A Practical Introduction to NEAT at Hainan University

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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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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, ...)

[Diagram showing the relationship between NEAT and its various components (DNS, STUN, HE, QoS, NAT, etc.).]
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
  - Quite 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):
  - https://tools.ietf.org/id/draft-dreibholz-taps-neat-socketapi-00.txt
  - 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;
const char* properties = "{\n   "transport": [{ "value": "SCTP", "precedence": 1 },,\n   { "value": "TCP", "precedence": 0 } ] }";

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);
nsa_cleanup();
```
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

const char* properties = "{
    "transport": [
        { "value": "SCTP", "precedence": 1 },
        { "value": "TCP", "precedence": 0 }
    ]
};

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
  
  – /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
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

- **Dreibholz, T.**: “NEAT Sockets API” (TXT, 43 KiB), IETF, Individual Submission, Internet Draft draft-dreibholztaps-neat-socketapi-00, April 11, 2017.


Thank you for your attention!
Any questions?

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