
ns-3 Direct Code Execution (DCE)

Quagga Manual

Release 1.12

Direct Code Execution project

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- [Doxygen](#): Documentation of the public APIs

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CHAPTER 1

Introduction

The Quagga support on DCE enables the users to reuse routing protocol implementations of Quagga (RIPv1, RIPv2, RIPng, OSPFv2, OSPFv3, BGP, BGP+, RAadv) as models of network simulation. It reduces the time of re-implementation of the model, and potentially improve the result of the simulation since it already “actively running” in the real world.

It was started as a Google Summer of Code (GSoC) 2008 by Liu Jian with numerous contributions especially on the netlink implementation with quagga porting into ns-3-simu (former name of ns-3-dce). You can look at his effort at the [link](#).

1.1 Current Status

Quagga support in DCE is unmaintained as of June 2023, but still is believed to work. It was last actively worked on in 2012. It is not clear whether the [upstream quagga project](#) is still completely compatible. Some people have started to use Free Range Routing (FRR) in place of quagga, but we do not have documentation for that.

Quagga support on DCE does not fully support all the environment that DCE has. The following shows the limited availability of each protocol.

	Basic Mode (ns-3 stack)	Advanced Mode (ns-3-linux)	Remarks
Rtadvd (zebra)	NG	OK	
RIPv1/v2 (ripd)	NG	OK	bind() fail
RIPng (ripngd)	NG	OK	send() fail
OSPFv2 (ospfd)	OK	OK	
OSPFv3 (ospf6d)	NG	OK	send() fail
BGP (bgpd)	OK	OK	
BGP+ (bgpd)	NG	OK	

2.1 Prerequisite

Quagga support on DCE requires several packages: autoconf, automake, flex, git-core, wget, g++, libc-dbg, bison, indent, pkgconfig, libssl-dev, libsysfs-dev, gawk

You need to install the prerequisite packages in advance.

2.2 Building ns-3, DCE, and DCE-Quagga

To install ns-3-dce-quagga, you can use **bake** as an installation tool as follows.

```
$ git clone https://gitlab.com/nsnam/bake.git
$ export BAKE_HOME=`pwd`/bake
$ export PATH=$PATH:$BAKE_HOME
$ export PYTHONPATH=$PYTHONPATH:$BAKE_HOME
$ export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:$BAKE_HOME
```

then build ns-3-dce with quagga:

```
mkdir dce
cd dce
bake.py configure -e dce-ns3-|version| -e dce-quagga-|version|
bake.py download
bake.py build
```

note that dce-quagga-1.12 is the DCE quagga module version 1.12. If you would like to use the development version of the module, you can specify **dce-quagga-dev** as a module name for bake.

If you want to use dce-quagga with DCE advanced mode (i.e., using Linux native network stack), you can build as following commands. This is highly recommended at this moment so that Quagga runs successfully.

```
mkdir dce
cd dce
bake.py configure -e dce-linux-|version| -e dce-quagga-|version|
bake.py download
bake.py build
```

For more information about ns-3-dce core, please refer the [DCE manual](#).

Then you can try some unit tests of ns-3-dce-quagga as follows:

```
$ cd source/ns-3-dce
$ ./test.py -s dce-quagga
...
PASS: TestSuite dce-quagga 9.775 s
1 of 1 tests passed (1 passed, 0 skipped, 0 failed, 0 crashed, 0 valgrind errors)
```

You can see the above PASSED test if everything goes fine. Congrats!

2.3 Examples

2.3.1 Basic

```
$ cd source/ns-3-dce
$ ./waf --run dce-zebra-simple
```

if everything goes fine, you would see the file “routes.log” in the current directory as follows. The routes “10.1.0/24” and “10.2.0/24” was announced by ospfd accordingly.

```
Time: 70s
Destination      Gateway          Genmask          Flags Metric Ref    Use Iface
127.0.0.0         0.0.0.0          255.0.0.0        U        0      -    -    0
10.1.1.0          0.0.0.0          255.255.255.0    U        0      -    -    1
10.2.1.0          0.0.0.0          255.255.255.0    U        0      -    -    2
10.1.0.0          10.2.1.1         255.255.255.0    UGS     20     -    -    2
10.2.0.0          10.1.1.1         255.255.255.0    UGS     20     -    -    1
```

2.3.2 OSPF

Another example of OSPF is generating pcap file.

```
$ cd source/ns-3-dce
$ ./waf --run dce-quagga-ospfd
```

You would see the following parsed output by tcpdump.

```
$ tcpdump -r dce-quagga-ospfd-0-0.pcap -n -vvv
:
(snip)
09:00:45.106325 IP (tos 0x0, ttl 1, id 0, offset 0, flags [none], proto OSPF (89),
->length 72, bad cksum 0 (->a55b)!)
    10.0.0.2 > 10.0.0.1: OSPFv2, Database Description, length 52
        Router-ID 10.0.0.2, Backbone Area, Authentication Type: none (0)
        Options [External], DD Flags [Master], MTU: 65535, Sequence: 0x4b3d3b2e
```

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```
Advertising Router 10.0.0.2, seq 0x80000002, age 0s, length 16
Router LSA (1), LSA-ID: 10.0.0.2
Options: [External]
```

2.3.3 OSPF with ns-3-linux

The final example of OSPF is using Linux kernel stack via DCE.

```
$ cd source/ns-3-dce
$ ./waf --run "dce-quagga-ospfd --netStack=linux"
```

then, you would see the following parsed output by tcpdump.

```
$ tcpdump -r dce-quagga-ospfd-0-0.pcap -n -vvv
:
(snip)
09:00:45.106325 IP (tos 0xc0, ttl 1, id 15116, offset 0, flags [none], proto OSPF,
→ (89), length 72)
    10.0.0.2 > 10.0.0.1: OSPFv2, Database Description, length 52
        Router-ID 10.0.0.2, Backbone Area, Authentication Type: none (0)
        Options [External], DD Flags [Master], MTU: 1500, Sequence: 0x4b3d3b2e
        Advertising Router 10.0.0.2, seq 0x80000002, age 0s, length 16
            Router LSA (1), LSA-ID: 10.0.0.2
            Options: [External]
```

2.4 Configuration Manual

In order to utilize quagga protocols in ns-3, users need to define in the scenario via ns3::QuaggaHelper.

```
#include "ns3/quagga-helper.h"

int main (int argc, char *argv[])
{
    QuaggaHelper quagga;
    quagga.EnableOspf (node, "10.0.0.0/8");
    quagga.EnableOspfDebug (node);
    quagga.EnableZebraDebug (node);
    quagga.Install (node);
}
```

Modifying DCE Quagga

3.1 Customizing Helper

At this moment, only a limited configuration of Quagga is implemented in the QuaggaHelper. For example, if you wanna configure the “cost” parameter of OSPF link, you do have to extend QuaggaHelper (quagga-helper.cc) to generate the following configuration for example.

```
interface sim0
  ip ospf cost 20
!
```

3.2 Customizing Binary

If you wanna extend the protocol by modifying the source code of Quagga, your extended binary should be located at the directory “ns-3-dce/build/bin_dce”.

CHAPTER 4

FAQ

(TBA)