NEAT Tutorial at Hainan University:
Getting Started with NEAT

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Disclaimer

- This is work in progress
- The API can change anytime
- The code has not been tested substantially (Report bugs at https://github.com/NEAT-project/neat/issues)
- Comments welcome

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neat
Motivation

• Many different applications
• New Transport Layer protocols/extensions
  – Stream Control Transmission Protocol (SCTP)
  – Concurrent Multipath Transfer for SCTP (CMT-SCTP)
  – Datagram Congestion Control Protocol (DCCP)
  – Multi-Path TCP (MPTCP)
• Problem:
  – “SCTP is not available for Windows”
  – “Firewall does not support SCTP → no NAT with SCTP → no SCTP”
  – “CMT-SCTP is only available for FreeBSD => no support in Linux”
  – => Application developer: “I just use regular TCP, it works everywhere!”
The NEAT Project

• A New, Evolutive API and Transport-Layer Architecture for the Internet

• Partners:
  – Simula Research Laboratory (SRL)
  – University of Oslo (UiO)
  – Karlstads Universitet (KAU)
  – Münster University of Applied Sciences
  – University of Aberdeen
  – Celerway, EMC, Mozilla, Cisco (companies)

• https://www.neat-project.org
• https://github.com/NEAT-project/neat
Goal

• A middleware between application and Transport Layer
• An application specifies its requirements:
  – Preferred Transport Layer protocols, maximum acceptable delay, ...
• NEAT: According to the requirements
  – Selects Transport Layer protocol(s),
  – Configures the Transport Layer protocols.
• Transport Layer
  – Kernel remains unchanged (makes deployment easy)
  – Possibility to use user-space implementations
    (currently: usrsctp → state-of-the-art SCTP, including CMT-SCTP!)
How Applications work Today

Note:
“BSD Sockets API” may significantly vary among different operating systems, e.g.:

- Different socket options
- Different features
How Applications work with NEAT

With NEAT:
• Applications use common NEAT interface
  • Describe requirements/configurations by properties and options
• NEAT uses APIs of the available Transport Layer protocols (TCP, SCTP, UDP, DCCP, MPTCP, ...)
• NEAT helps with additional features (DNS lookup, QoS settings, NAT, TLS, ...)
The Implementation

• Implementation
  – Implemented in C, Open Source under BSD license
  – Portable (currently supports FreeBSD, Linux, Mac OS X, and NetBSD)

• Source
  – Git repository: https://github.com/NEAT-project/neat
  – Branch: dreibh/neat-socketapi
  – Ready-to-use packages:
    • Ubuntu: https://launchpad.net/~dreibh/+archive/ubuntu/ppa/+packages
    • Fedora: https://packages.nntb.no/nornet-applications/fedora/
    • Note: use system's package management tool to add repository!
The APIs

• NEAT Callback API
  - Asynchronous (non-blocking) functions
  - Application registers callbacks for events (like data/message received, new incoming connection, etc.)
  - Practical for asynchronous applications (like BOOST sockets, etc.)
  - Different from BSD Sockets-like API

• NEAT Sockets API
  - An API like the BSD Sockets API
  - Blocking mode (e.g. to wait for data), non-blocking mode (e.g. poll())
  - Easy porting of existing applications
The NEAT Sockets API

• Documentation (as Internet Draft):
  – Work in progress!

• In the following:
  – Server pseudo-code example
  – Client pseudo-code example
  – How to get running code examples?
Server Example: Blocking Mode (1)

```c
uint16_t port=8888;
static const char* properties = 
   "{"transport": 
      { "value": [ "MPTCP", "SCTP", "SCTP/UDP", "TCP" ],
      "precedence": 1 } }";

int sd = nsa_socket(0, 0, 0, properties);
nsa_bindn(sd, port, NULL, 0, 0);
nsa_listen(sd, 10);
while(1) {
   int newSD = nsa_accept(sd, NULL, 0);
   Start new thread to handle requests from newSD;
}
nsa_close(sd);
nsaCleanup();
```
Server Example: 
Blocking Mode (2)

```c
void serviceThread(int newSD) {
    ssize_t readBytes = nsa_read(newSD, ...);
    while(readBytes > 0) {
        // do something with the received data
        ...
        // send something ...
        nsa_write(newSD, ...);
        ...
        readBytes = nsa_read(newSD, ...);
    }
    nsa_close(newSD);
}
```
Client Example

```c
static const char* properties = 
    "\{ \"transport\": { \
        \"value\": [ \"MPTCP\", \"SCTP\", \"SCTP/UDP\", \"TCP\" ],\n        \"precedence\": 1 } } \";

int sd = nsa_socket(0,0,0,properties);
nsa_connectn(sd, "myserver.nntb.no", 8888, NULL, NULL, 0);
while(1) {
    // send something ...
    nsa_write(newSD, ...);
    // receive something
    nsa_read(newSD, ...);
}
nsa_close(sd);
nsa_cleanup();
```
How to Get Running Code Examples?

• Install NEAT libraries in Ubuntu (16.04 or later):
  - sudo apt-add-repository -s -y ppa:dreibh/ppa
  - sudo apt update
  - sudo apt install libneat-socketapi-dev

• Example HTTP servers and client:
  - git clone https://bitbucket.org/dreibh/neat-examples
  - cd neat-examples
  - ./autogen.sh
  - Read the README in the “examples” directory!
Using NEAT in NorNet Core

• Install NEAT libraries in a NorNet Core sliver:
  - `sudo dnf install libneat-socketapi-devel`
  - `/etc/yum.repos.d/nornet.repo contains the repository (it is already configured, i.e. nothing to do here!):
    - [NorNet-Applications]
    - name=NorNet Applications
    - baseurl=http://packages.nntb.no/nornet-applications/fedora/$releasever/$basearch
    - enabled=1
    - gpgcheck=1
    - gpgkey=file:///etc/pki/rpm-gpg/nornet.key

• Build and run the examples

https://www.nntb.no
Feedback

• Questions on NEAT?
• Discovered a bug?
• Having a feature request?

• Please file tickets in the issue tracker!
• https://github.com/NEAT-project/neat/issues

• Your feedback is highly appreciated!
Conclusion

• Summary
  − NEAT provides a smart middleware layer between application and transport protocols
  − Easy-to-use NEAT Sockets API

• Ongoing and Future Work
  − Notifications (similar to SCTP's notifications handling API)
  − Transport Layer Security support in NEAT
  − Adapt applications (like NetPerfMeter, RSPLIB, ...) to use NEAT
Literature


Thank you for your attention!
Any questions?

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