AINFV: Analysis of Isolation (memory/packet) in Network Function Virtualization

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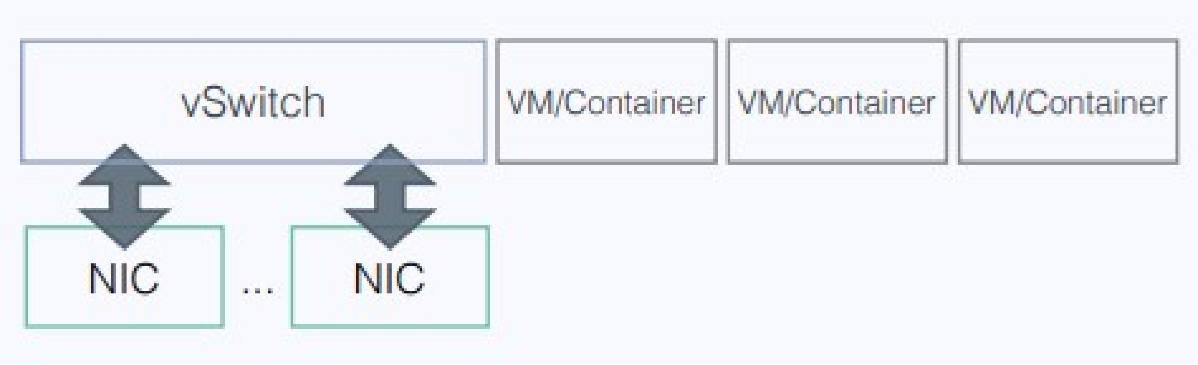
Network Function Virtualization (NFV)

- What is NFV?
- Why we use NFV?
- What are the requirement of NFV?
- Issues of Using NFV
  - Executing NFs
  - Developing NFs

Executing NFs

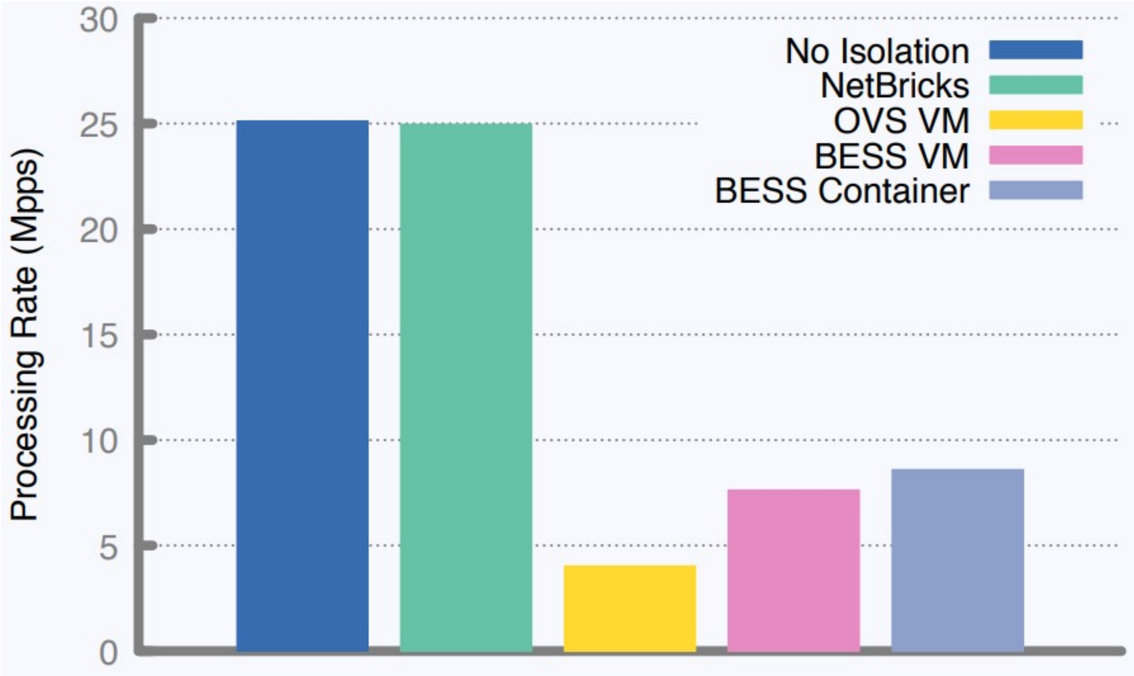
- Isolation vs Performance
- Types of Isolation
  - Memory Isolation
  - Packet Isolation
- Current Approach
  - Using VMs or Containers
  - Using vSwitch



[10]

Executing NFs

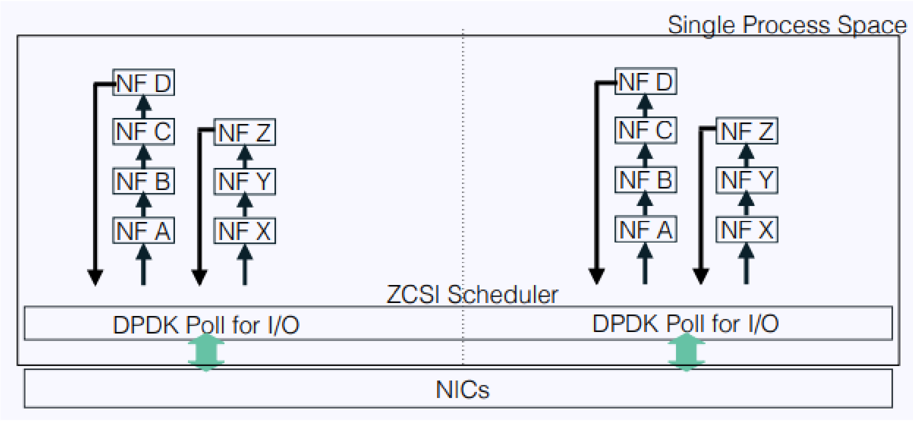
- Isolation vs Performance
- Current Approach



Isolation costs Performance [10]

Executing NFs

- NetBricks[1]
- Execution Environment
  - Single Process Space
- Isolation using software Isolation
  - Packet Isolation : Unique Types
  - Memory Isolation : Type checks and array bounds checks



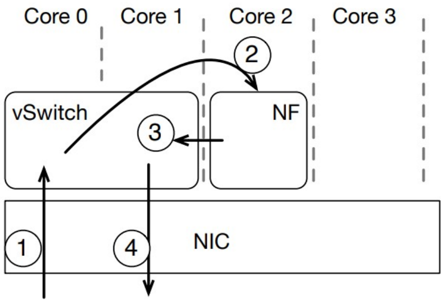
NetBricks Architecture[10]

Executing NFs

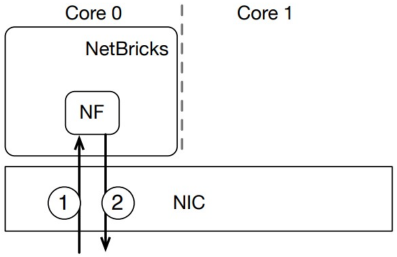
- NetBricks
- Memory Isolation
  - Type checking at compile time
  - Bound checking at runtime to avoid memory overflow and underflow
  - Disallowing pointer arithmetic in NF code
- Packet Isolation
  - Using Unique types to prevent data race at compile time
  - One NF has access to a packet at a time ensuring zero copy I/O

Isolation Analysis

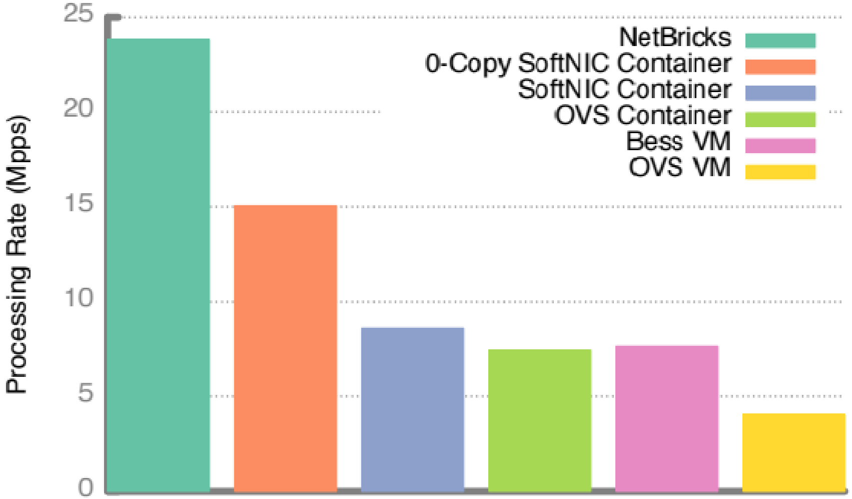
- Simple NF vs NF chains vs Complex NF
- Simple NF
    - Swaps source and destination address of receiving packets



For VM/Container[1]



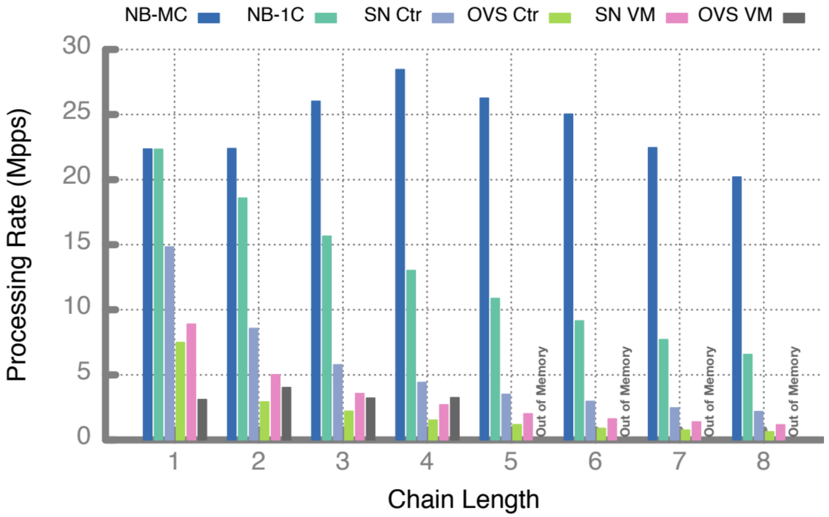
For NetBricks[1]



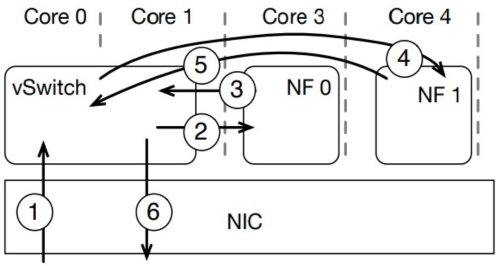
Throughput achieved using different Isolation techniques [1]

Isolation Analysis

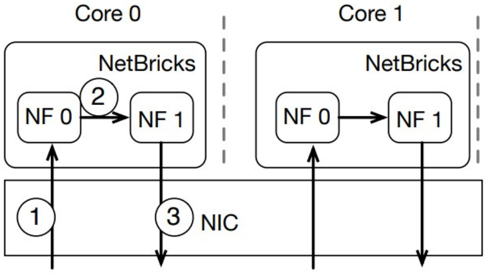
- Simple NF vs NF chains vs Complex NF
- NF chains
    - Multiple instances of Packet TTL (time to live) = 0 NFs
    - Two cases:
        - Single-core
        - Multi-core



Throughput analysis [1]



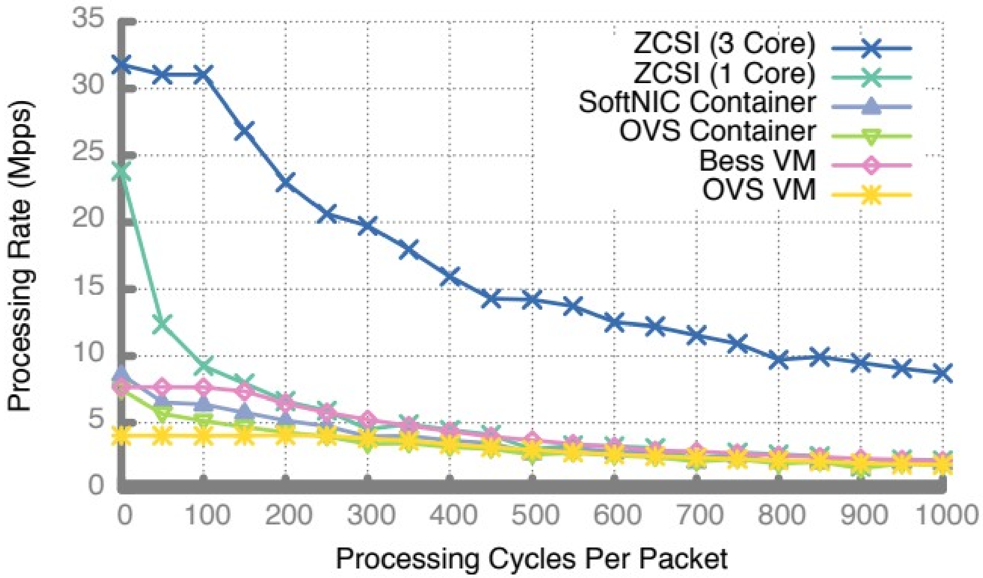
For VM/Container[1]



For NetBricks[1]

Isolation Analysis

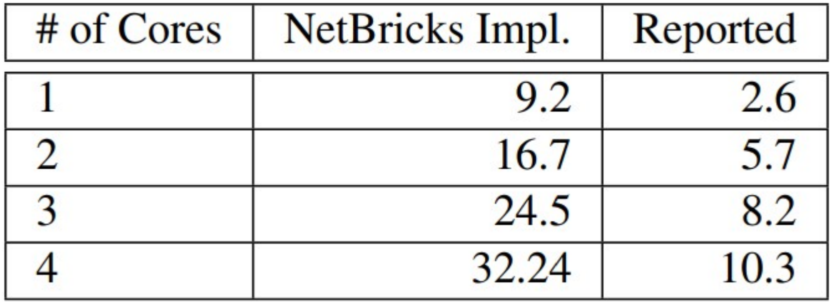
- Simple NF vs NF chains vs Complex NF
- Complex NF
  - Simple NF used with increased computation time per packet
  - Two cases:
    - Single-core
    - Three-cores



Throughput of complex NF using different technologies[1]

Developing NFs

- High-Level Programming Language vs Performance
- Current Approach
  - More focused on Low-level code
  - Spending a lot of time on optimization
- NetBricks
  - Separate common functionality and User-defined functionality
- Example NF : Maglev Load Balancer
  - 3.2x to 2.9x better performance



# of Cores	NetBricks Impl.	Reported
1	9.2	2.6
2	16.7	5.7
3	24.5	8.2
4	32.24	10.3

Throughput in MPPS [1]

Related Frameworks

- Developing NF
  - YANFF[2]
  - libVNF[3]
  - FLICK[4]
- Executing NF
  - NetVm[5] / OpenNetVM[6]
  - HyperNF[7]
  - G-NET[8]
- Isolation
  - SafeBricks[9]

Conclusion & Further Research

- Conclusion
  - Isolation is necessary for performance of NFV
  - VM/Container ensures isolation but at the cost of Performance degradation
  - NetBricks runs NF as a single process
    - Ensures both memory and packet isolation
- Further Research
  - Add control plane functionality to NetBricks
  - NetBricks integration with MANO systems

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