Multi-Worker NFD: an NFD-compatible High Speed NDN Forwarder

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Motivation

- NDN Forwarding Daemon (NFD)
  - is a default NDN forwarder
  - is designed for modularity and feature extensibility
  - but has low forwarding performance

- Main bottleneck of NFD performance
  - Single-Thread Forwarding Architecture
Multi-Worker NFD (MW-NFD)

- Design Goals
  - High-speed NDN Forwarding
  - Full compatibility with NFD and existing NDN applications
  - Keep NFD’s Forwarding Plane Architecture for easy porting of any new NFD features

- Design Principles
  - Support multiple forwarding threads running on different cores
  - Keep NFD’s forwarding plane in forwarding threads
  - Support all the management features of NFD with same API

- Based on NFD v0.7.0
MW-NFD Architecture

Management

RIB Manager

forwarding worker #1
Strategy, NDNLP, PIT, CS, FIB, Tx

forwarding worker #2
Strategy, NDNLP, PIT, CS, FIB, Tx

forwarding worker #k
Strategy, NDNLP, PIT, CS, FIB, Tx

Local App. #1

Local App. #m

Port 0
Rx & Dist.

Port 1
Rx & Dist.

Message Queue

Face
Input Threads

- Allocate **one input thread to each input port**
- Receive packets from faces associated to the port
  - register **associated faces to the thread's io_service**
- Packet parsing and distribution to workers based on
  - Interest *
    - hash of name prefix of pre-configured length (default = 2)
  - Data/Nack without PIT token *
    - same to Interest
  - Data/Nack with PIT token *
    - worker-id of matching Interest encoded in PIT token
  - First fragment Interest/Data/Nack
    - same to Interest/Data/Nack
    - store selected worker-id with its fragment_index
  - Subsequent fragments :
    - stored worker-id for its fragment_index

(*) : adopted from NDN-DPDK
Management Thread

- Launches input and forwarding worker threads on configured cpu cores
- Receives and distributes packets from local application faces and internal face
- **Processing all management commands** (nfdc commands) by interacting with input and worker threads
  - under development
Forwarding Demo Configuration

- NDN Pktgen: based on DPDK pktgen 19.12
- FIB: 10K (avg prefix length = 4.26)
- Interest Stream: 10M with unique names (adding 2~4 words to FIB entries)
- Platform
  - MW-NFD: Xeon Gold 6242 (2.8GHz, 16 cores) with two 10GE ports NIC
Forwarding Throughput

- Interest + Data Forwarding Throughput
- 16.4 Gbps (for 10 workers, 8192 B Data)
- MW-NFD can yield about 13 times of NFD throughput
Future Work

- Develop management features fully compatible with NFD
  - nfdc command processing
- **Compatibility tests** with existing NDN applications
- Enhancing some forwarding logic implementations
  - Packet receiving in input threads
  - some NFD forwarding logics (CS lookup/insert, etc)
- **Source release after compatibility testing**