_SETATTR         = 34,
///   OP_SETCLIENTID     = 35,
///   OP_SETCLIENTID_CONFIRM = 36,
///   OP_VERIFY          = 37,
///   OP_WRITE           = 38,
///   OP_RELEASE_LOCKOWNER = 39,
///   OP_ILLEGAL         = 10044
/// };
///
/// union nfs_argop4 switch (nfs_opnum4 argop) {
///   case OP_ACCESS:      ACCESS4args opaccess;
///   case OP_CLOSE:      CLOSE4args opclose;
///   case OP_COMMIT:     COMMIT4args opcommit;
///   case OP_CREATE:     CREATE4args opcreate;
///   case OP_DELEGPURGE: DELEGPURGE4args opdelegpurge;
```



```

/// case OP_DELEGRETURN:  DELEGRETURN4args opdelegreturn;
/// case OP_GETATTR:      GETATTR4args opgetattr;
/// case OP_GETFH:        void;
/// case OP_LINK:         LINK4args oplink;
/// case OP_LOCK:         LOCK4args oplock;
/// case OP_LOCKT:        LOCKT4args oplockt;
/// case OP_LOCKU:        LOCKU4args oplocku;
/// case OP_LOOKUP:       LOOKUP4args opllookup;
/// case OP_LOOKUPP:      void;
/// case OP_NVERIFY:      NVERIFY4args opnverify;
/// case OP_OPEN:         OPEN4args opopen;
/// case OP_OPENATTR:     OPENATTR4args opopenattr;
/// case OP_OPEN_CONFIRM: OPEN_CONFIRM4args opopen_confirm;
/// case OP_OPEN_DOWNGRADE:
///
/// case OP_OPEN_DOWNGRADE4args opopen_downgrade;
/// case OP_PUTFH:        PUTFH4args opputfh;
/// case OP_PUTPUBFH:     void;
/// case OP_PUTROOTFH:    void;
/// case OP_READ:         READ4args opread;
/// case OP_READDIR:      REaddir4args opreaddir;
/// case OP_READLINK:     void;
/// case OP_REMOVE:       REMOVE4args opremove;
/// case OP_RENAME:       RENAME4args oprename;
/// case OP_RENEW:        RENEW4args oprenew;
/// case OP_RESTOREFH:    void;
/// case OP_SAVEFH:       void;
/// case OP_SECINFO:      SECINFO4args opsecinfo;
/// case OP_SETATTR:      SETATTR4args opsetattr;
/// case OP_SETCLIENTID: SETCLIENTID4args opsetclientid;
/// case OP_SETCLIENTID_CONFIRM: SETCLIENTID_CONFIRM4args
///                               opsetclientid_confirm;
/// case OP_VERIFY:       VERIFY4args opverify;
/// case OP_WRITE:        WRITE4args opwrite;
/// case OP_RELEASE_LOCKOWNER:
///
/// case OP_RELEASE_LOCKOWNER4args
///                               oprelease_lockowner;
/// case OP_ILLEGAL:      void;
/// };
///
/// union nfs_resop4 switch (nfs_opnum4 resop) {
/// case OP_ACCESS:       ACCESS4res opaccess;
/// case OP_CLOSE:        CLOSE4res opclose;
/// case OP_COMMIT:       COMMIT4res opcommit;
/// case OP_CREATE:       CREATE4res opcreate;
/// case OP_DELEGPURGE:   DELEGPURGE4res opdelegpurge;
/// case OP_DELEGRETURN:  DELEGRETURN4res opdelegreturn;
/// case OP_GETATTR:      GETATTR4res opgetattr;
/// case OP_GETFH:        GETFH4res opgetfh;

```

```

/// case OP_LINK:          LINK4res oplink;
/// case OP_LOCK:          LOCK4res oplock;
/// case OP_LOCKT:         LOCKT4res oplockt;
/// case OP_LOCKU:         LOCKU4res oplocku;
/// case OP_LOOKUP:        LOOKUP4res oplookup;
/// case OP_LOOKUPP:       LOOKUPP4res oplookupp;
/// case OP_NVERIFY:       NVERIFY4res opnverify;
/// case OP_OPEN:          OPEN4res opopen;
/// case OP_OPENATTR:      OPENATTR4res opopenattr;
/// case OP_OPEN_CONFIRM:  OPEN_CONFIRM4res opopen_confirm;
/// case OP_OPEN_DOWNGRADE:
///                          OPEN_DOWNGRADE4res
///                          opopen_downgrade;
/// case OP_PUTFH:          PUTFH4res opputfh;
/// case OP_PUTPUBFH:       PUTPUBFH4res opputpubfh;
/// case OP_PUTROOTFH:      PUTROOTFH4res opputrootfh;
/// case OP_READ:          READ4res opread;
/// case OP_READDIR:       READDIR4res opreaddir;
/// case OP_READLINK:      READLINK4res opreadlink;
/// case OP_REMOVE:        REMOVE4res opremove;
/// case OP_RENAME:        RENAME4res oprename;
/// case OP_RENEW:         RENEW4res oprenew;
/// case OP_RESTOREFH:     RESTOREFH4res oprestorefh;
/// case OP_SAVEFH:        SAVEFH4res opsavefh;
/// case OP_SECINFO:        SECINFO4res opsecinfo;
/// case OP_SETATTR:       SETATTR4res opsetattr;
/// case OP_SETCLIENTID:   SETCLIENTID4res opsetclientid;
/// case OP_SETCLIENTID_CONFIRM:
///                          SETCLIENTID_CONFIRM4res
///                          opsetclientid_confirm;
/// case OP_VERIFY:        VERIFY4res opverify;
/// case OP_WRITE:         WRITE4res opwrite;
/// case OP_RELEASE_LOCKOWNER:
///                          RELEASE_LOCKOWNER4res
///                          oprelease_lockowner;
/// case OP_ILLEGAL:       ILLEGAL4res opillegal;
/// };
///
/// struct COMPOUND4args {
///     comptag4          tag;
///     uint32_t          minorversion;
///     nfs_argop4        argarray<>;
/// };
///
/// struct COMPOUND4res {
///     nfsstat4          status;
///     comptag4          tag;
///     nfs_resop4        resarray<>;

```

```

/// };
///
///
/// /*
///  * Remote file service routines
///  */
/// program NFS4_PROGRAM {
///     version NFS_V4 {
///         void
///         NFSPROC4_NULL(void) = 0;
///
///         COMPOUND4res
///         NFSPROC4_COMPOUND(COMPOUND4args) = 1;
///
///     } = 4;
/// } = 100003;
///
/// /*
///  * NFS4 Callback Procedure Definitions and Program
///  */
/// struct CB_GETATTR4args {
///     nfs_fh4 fh;
///     bitmap4 attr_request;
/// };
///
/// struct CB_GETATTR4resok {
///     fattr4 obj_attributes;
/// };
///
/// union CB_GETATTR4res switch (nfsstat4 status) {
///     case NFS4_OK:
///         CB_GETATTR4resok      resok4;
///     default:
///         void;
/// };
///
/// struct CB_RECALL4args {
///     stateid4      stateid;
///     bool          truncate;
///     nfs_fh4      fh;
/// };
///
/// struct CB_RECALL4res {
///     nfsstat4      status;
/// };
///
/// /*
///  * CB_ILLEGAL: Response for illegal operation numbers

```

```
/// */
/// struct CB_ILLEGAL4res {
///     nfsstat4      status;
/// };
///
/// /*
///  * Various definitions for CB_COMPOUND
///  */
/// %
/// enum nfs_cb_opnum4 {
///     OP_CB_GETATTR      = 3,
///     OP_CB_RECALL      = 4,
///     OP_CB_ILLEGAL      = 10044
/// };
///
/// union nfs_cb_argop4 switch (unsigned argop) {
///     case OP_CB_GETATTR:
///         CB_GETATTR4args      opcbgetattr;
///     case OP_CB_RECALL:
///         CB_RECALL4args      opcbrecall;
///     case OP_CB_ILLEGAL:
///         void;
/// };
///
/// union nfs_cb_resop4 switch (unsigned resop) {
///     case OP_CB_GETATTR:      CB_GETATTR4res      opcbgetattr;
///     case OP_CB_RECALL:      CB_RECALL4res      opcbrecall;
///     case OP_CB_ILLEGAL:      CB_ILLEGAL4res      opcbillegal;
/// };
///
///
/// struct CB_COMPOUND4args {
///     comptag4      tag;
///     uint32_t      minorversion;
///     uint32_t      callback_ident;
///     nfs_cb_argop4 argarray<>;
/// };
///
/// struct CB_COMPOUND4res {
///     nfsstat4      status;
///     comptag4      tag;
///     nfs_cb_resop4 resarray<>;
/// };
///
///
/// /*
///  * Program number is in the transient range since the client
///  * will assign the exact transient program number and provide
```

```
/// * that to the server via the SETCLIENTID operation.
/// */
/// program NFS4_CALLBACK {
///     version NFS_CB {
///         void
///         CB_NULL(void) = 0;
///         CB_COMPOUND4res
///         CB_COMPOUND(CB_COMPOUND4args) = 1;
///     } = 1;
/// } = 0x40000000;
```

2. Security Considerations

See the Security Considerations section of [3].

3. IANA Considerations

See the IANA Considerations section of [3].

4. Normative References

- [1] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", March 1997.
- [2] Eisler, M., "XDR: External Data Representation Standard", STD 67, RFC 4506, May 2006.
- [3] Haynes, T. and D. Noveck, "NFS Version 4 Protocol", draft-ietf-nfsv4-rfc3530bis-04 (work in progress), July 2010.

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