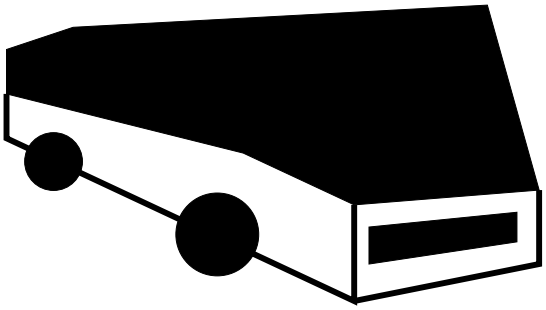
ND-Bus Documentation



Document version 0 (2010-09-08)

Covers ND-Bus version 0

This document is available online as HTML website at http://nd-bus.sourceforge.net and as PDF file at http://nd-bus.sourceforge.net/nd-bus.pdf.

Contents

Chapter 1

ND-Bus

1.1 Table of contents

1.2 What is ND-Bus?

The name *ND-Bus* stands for *Network-enabled Desktop Bus*. ND-Bus is an inter-process communication system which can be used by applications on a single computer and/or within a network to exchange any kind of data, send messages and make remote function calls. Although many kinds of applications may use ND-Bus, it is mainly intended to connect applications with graphical user interfaces on desktop computers and mobile devices like laptops and smartphones. ND-Bus is currently only being developed by a single person but hopefully an international *ND-Bus Community* will soon emerge to realize ND-Bus. The community defines the *ND-Bus Specification* which can be used by everyone who wants to make her own implementations. Furthermore a reference implementation which supports many popular platforms is under development. ND-Bus wants to become the replacement for `D-Bus` which is the defacto standard message bus system for GNU/Linux now, but has no appropriate networking support by design. The overall design of ND-Bus is not only heavily inspired by D-Bus but also includes legacy support for the current

D-Bus protocol. This is first of all because D-Bus is really good but also to simplify the migration from D-Bus to ND-Bus.

1.3 ND-Bus is free software

The ND-Bus Specification is open and freely available for everyone. There are no patent restrictions. All documentation is published under the terms of the GNU Free Documentation License. All sources are published under the terms of the GNU General Public License.

1.4 Features

The list of features is only a first draft. Nothing of this has been realized yet.

- Replacement for D-Bus, but with network support by design
- Legacy support for D-Bus
- Make things like Telepathy less painful for developers
- Transparent signals and slots mechanism across applications on one computer and on a network
- Ability for file transport
- Strong encryption between different machines
- Authentication using certificates
- Optional end-to-end-encryption between applications
- Automatic service discovery
- Service introspection
- Fine grained access rights
- Reference implementation running at least on GNU/Linux, Windows and MacOS
- Later support for other platforms like: FreeBSD, MeeGo, Android, iPhone and Windows phones

1.5 Requirements

The following list states the requirements for running the current reference implementation.

- Platform supported by Qt (see list here), currently only tested on GNU/Linux and Windows
- Installed Qt libraries of version 4.6 or greater

General requirements for fully implementing the current ND-Bus Specification on an arbitrary platform:

- TCP and TLS available

1.6 Development status

Development of ND-Bus has just been started and is currently in the architecture design phase. No code has been released yet.

1.7 FAQ

- Q: Why does ND-Bus beside of running on GNU also aim to run on proprietary platforms like Windows and MacOS instead of concentrating all afforts on supporting only free software?
- A: Firstly ND-Bus is about connecting applications and thus about connecting users. ND-Bus wants to build a bridge between the users of GNU who are free and the people that want to use or for some reasons are forced to use proprietary systems and are thus not free. Secondly if applications on free and proprietary systems are able to talk to each other easily, the barrier to replace existing proprietary systems with free systems is lowered. I think more free software should also run on e.g. Windows as the average user doesn't care what operating system she is using as long as it runs all her applications. If all your applications run on all major platforms you are free to decide if you want to use a free or proprietary platform.
- Q: Why do you start from scratch instead of extending the current D-Bus implementation?
- A: D-Bus is optimized for operating on a single machine. Extending the design to support network transparency would break the implementation in multiple places and there would be a need to introduce incompatible changes to the protocol. The maintainers of D-Bus do not wish to support true network ability anyway and especially don't want to break compatibility. Furthermore D-Bus uses a binary protocol that is platform dependent and thus a problem in mixed environments. The last important point is that D-Bus is written in C and is thus hard to maintain, hard to modularize, error prone and in some ways platform dependent. ND-Bus tries to face these problems by making use of the multiplatform toolkit Qt. Not only does this allow to write ND-Bus in C++, it also abstracts all platform details, resp. operating system details, and so makes it possible to write one source that compiles with no changes on all major platforms, not only Unix-like systems (as D-Bus does) but also on Windows, MacOS and some smartphones. Using Qt makes the development much easier and the produced code becomes stable much faster. Also it is far easier to integrate encryption, network ability and things like regular expressions and state machines. Last but not least: As writing good code with Qt is much easier than with plain C more people with even lower programming skills can actively participate in the development process.
- Q: Don't you think relying on Qt is a drawback? Gnome is based on GTK+ and not on Qt!
- A: I don't like GTK+ and I think Qt is the only serious C++ toolkit available under the GPL today. Qt is the base for KDE, it is the base for MeeGo's GUI and it is used in more and more mobile devices like touchpads, smartphones and soon TVs and car entertainmaint computers. And it runs on Windows and MacOs. If you use Gnome then you'll have to install only a few additional libraries to be able to run Qt based applications.
- Q: But doesn't this mean, that GTK+ applications won't be able to connect to ND-Bus?
- A: No! The core of ND-Bus, the daemon process, will be written in Qt/C++. Applications that want to connect to this daemon can be written in any language and with any toolkit. Of course it will be easier to write applications that connect to ND-Bus when appropriate libraries are available for that language/toolkit. But those 'client' libraries have to be developed for all langauges, even for Qt.
- Q: Telepathy does already everything one can want.

- A: Parts of Telepathy do only exist, because of the missing features in D-Bus. In some places Telepathy abuses D-Bus for things D-Bus was not designed for.
- Q: You're stupid and wasting your time!
- A: We'll see.

1.8 Mailing list

All ND-Bus discussion is currently on nd-bus-interest@lists.sourceforge.net

1.9 Twitter

You can receive news and contact the community on Twitter

1.10 Bugs, patches, feature & support requests

Please use our tracking system: SorgeForge.net trackers

1.11 Developer guidelines

The developer guidelines shall help to keep the community afforts consistent. It is a work in progress, see the current document here: Developer guidelines

1.12 Source code

All sources are being managed with Git.

- Browse the repository online: http://nd-bus.git.sourceforge.net
- Read-only access: git://nd-bus.git.sourceforge.net/gitroot/nd-bus/nd-bus
- Read-write access for developers: ssh://nd-bus.git.sourceforge.net/gitroot/nd-bus/nd-bus

Chapter 2

Developer guidelines

2.1 Table of contents

2.2 Preface

The following paragraphs describe some standard processes, behavior and tools. The coding standard is based on the Kdelibs coding style, the Qt coding style and the GNU coding standards The document is incomplete and everyone has different preferences. If you find something is missing or could be done better then please discuss it on the mailing list.

2.3 Organization

Development of ND-Bus has just been started and the ND-Bus Community currently consists of only one active member - that's me. So all all work is done by - you guessed it right - myself. I hope the community will soon grow. Until then I am the lonely dictator of ND-Bus. As soon as someone else joins the community ND-Bus will get a more democratic form of organization.

2.4 General rules

- Portability comes first. The primary purpose of ND-Bus is to connect applications on very different platforms, especially GNU/Linux, Windows and MacOS.
- Use C++ instead of any other programming language
- Use Qt instead of other toolkits
- When using C++ use Qt
- Avoid arbitrary limits on the length or number of any data structure, including file names, lines, files, and symbols, by allocating all data structures dynamically.
- Check every function call for an error return, unless you know you wish to ignore errors.
- Try to make all functions reentrant and thread safe
- Assume the targeted hardware has multiple CPUs. Try to create parallel algorithms instead of long sequential algorithms. Create multiple threads when it's worth the overall effort.
- A program shall not only write error messages to the terminal but also into a file
- If you need a some functionality and the language/toolkit you are using offers classes etc. to support this: Use them instead of reinventing the wheel.
- Everything has to be put under version control. This applies to source code and documentation. ND-Bus uses Git for this purpose. If you are not already familiar with SCM systems in general and with Git in particular, then please take an evening or evening two and read the Git manual and tutorial.

2.5 Internationalization

- With no exception use American English for every thing in source files and documentation.
- When programming with Qt use its abilities for translation of user interfaces.
- When programming in C use GNU gettext for internationalization if possible.

- It is mandatory to make translations of user interfaces possible, but poviding any actual translation is not a primary task
- Try to integrate unicode support

2.6 Documentation

- First of all: Raw / very short documentation is not good but better than nothing.
- Please don't think 'I can write the documentation for this function later'. As soon as you have a piece of working code and a more or less stable API, then please take the time and write the documentation for it. Otherwise it will become harder and harder to remember all details as days go by and you already have turned your attention to something else.
- I will not integrate any code into ND-Bus that has an incomplete API documentation. (Incomplete documentation of internals is acceptable to some degree).
- Documentation for developers must be supplied in American English
- End user documentation must also be supplied in American English. Translations to other languages are nice to have but not a primary task
- Use `Doxygen` for source code documentation when ever possible. Use Doxygen also for all other kind of documentation. Standard configuration files for Doxygen are provided by the ND-Bus Community.
- ND-Bus provides all documentation at least in HTML and PDF format. PS files and man pages should also be provided when it's not too much work.
- In general, prefer vector graphics to raster graphics.
- It is recommanded to use `xfig` for drawing vector graphics. Save your files always in the FIG-format and export them as PDF files to include them in the documentation.
- It is recommanded to use `GIMP` when you need to create/manipulate raster graphics. Always save your work in the XCF file format and export the image as PNG file to include them in the documentation.
- Don't forget to put your XFIG and XCF files under version control.

2.7 Legal

- All ND-Bus source code must be published under the terms of the current GPL
- All ND-Bus documentation must be published under the terms of the current GFDL
- All files must state an appropriet legal notice

2.8 Identation

- 4 Spaces, no tabs

2.9 General naming conventions

- Names start with a lowercase letter.
- Each new word in a name starts with a capital letter
- Avoid short names and abbreviations like 'randGetVal' or 'snd'
- Exceptions: The meaning of a short name is absolutely obvious or the name is e.g. a counter variable or similar temporary object
- If an abbreviation is part of a name then only the first letter is upper case, eg. getIpAddress and ipIsValid instead of getIPAddress and IPIsValid
- Exception: 'NDBus' must be written like this always.

2.10 Variables

- Each variable declaration on a new line
- Wait with declaring a variable until it is needed

2.11 Functions

- Forward declarations are mendatory
- Try to avoid pointers and use references
- In the parameter list the input-parameters come first, followed by combined input/output-parameters and output-parameters at last
- Try to avoid combined input/output-parameters.
- As a rule of thumb, a function should either return void if it can't fail anyhow, return bool if can fail and no further error handling is needed (false means error) or return int (qint32) where zero means success and anything else is a well documented error code.
- Avoid returning anything else, e.g. strings, without good reason.
- Exception: Class member function that simply return class private data etc.

2.12 Classes

- General naming conventions also apply to class declarations, but with the exception that class names start with a capital letter

2.13 Templates

- Use them

2.14 C++ Exceptions

- Don't use them

2.15 Whitespace

- Use blank lines to group statements
- Use only one empty line
- Use one space after each keyword
- For pointers or references, use a single space before '$*$' or '&', but not after
- No space after a cast

2.16 Types

- Use Qt types like qint32 instead of int where possible
- Avoid C-style casts when possible, use c++ casts
- Use QStrings instead of c-style strings
- Use Qt container classes instead of STL container classes
- Use STL-style iterators for Qt containers, not Java-style

2.17 Braces

- The left curly brace goes on the same line as the start of the statement.
- Use curly braces even when the body of a conditional statement contains only one line.
- Use curly braces when the body of a conditional statement is empty
- Exception: Function implementations, class, struct and namespace declarations always have the opening brace on the start of a line.

2.18 Switch statements

- Case labels are on the same column as the switch
- The default label is mentatory
- Every case must have a break (or return) statement at the end or a comment to indicate that there's intentionally no break

2.19 Parentheses

- Use parentheses to group expressions
- Avoid assignments inside conditions

2.20 Line breaks

- Try to keep lines shorter than 100 characters, inserting line breaks as necessary.
- Commas go at the end of a broken line; operators start at the beginning of the new line.

2.21 Qt Includes

- If you add includes for Qt classes, use both the module and class name. This allows library code to be used by applications without excessive compiler include paths.

2.22 Preprocessor

- General rule: Avoid the use of the c preprocessor when ever possible
- Use enum types and constant types instead of defines
- Try to use if() statements with constant types instead of ifdef with defines when conditional compilation is needed; modern compilers will create exactly the them output but can perform more extensive type checking before.
- Exception: ifndef statements for header file protection are ok.
- Avoid function-like macros

Chapter 3

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Chapter 4

Overall design

4.1 Glossary

The following terms are defined within the ND-Bus specification:

Domain Abstraction for operating system context.

User Abstraction for what a *user* is in Unix.

Service group Abstraction for what *session bus*, *system bus* and similar are in D-Bus.

Service Abstraction for what a *process* is in Unix.

Instance identifiers Each service group has a name that specifies what this group is good for. There might be multiple service groups for the same purpose, so they both have the same name. These instances can be identified/differentiated by their *instance identifers*. It's the same with services. For example if a user runs 3 gnome sessions in parallel, they all can have the service group name "gnome_session", but their instance identifiers are 0,1 and 2.

Instance contingent The number of instances of a particular service group can be restricted. The total amount is called *instance contingent*. When the maximum number of registered service group instances has been reached we say *the instance contingent is exhausted*. The same applies to services.

Service group master service The service that created a service group.

Service identification Uniquely identifies a service by the set of its corresponding domain, user, service group and service.

Node tree Structured view on the nodes of a service.

Node Abstract container for interfaces and nodes.

Interface Abstraction for what objects are in object oriented programming.

Method Function within an interface. Functions have input and output parameters. Methods are *called* by remote services and *executed* by its interface.

Signal Special function within an interface. Signals have output parameters only. Signals are *emitted* by its containing interface. Remote services can register to a particular signal to *receive* it.

4.2 Hierarchy

The term *service* is of central relevance within the ND-Bus terminology. A service is something that does something, provides some functionality to something else and may make use of the functionality of something else.

ND-Bus is about connecting services.

Todays operating systems encapsulate certain functionality within applications. The term service is more abstract. ND-Bus does not know about applications. So it depends on the implementation what part of computer software offers a ND-Bus service. Normally it is an application that will provide exactely one service, but of course is also possible that an application or that something else, e.g. a simple microcontroller firmware without an OS or the kernel of an OS, offers one or more services.

In ND-Bus services are hierarchically organized. On top is a mesh of *domains*. Domain is an abstraction for an organizational unit. With nowadays computers a domain normally includes exactely one operating system instance. Within a domain the next organizational unit are the *users*. Users can be anything, normally they are the people who use the OS (Unix/Windows user). On the next level there are the *servicegroups* that bundle services on arbitrary criterions. E.g. all services that belong to a particular desktop session are grouped together or all services that belong to the OS kernel. The next level are the services themselves. So: every service belongs to exactely one domain, exectely one user and exectely one servicegroup. If multiple servicegroups bundle the same kind of services those servicegroups can have same name, but they can still be differentiated by their unique *instance identifiers*. This is analogous with service that provide the same functionality.

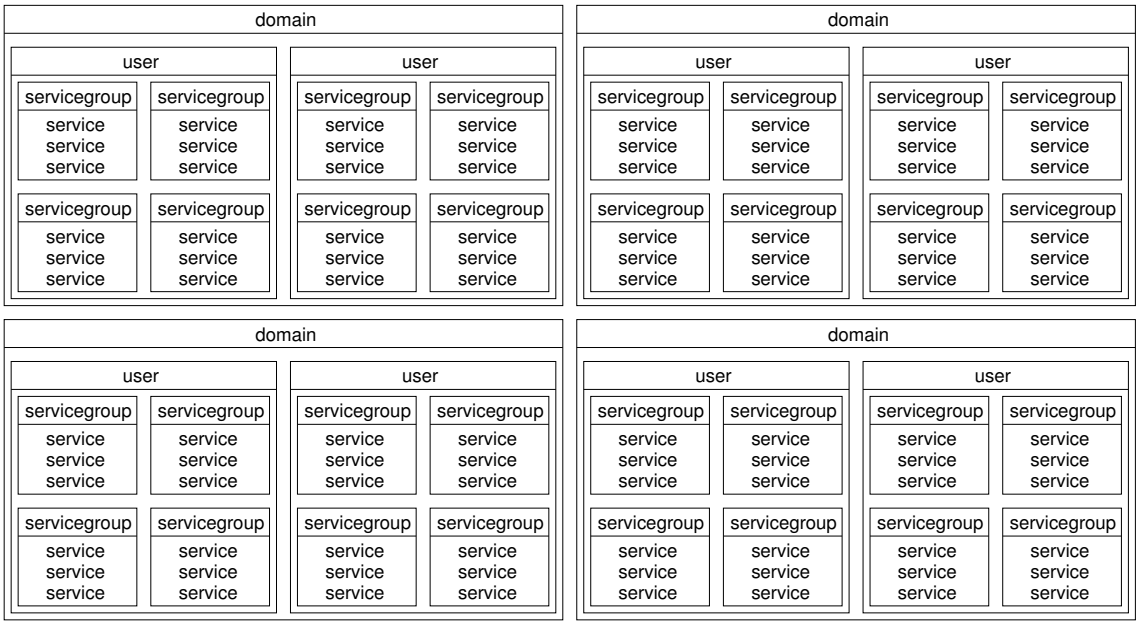

Figure 4.1: Hierarchy (loose notation)

Every service within ND-Bus can play exactely one *role*. An ordinary service (e.g. mediaplayer, terminal emulator, webbrowser) has the role *customer*. But within every domain there must be exectely one service in the role of the *agent*. This one mainly acts as a broker to help the customers to connect to each other. One can see if a service is agent or customer by its name: An agent is always service "org.ndbus.agent" (with instance identifier 0) within user "ndbus" and servicegroup "ndbus" (with instance identifier 0).

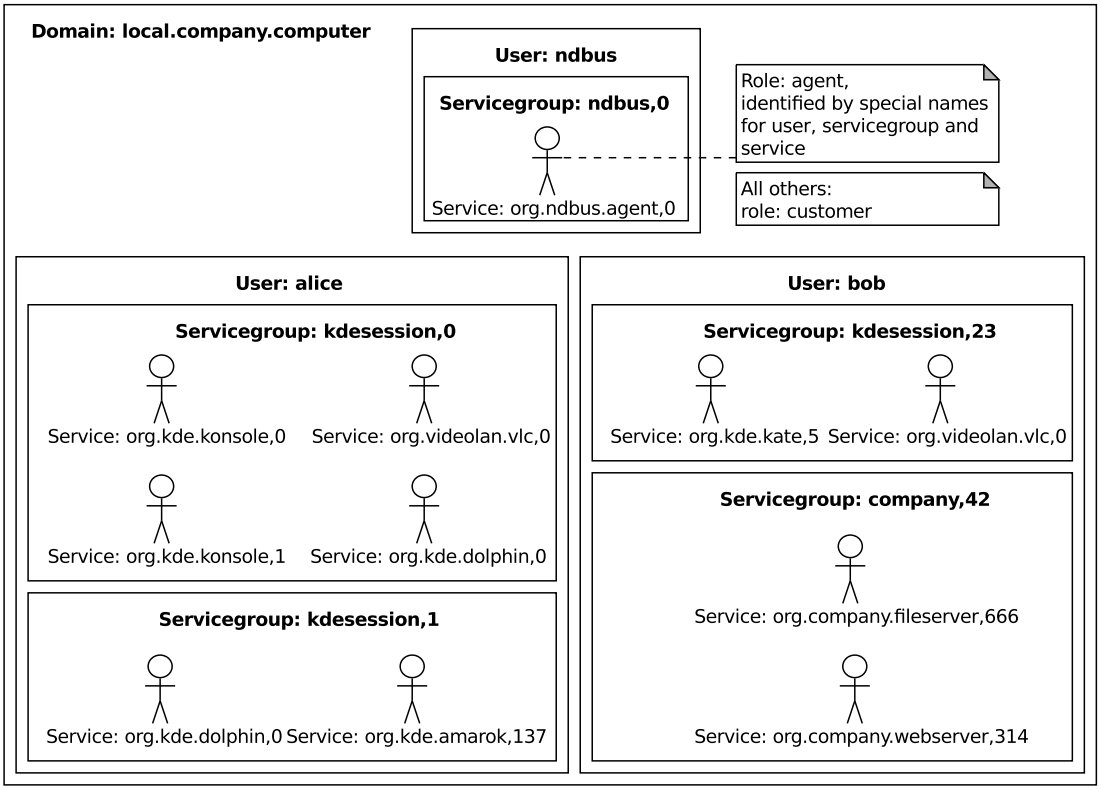

Figure 4.2: Example domain (loose notation)

Like already stated, service provide functionality. This includes *methods*, *signals* and data represented as *files*. All these are again hierarchically organized within a service. This hierarchy is a tree. Within the tree there are containers called *nodes*. A node can again contain nodes and other things: files and *interfaces*. An interface is an abstraction similar to objects in object-oriented programming languages. Interfaces can contain methods and signals.

4.3 Valid names

The various names in ND-Bus have some restrictions:

- All names have a maximum length of 255 characters
- All names are case sensitive
- Names for domain, user, servicegroup, service, file and interface must exactely match: `([A-Za-z_]+[A-Za-z0-9_]*)(\.([A-Za-z_]+[A-Za-z0-9_]*))*`
- Names for nodes, methods and signals must exactely match: `[A-Za-z_]+[A-Za-z0-9_]*`
- Exception: The root node of the tree has the fixed name "/".
- Parameter names of methods and signals must exactely match: `[A-Za-z_]+[A-Za-z0-9_]*`

4.4 Types

In various places the ND-Bus specification refers to particular data types, e.g. in the context of message formats. Especially can methods and signals only use a limited set of specific types as parameters. It is not possible to use other types than listed below, but with `List<Variant>` and `Map<String, Variant>` one can construct arbitrarily complex data structures of the given types.

Conventinal name	Description

4.5 Entities

All the things named before, means: domains, users, servicegroups, services, nodes, files, interfaces, methods and signals, are generally refered to as "entities" to make it easier to talk about them.

An entity is described by a combination of a *classifier*, *name* and *parameters*. The combination is the *signature* of the entity. The signature is a `STRING` formated as: `<classifer>;<name>(;<parameter>)*`. The number and format of the parameters and depend on the classifier. Every kind of entity has a unique classifier.

4.6 Valid classifiers

Classifiers are of type `UINT8` and must be given in their decimal representations with no leading zeros.

Conventional name	Decimal value
DOMAIN	0
USER	1
SERVICEGROUP	2
SERVICE	3
NODE	4
FILE	5
INTERFACE	6
METHOD	7
SIGNAL	8

4.6.1 Valid entity parameters

As stated before, entity signatures may include zero or more parameters. The number of parameters is fixed for a given classifier.

Domain No parameters.

User No parameters.

Servicegroup Has its instance identifer as parameter. It is of type `UINT32` and must be given in its decimal representation with no leading zeros. In some context the the parameter may be left blank (empty string).

Service Has its instance identifer as parameter. It is of type `UINT32` and must be given in its decimal representation with no leading zeros. In some context the the parameter may be left blank (empty string).

Node Has its path as parameter. Thus parameter must be a valid path, means left blank (empty string) when node is "/" or otherwise exactely match: `/|(/<name>)+`, where `<name>` is a valid node name, but not "/".

File No parameters.

Interface No parameters.

Method Has 2 parameters:

- Parameter 0: List of the input parameters of the method
- Parameter 1: List of the output parameters of the method

Both parameters use the same format: `(<type>=<param>)+(,<type>=<param>)*`, where `<type>` is a valid type name and `<param>` is a valid method parameter name. A parameter can be left blank (empty string) to indicate an empty parameter list.

Signal Has as parameter the list of the output parameters of the signal. The parameters uses the format: `(<type>=<param>)+(,<type>=<param>)*`, where `<type>` is a valid type name and `<param>` is a valid method parameter name. The parameter can be left blank (empty string) to indicate an empty parameter list.

4.6.2 Entity identifiers

The combination of domain, user, servicegroup and service uniquely identifies a service within ND-Bus. Nodes, files, interfaces, methods and signals are parts of a particular service and thus are organized in a tree structure. A particular entitiy can be refered to either by its *complete identifier* or by its *short identifier* which omits domain, user, servicegroup and service. Which identifier can be used depends on the context. Such an identifier is a sequence of ":"-separeted signatures defining the position of an entity within a ND-Bus system, starting from the domain.

Examples for complete identifiers:

Node: `0;local.alice:1;peter:2;kdesession;0:3;org.kde.amarok,0:4;control;/app/main`

Root node: `0;local.alice:1;peter:2;kdesession;0:3;org.kde.amarok,0:4;/;`

Method: `0;local.bob:1;peter:2;kde;0:3;org.app,0:4;/;:6;org.nice:7;doIt;;`

Service: `0;local.bob:1;peter:2;terminal;0:3;cc.funny.tool;1337`

Domain: `0;org.ndbus`

Same examples for short identifiers:

Node: `4;control;/app/main`

Root node: `4;/;`

Method: `7;doIt;;`

Service: not applicable

Domain: not applicable

4.7 Transport

Services talk to each other via sockets. The ND-Bus specification describes 3 different kinds of sockets that services may use as transport mechanism:

Local sockets Can only be used for local connections. Implemented on top of Unix domain sockets. Fast and secure, recommanded for local connections. Exeption: On Windows it's fast, too, but insecure, because there it is implemented on top of Named Pipes. If you don't trust your Windows installation (and programs and users) then don't use local sockets.

TCP sockets On systems that don't support local sockets one can use TCP sockets for the local connections. It is also possible to use TCP sockets for the remote connections. TCP sockets are slower than local sockets and insecure. So in general it is not recommanded to use them without reasons.

TLS sockets This is recommanded for remote connections. It is much slower than TCP sockets but secure.

4.8 Message format

All ND-Bus communication is point-to-point so there is no need for addressing information within messages. The message is the smallest logical entity within the protocol. Every message belongs to a single transmission. Within each transmission each message has a unique *message sequence number (MSN)*. Within each connection each transmission has a unique *transmission sequence number (TSN)*. The *message size (MS)* indicated the number of bytes of the whole encoded message (including the size information itself). MS, TSN, MSN and MT form the *message header (MH)*. All contents of a message must be encoded in the *ND-Bus DataStream format*.

Field index	Type	Description
0	`UINT32`	Message size
1	`UINT32`	Transmission sequence number
2	`UINT32`	Message sequence number
3	`UINT32`	Message type

The MH may be followed by the payload of the message. If a message contains any payload and how it is formatted depends on the *message type (MT)*:

Conventional name	Decimal value	Description
`ERROR`	0	Error reply
`METHOD`	1	Method call
`METHOD_RETURN`	2	Method reply with returned data
`FILE`	3	File request
`FILE_PART`	4	Reply to file request with part of file
`FILE_ACK`	5	Reception of file part acknowleged (if part left: ready for next)
`AUTH`	6	Authentication request for previously requested action
`AUTH_RETURN`	7	Authentication reply
`SIGNAL_SUBSCRIBE`	8	Signal subscription request
`SIGNAL_ACK`	9	Signal subscription reply
`SIGNAL`	10	Signal emission

4.8.1 Format of ERROR message payload

Field index	Type	Description
0	`UINT32`	Error code (depends on context)
1	`STRING`	Error message (depends on context)

4.8.2 Format of METHOD message payload

Field index	Type	Description
0	STRING	Node
1	STRING	Interface
2	STRING	Method
3	VARIANTLIST	Input

4.8.3 Format of METHOD_RETURN message payload

Field index	Type	Description
0	VARIANTLIST	Output

4.8.4 Format of FILE message payload

Field index	Type	Description
0	STRING	Node
1	STRING	File

4.8.5 Format of FILE_PART message payload

Field index	Type	Description
0	UINT32	Parts left (last part: 0)
1	BYTEARRAY	Part of file

4.8.6 Format of FILE_ACK message payload

This message type contains no payload.

4.8.7 Format of AUTH message payload

Field index	Type	Description
0	BYTEARRAY	Chunck as challenge for authentication procedure

4.8.8 Format of AUTH_RETURN message payload

Field index	Type	Description
0	BYTEARRAY	Returned chunck of authentication procedure

4.8.9 Format of SIGNAL_SUBSCRIBE message payload

Field index	Type	Description
0	STRING	Node
1	STRING	Interface
2	STRING	Signal

4.8.10 Format of SIGNAL_ACK message payload

This message type contains no payload.

4.8.11 Format of SIGNAL message payload

Field index	Type	Description
0	`STRING`	Node
1	`STRING`	Interface
2	`STRING`	Signal
3	`VARIANTLIST`	Output

4.9 Connecting daemon to daemon

Daemon A of local.alice wants to connect to daemon B of local.bob.

- A looks up the information to connect to B
- A establishes network connection to B
- A calls `/:org.ndbus:hello` on B
- A calls `/:org.ndbus:authenticate` on B
- A calls `/:org.ndbus.daemon.daemons:connectDomains` on B
- A and B are now connected.

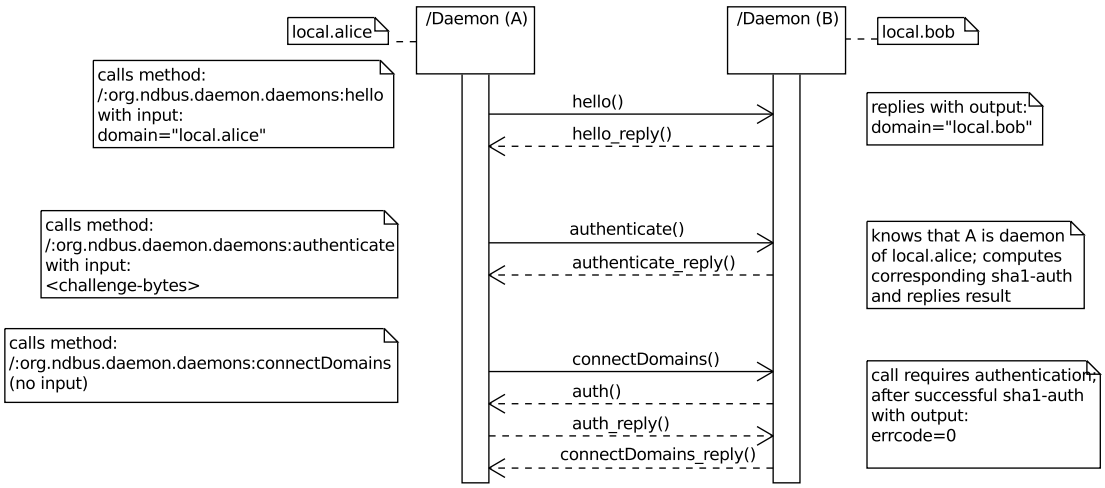

Figure 4.3: Connecting daemon to daemon

4.9.1 Connecting service to domain

Process P wants to connect to daemon A of local.alice A and become a service.

- P looks up the information to connect to A
- P establishes network connection to A
- P calls `/:org.ndbus:hello` on A
- P calls `/:org.ndbus:authenticate` on A
- P calls `/:org.ndbus.daemon.services:joinDomain` on A
- P calls `/:org.ndbus.daemon.services:joinUser` on A
- P calls `/:org.ndbus.daemon.services:joinServiceGroup` on A
- P calls `/:org.ndbus.daemon.services:addService` on A
- P and A are now connected, P is service in desired servicegroup. P can now go on and adds its nodes, interfaces etc.

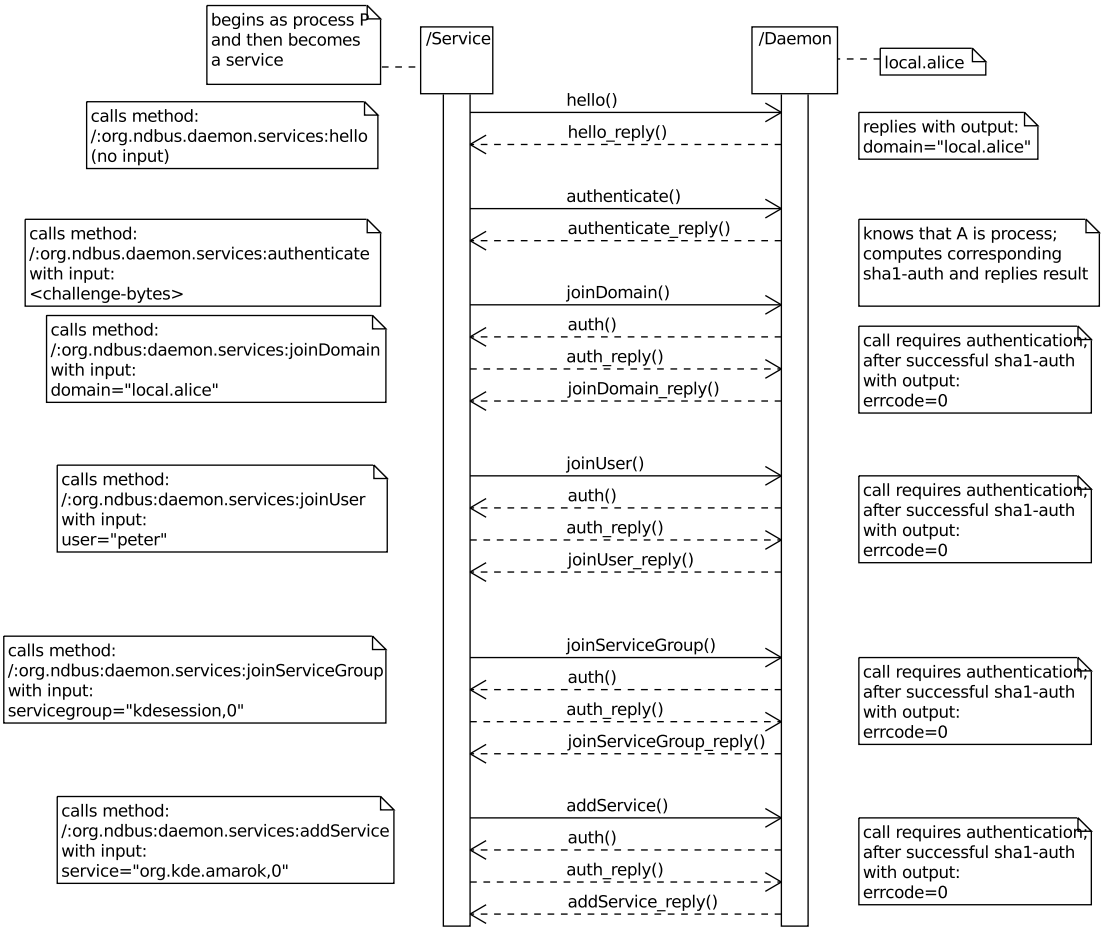

Figure 4.4: Connecting service to daemon

4.9.2 Connecting service to domain

Service A at daemon DA on local.alice wants to connect to service B at daemon DB on local.bob.

- A calls `/:org.ndbus.daemon.services:broker` on DA (and thus asks for e.g. domain="local.bob", user="system",servicegroup="system",service="org.kernel.acpi")
- DA looks up A, checks its policy and may deny the request
- DA calls `/:org.ndbus.daemon.daemons:broker` on DB
- B checks its policy and may deny the request
- DB return session_cookie(X,Y) S to DA
- DA returns S to A
- A establishes network connection to B
- A calls `/:org.ndbus:hello` on B (and thus identifies itself e.g. as domain="local.alice", user="barne",servicegroup="kdesession,0",service="cc.chubbyblackcat.funnyremotetool")
- A calls `/:org.ndbus.authenticate` on B
- B calls `/:org.ndbus.daemon.services:broker` on DB
- DB returns S to B
- B uses S to authenticate itself against A
- A calls `/:org.ndbus.service.services:connectServices` on B (as this commands needs authentication, on success A and B now both are authenticated against each other (using S).
- X and Y are now connected

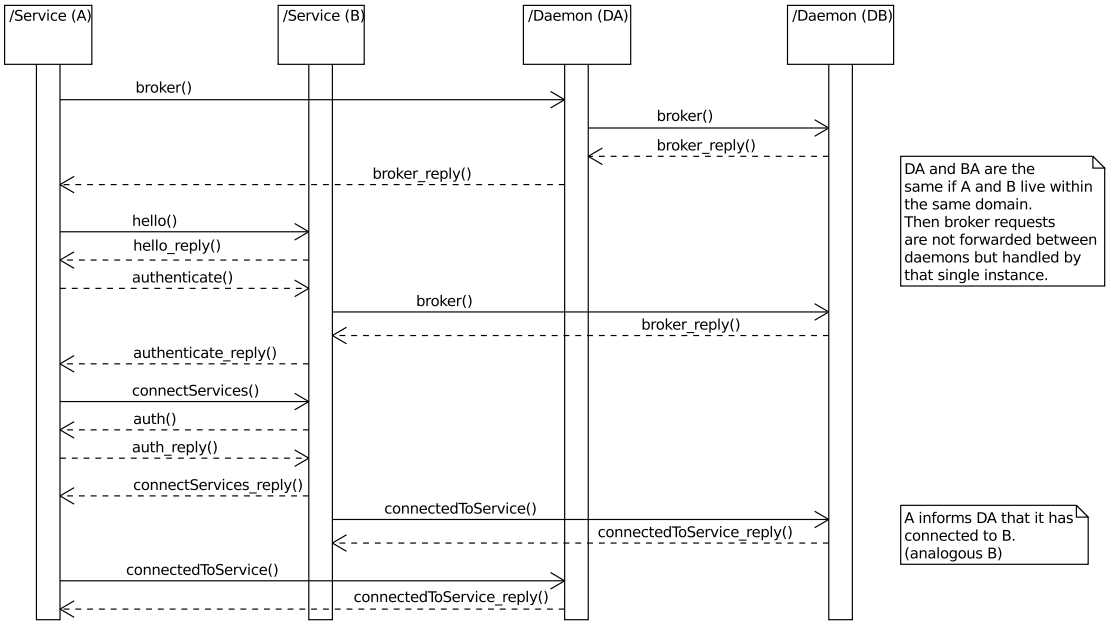

Figure 4.5: Connecting service to service

Chapter 5

Standard interfaces

5.1 org.ndbus.introspector

5.1.1 Method: identify

Direction	Field index	Type	Name
out	0	STRING	service

5.1.2 Method: nodeNames

Direction	Field index	Type	Description
in	0	STRING	node
out	0	STRINGLIST	nodeNames

5.1.3 Method: files

Direction	Field index	Type	Description
in	0	STRING	node
out	0	STRINGLIST	files
out	1	INT32	errcode

5.1.4 Method: interfaces

Direction	Field index	Type	Description
in	0	STRING	node
out	0	STRINGLIST	interfaces
out	1	INT32	errcode

5.1.5 Method: methods

Direction	Field index	Type	Description
in	0	STRING	node
in	1	STRING	interface
out	0	STRINGLIST	methods
out	1	INT32	errcode

5.1.6 Method: signals

Direction	Field index	Type	Description
in	0	STRING	node
in	1	STRING	interface
out	0	STRINGLIST	signals
out	1	INT32	errcode

5.1.7 Signal: nodeAdded

Field index	Type	Description
0	STRING	parentNode
1	STRING	node

5.1.8 Signal: nodeDeleted

Field index	Type	Description
0	STRING	parentNode
1	STRING	node

5.1.9 Signal: fileAdded

Field index	Type	Description
0	STRING	parentNode
1	STRING	file

5.1.10 Signal: fileDeleted

Field index	Type	Description
0	STRING	parentNode
1	STRING	file

5.1.11 Signal: fileChanged

Field index	Type	Description
0	STRING	parentNode
1	STRING	file
2	STRING	parentNodeNew
3	STRING	fileNew

5.1.12 Signal: interfaceAdded

Field index	Type	Description
0	STRING	parentNode
1	STRING	interface

5.1.13 Signal: interfaceDeleted

Field index	Type	Description
0	STRING	parentNode
1	STRING	interface

5.1.14 Signal: methodAdded

Field index	Type	Description
0	STRING	parentNode
1	STRING	interface
2	STRING	method

5.1.15 Signal: methodDeleted

Field index	Type	Description
0	STRING	parentNode
1	STRING	interface
2	STRING	method

5.1.16 Signal: signalAdded

Field index	Type	Description
0	STRING	parentNode
1	STRING	interface
2	STRING	signal

5.1.17 Signal: signalDeleted

Field index	Type	Description
0	STRING	parentNode
1	STRING	interface
2	STRING	signal

5.2 org.ndbus.daemon.introspector

5.2.1 Method: domains

Direction	Field index	Type	Description
out	0	STRINGLIST	domains
out	1	INT32	errcode

5.2.2 Method: users

Direction	Field index	Type	Description
in	0	STRING	domain
out	0	STRINGLIST	users
out	1	INT32	errcode

5.2.3 Method: serviceGroups

Direction	Field index	Type	Description
in	0	STRING	domain
in	1	STRING	user
out	0	STRINGLIST	servicegroups
out	1	INT32	errcode

5.2.4 Method: services

Direction	Field index	Type	Description
in	0	STRING	domain
in	1	STRING	user
in	2	STRING	servicegroup
out	0	STRINGLIST	services
out	1	INT32	errcode

5.2.5 Method: nodes

Direction	Field index	Type	Description
in	0	STRING	domain
in	1	STRING	user
in	2	STRING	servicegroup
in	3	STRING	service
in	4	STRING	node
out	0	STRINGLIST	nodes
out	1	INT32	errcode

5.2.6 Method: files

Direction	Field index	Type	Description
in	0	STRING	domain
in	1	STRING	user
in	2	STRING	servicegroup
in	3	STRING	service
in	4	STRING	node
out	0	STRINGLIST	files
out	1	INT32	errcode

5.2.7 Method: interfaces

Direction	Field index	Type	Description
in	0	STRING	domain
in	1	STRING	user
in	2	STRING	servicegroup
in	3	STRING	service
in	4	STRING	node
out	0	STRINGLIST	interfaces
out	1	INT32	errcode

5.2.8 Method: methods

Direction	Field index	Type	Description
in	0	STRING	domain
in	1	STRING	user
in	2	STRING	servicegroup
in	3	STRING	service
in	4	STRING	node
in	5	STRING	interface
out	0	STRINGLIST	methods
out	1	INT32	errcode

5.2.9 Method: signals

Direction	Field index	Type	Description
in	0	STRING	domain
in	1	STRING	user
in	2	STRING	servicegroup
in	3	STRING	service
in	4	STRING	node
in	5	STRING	interface
out	0	STRINGLIST	signals
out	1	INT32	errcode

5.2.10 Signal: domainAdded

Field index	Type	Description
0	STRING	domain

5.2.11 Signal: domainDeleted

Field index	Type	Description
0	STRING	domain

5.2.12 Signal: userAdded

Field index	Type	Description
0	STRING	domain
1	STRING	user

5.2.13 Signal: userDeleted

Field index	Type	Description
0	STRING	domain
1	STRING	user

5.2.14 Signal: serviceGroupAdded

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup

5.2.15 Signal: serviceGroupDeleted

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup

5.2.16 Signal: serviceAdded

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup
3	STRING	service

5.2.17 Signal: serviceDeleted

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup
3	STRING	service

5.2.18 Signal: nodeAdded

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup
3	STRING	service
4	STRING	parentnode
5	STRING	node

5.2.19 Signal: nodeDeleted

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup
3	STRING	service
4	STRING	parentnode
5	STRING	node

5.2.20 Signal: fileAdded

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup
3	STRING	service
4	STRING	node
5	STRING	file

5.2.21 Signal: fileDeleted

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup
3	STRING	service
4	STRING	node
5	STRING	file

5.2.22 Signal: fileChanged

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup
3	STRING	service
4	STRING	node
5	STRING	file
6	STRING	nodeNew
7	STRING	fileNew

5.2.23 Signal: interfaceAdded

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup
3	STRING	service
4	STRING	node
5	STRING	interface

5.2.24 Signal: interfaceDeleted

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup
3	STRING	service
4	STRING	node
5	STRING	interface

5.2.25 Signal: methodAdded

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup
3	STRING	service
4	STRING	node
5	STRING	interface
6	STRING	method

5.2.26 Signal: methodDeleted

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup
3	STRING	service
4	STRING	node
5	STRING	interface
6	STRING	method

5.2.27 Signal: signalAdded

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup
3	STRING	service
4	STRING	node
5	STRING	interface
6	STRING	signal

5.2.28 Signal: signalDeleted

Field index	Type	Description
0	STRING	domain
1	STRING	user
2	STRING	servicegroup
3	STRING	service
4	STRING	node
5	STRING	interface
6	STRING	signal

5.3 org.ndbus.service.daemons

5.3.1 Method: disconnect

This method has no parameters.

5.3.2 Method: disconnectFromService

Direction	Field index	Type	Description
in	0	STRING	domain
in	1	STRING	user
in	2	STRING	servicegroup
in	3	STRING	service
out	0	INT32	errcode

5.3.3 Method: connectedServices

out	0	STRINGLIST	services
out	1	INT32	errcode

5.3.4 Signal: serviceConnected

0	STRING	service

5.3.5 Signal: serviceDisconnected

0	STRING	service

/org.ndbus.daemon.daemons method hello i: string domain, string user, string servicegroup, string service o: string domain, string user, string servicegroup, string service, int32 errcode method authenticate i: bytearray challenge o: bytearray replay, int32 errcode method connect i: o: int32 errcode method connectionRequest i: string user, string servicegroup, string service, string user, string servicegroup, string service o: bytearray sessionCookie, int32 errcode

/org.ndbus.daemon.services method hello i: string domain, string user, string servicegroup, string service o: string domain, string user, string servicegroup, string service, int32 errcode method authenticate i: bytearray challenge o: bytearray replay, int32 errcode method connect i: o: int32 errcode method joinDomain i: string domain, bytearray password o: int32 errcode method joinUser i: string user, bytearray password o: int32 errcode method joinServiceGroupAddService i: string servicegroup, bool addIfDoesNotExist, bytearray servicegroup_password, string service, bytearray service_password o: string servicegroup, string service, int32 errcode method addServiceGroupAddService i: string servicegroup, bool joinIfDoesExist, bytearray servicegroup_password, string service, bytearray service_password o: string servicegroup, string service, int32 errcode method addService i: string service, bytearray password o: string service, int32 errcode method addNode i: string node, string newNode o: int32 errcode method addInterface i: string node, string interfaces o: int32 errcode method addMethod i: string node, string interface, string name, string parameters o: int32 errcode method addSignal i: string node, string interface, string name, string parameters o: int32 errcode method connectionRequest i: string domain, string user, string servicegroup, string service o: bytearray sessionCookie, int32 errcode

/org.ndbus.service.services method hello i: string domain, string user, string servicegroup, string service o: string domain, string user, string servicegroup, string service, int32 errcode method authenticate i: bytearray challenge o: bytearray replay, int32 errcode method connect i: string domain, bytearray password o: int32 errcode