VPP Host Stack

Transport and Session Layers

Florin Coras, Dave Barach

VPP - A Universal Terabit Network Platform

For Native Cloud Network Services

EFFICIENCY
The most efficient software data plane Packet Processing on the planet

PERFORMANCE
FD.io on x86 servers outperforms specialized packet processing HW

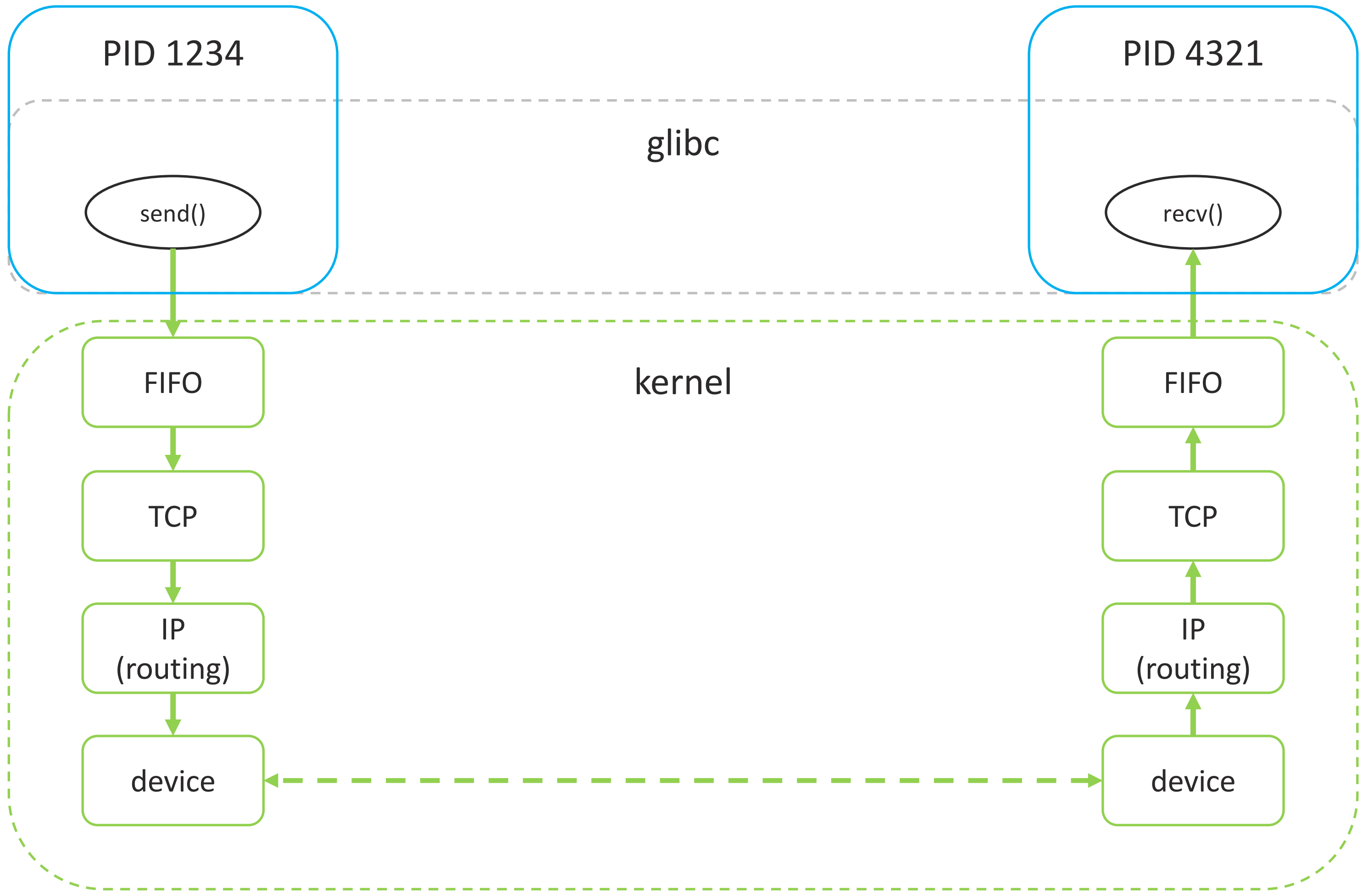
SOFTWARE DEFINED NETWORKING
Software programmable, extendable and flexible

CLOUD NETWORK SERVICES
Foundation for cloud native network services

LINUX FOUNDATION
Open source collaborative project in Linux Foundation

Breaking the Barrier of Software **D**efined **N**etwork **Services**
1 Terabit Services on a Single Intel® Xeon® Server !

Motivation: Container networking



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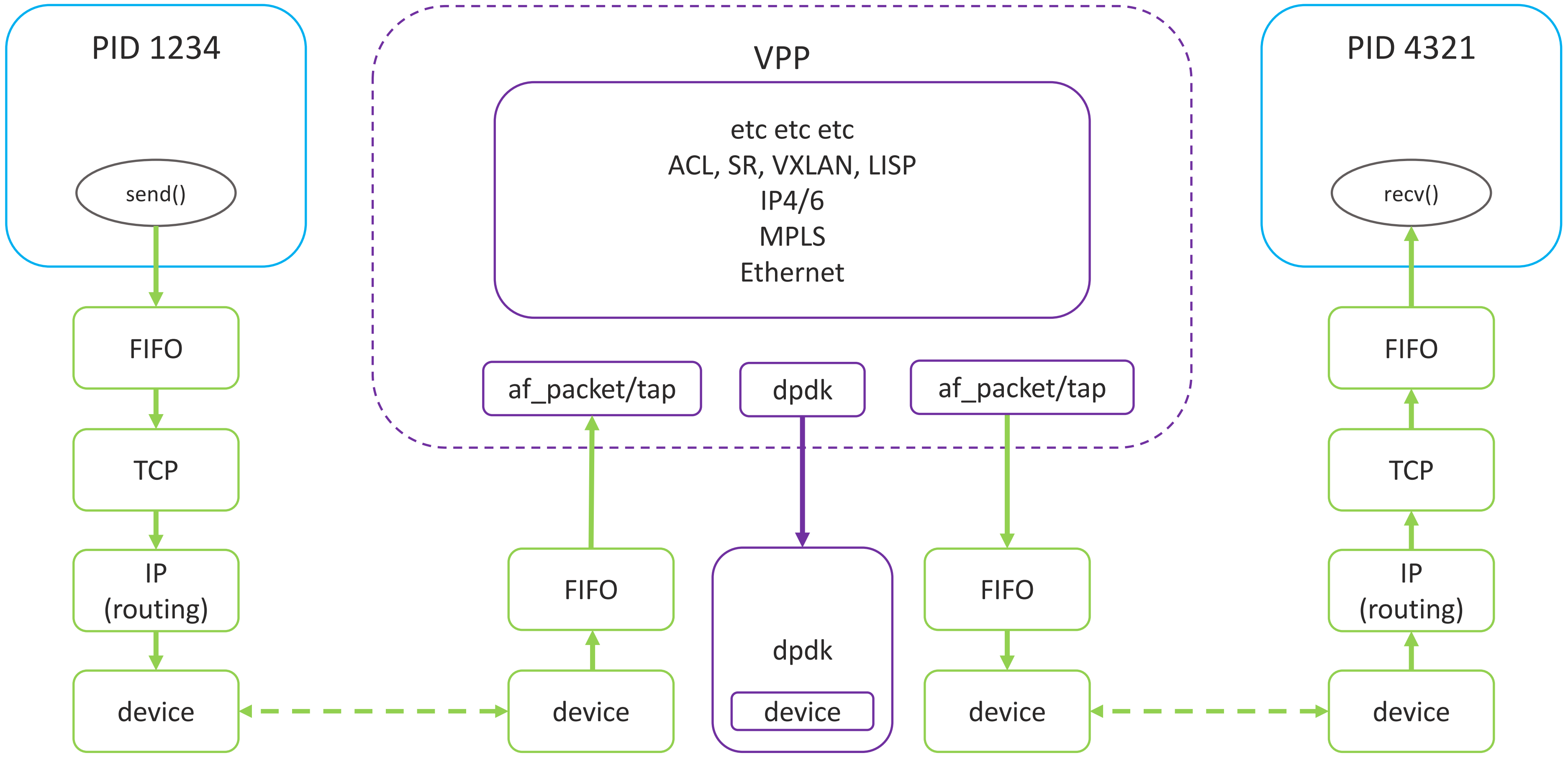
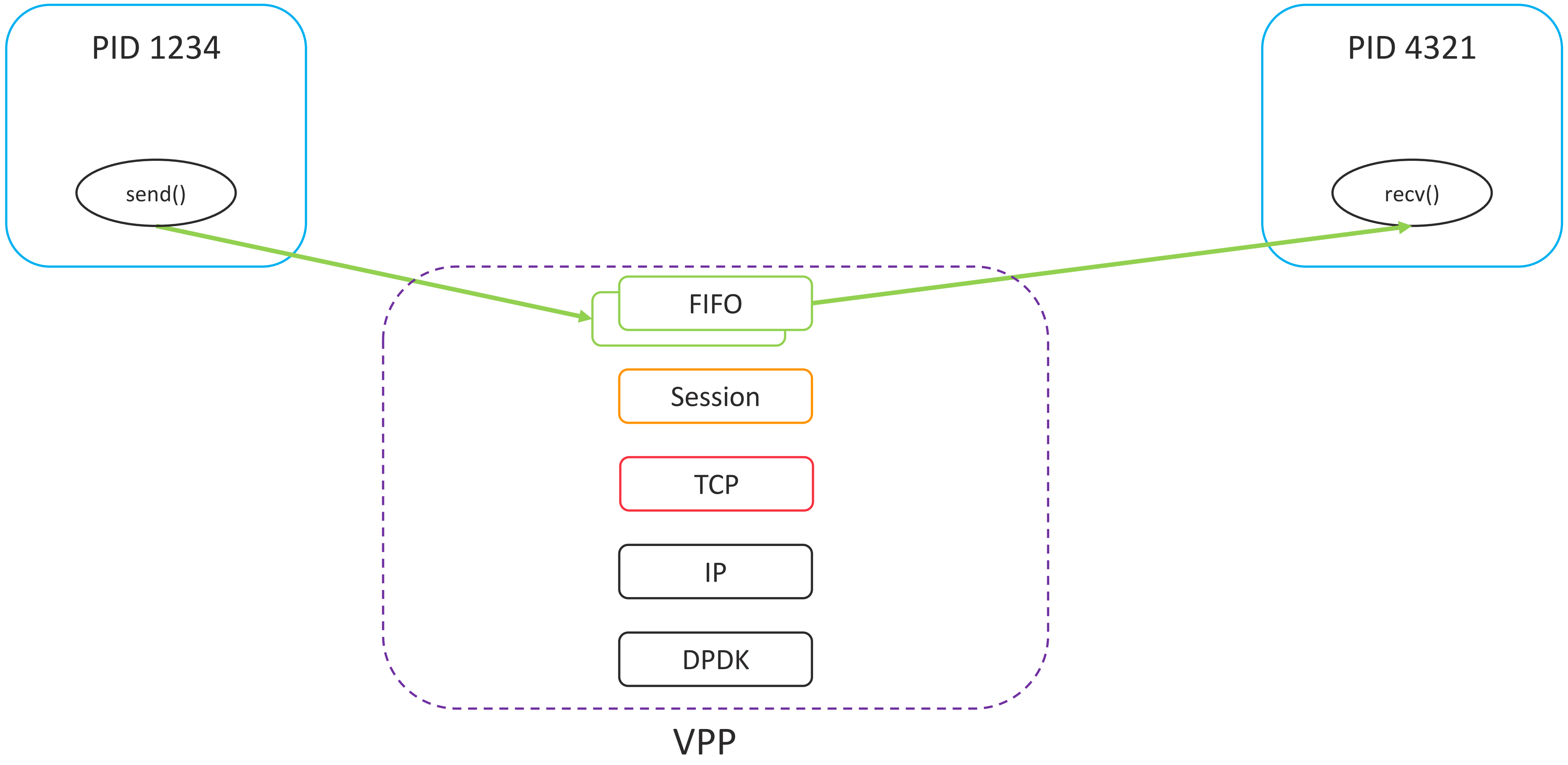
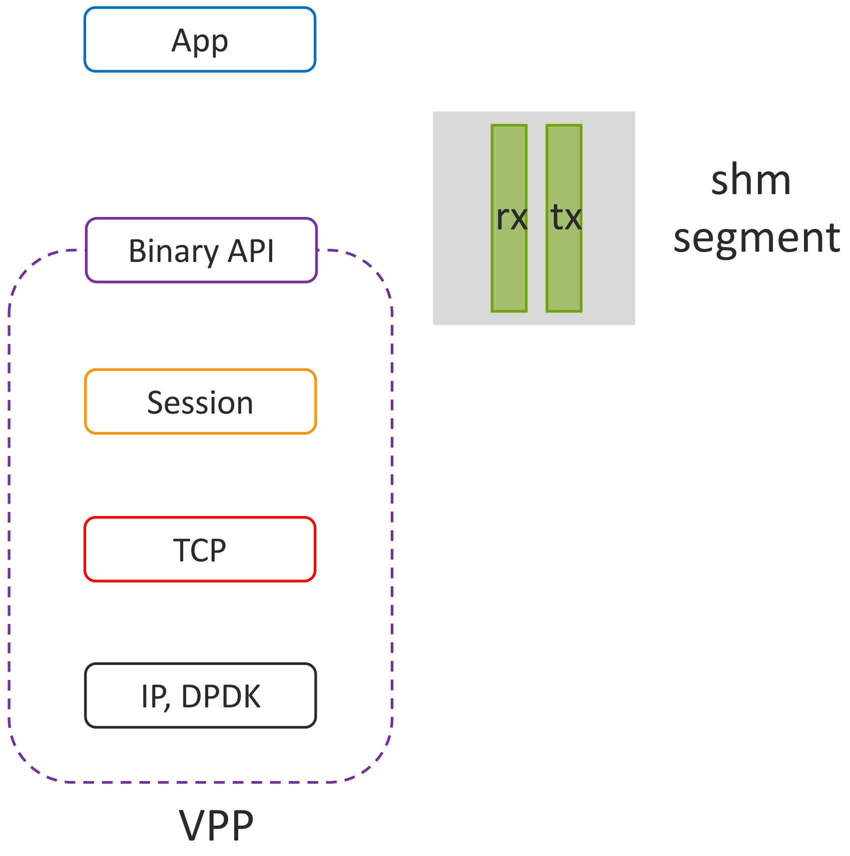


Why not this?

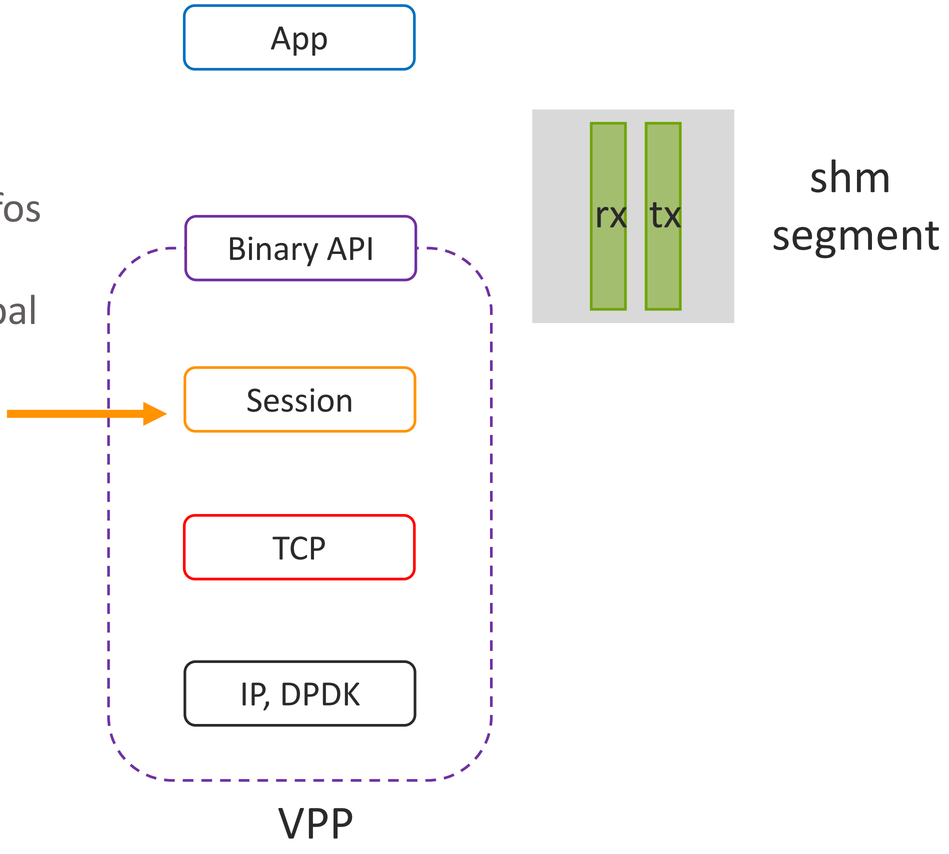


VPP Host Stack

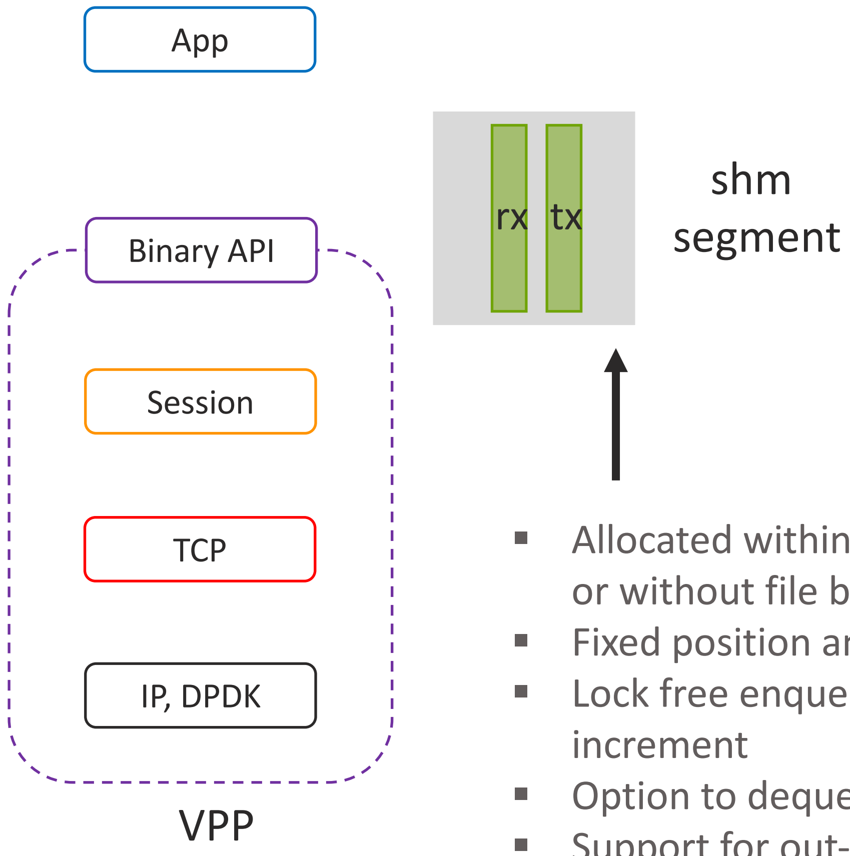


VPP Host Stack: Session Layer

- Maintains per app state and conveys to/from session events
- Allocates and manages sessions/segments/fifos
- Isolates network resources via namespacing
- Session lookup tables (5-tuple) and local/global session rule tables (filters)
- Support for pluggable transport protocols
- Binary/native C API for external/builtin applications



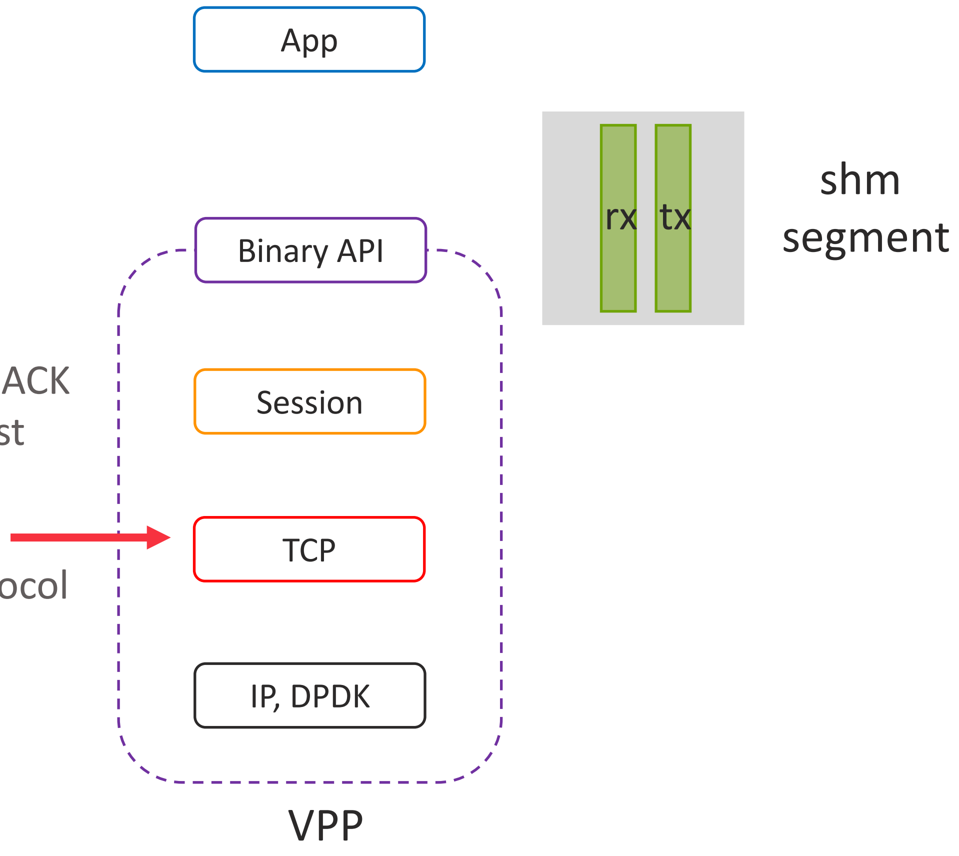
VPP Host Stack: SVM FIFOs



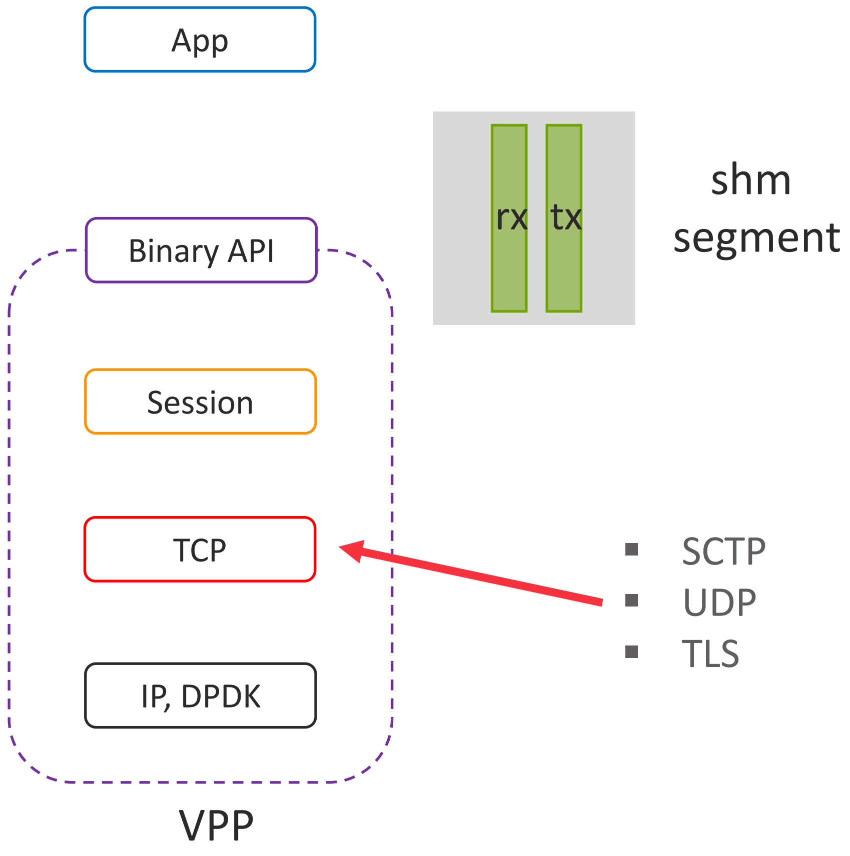
- Allocated within shared memory segments with or without file backing (ssvm/memfd)
- Fixed position and size
- Lock free enqueue/dequeue but atomic size increment
- Option to dequeue/peek data
- Support for out-of-order data enqueues

VPP Host Stack: TCP

- Clean-slate implementation
- “Complete” state machine implementation
- Connection management and flow control (window management)
- Timers and retransmission, fast retransmit, SACK
- NewReno congestion control, SACK based fast recovery
- Checksum offloading
- Linux compatibility tested with IWL TCP protocol tester



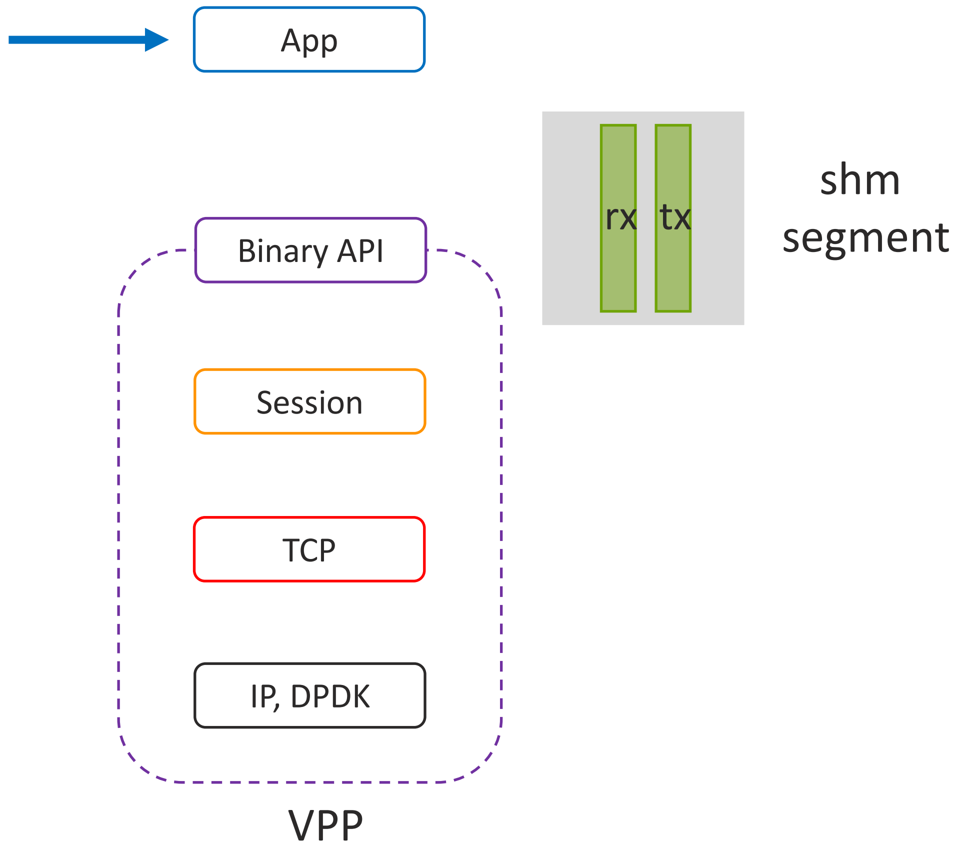
VPP Host Stack: more transports



- SCTP
- UDP
- TLS

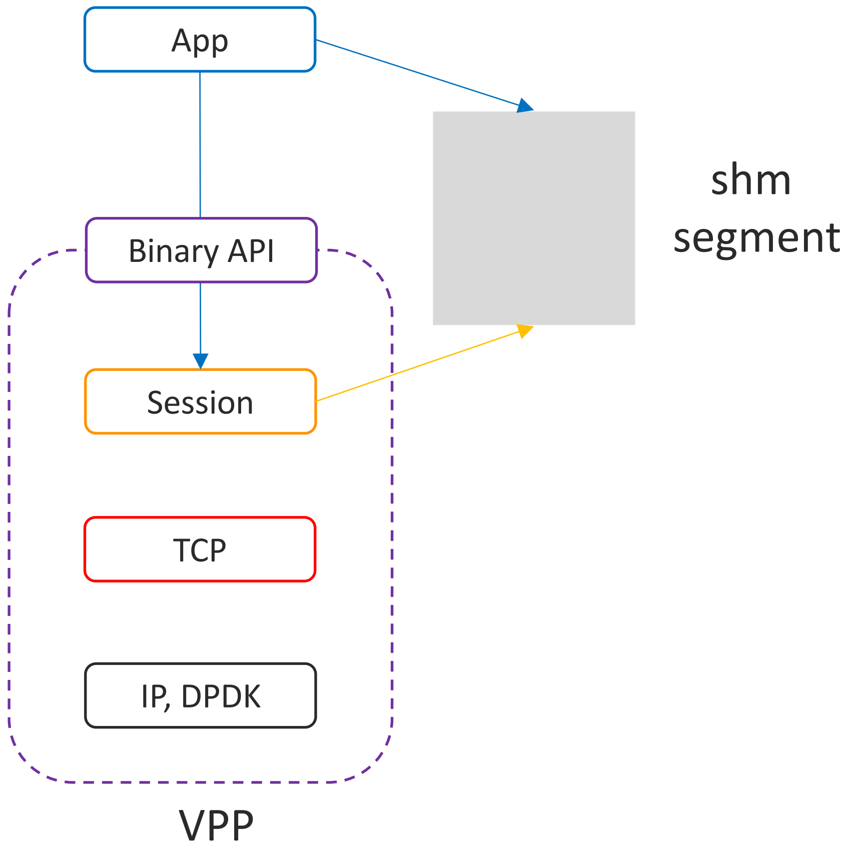
VPP Host Stack: Comms Library (VCL)

- Comms library (VCL) apps can link against
- LD_PRELOAD library for legacy apps
- epoll

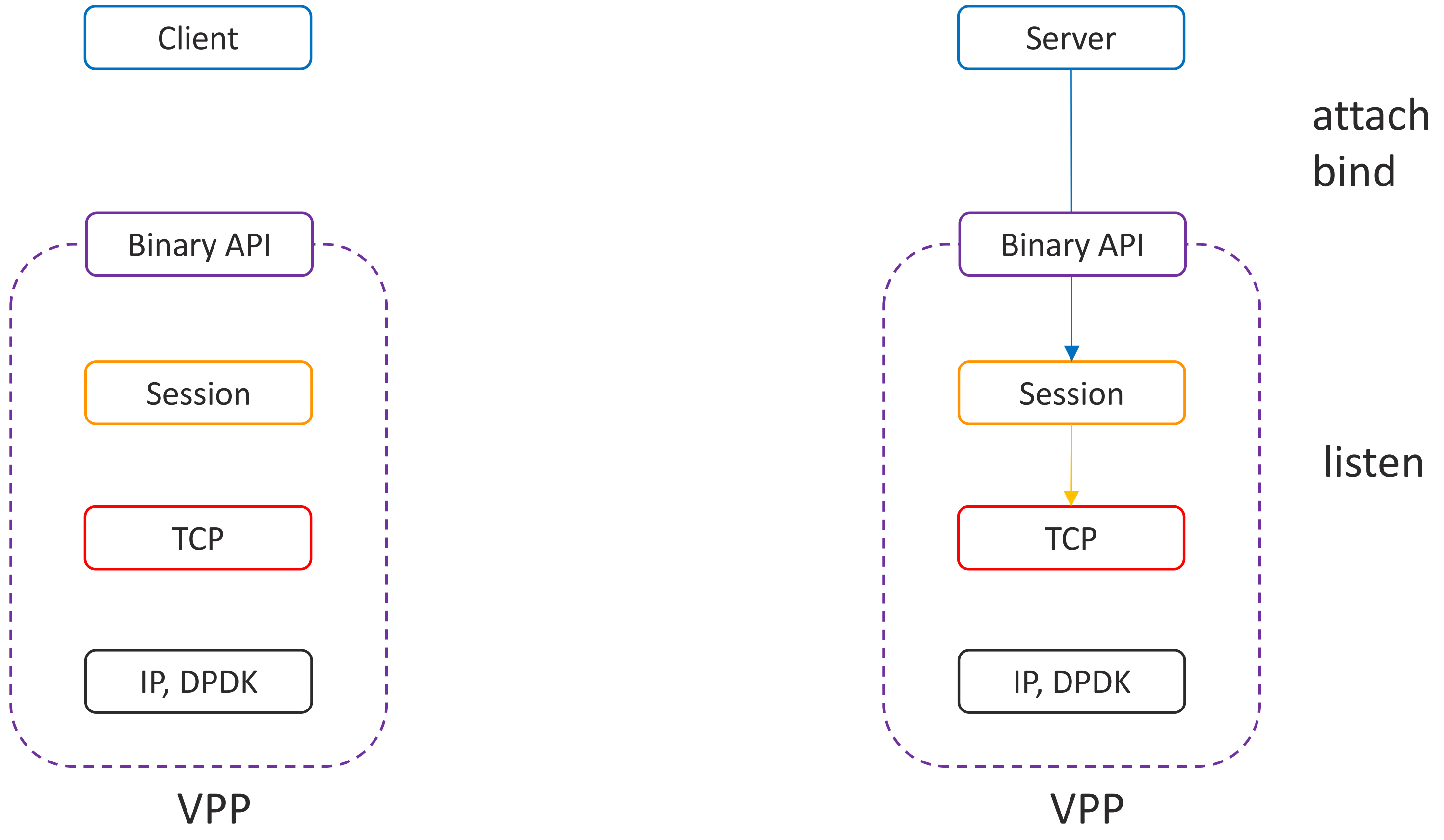


Application Attachment

attach
bind (server)
connect (client)



Session Establishment



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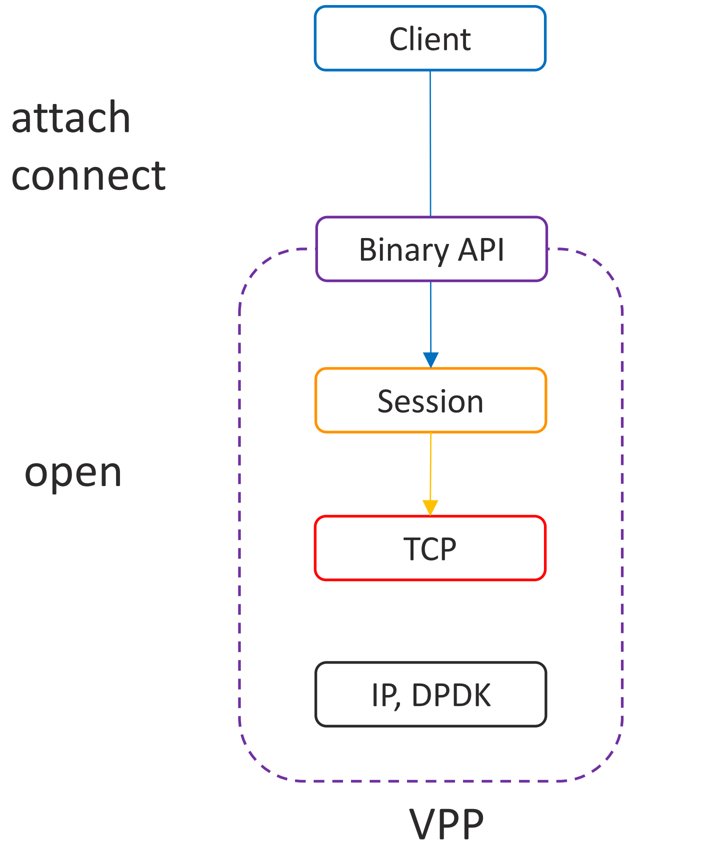

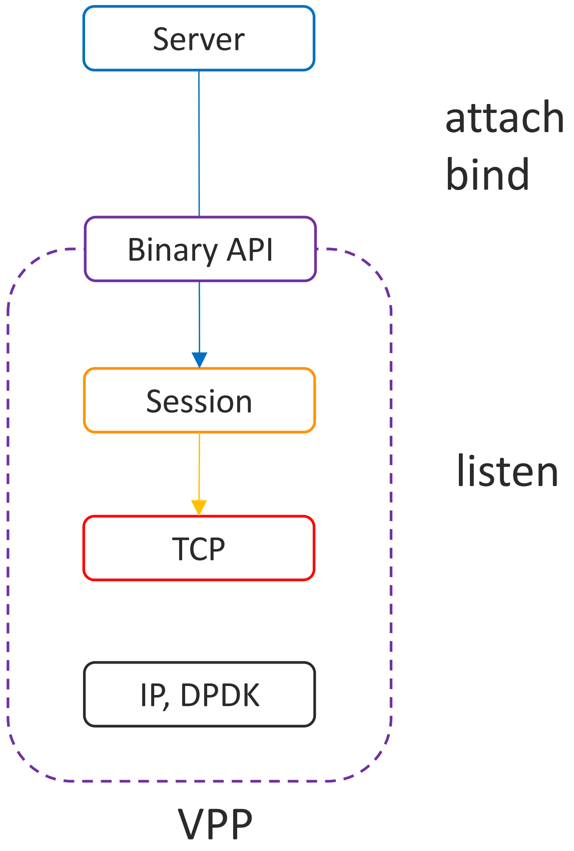

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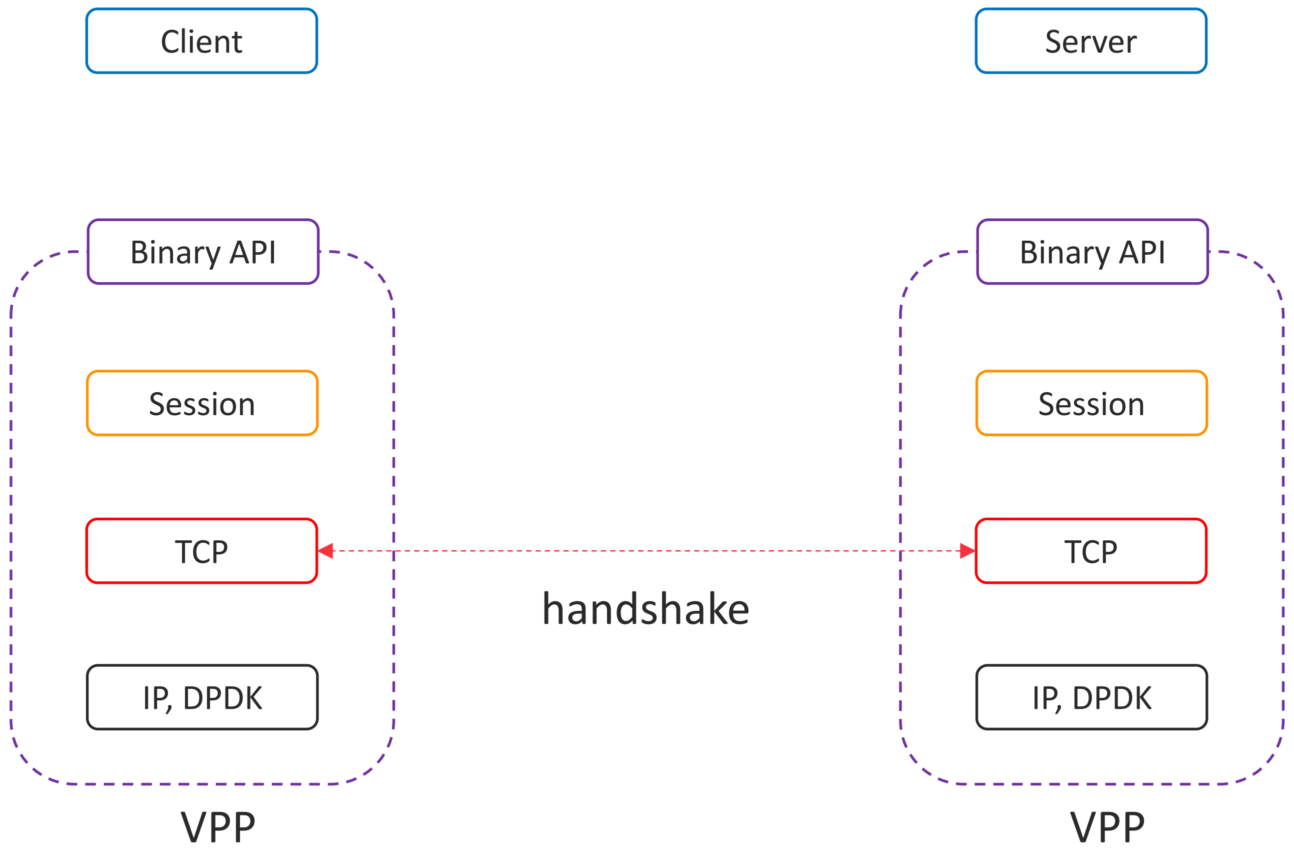

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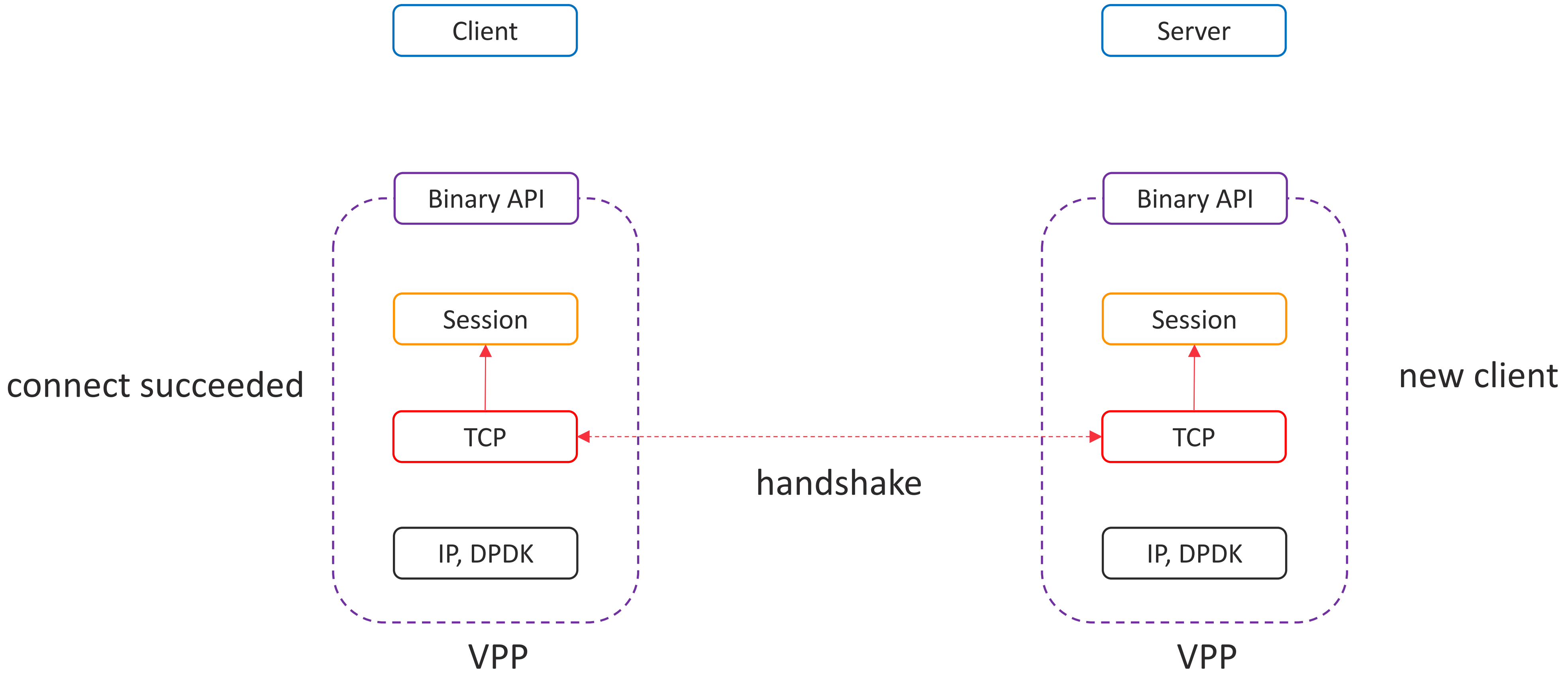

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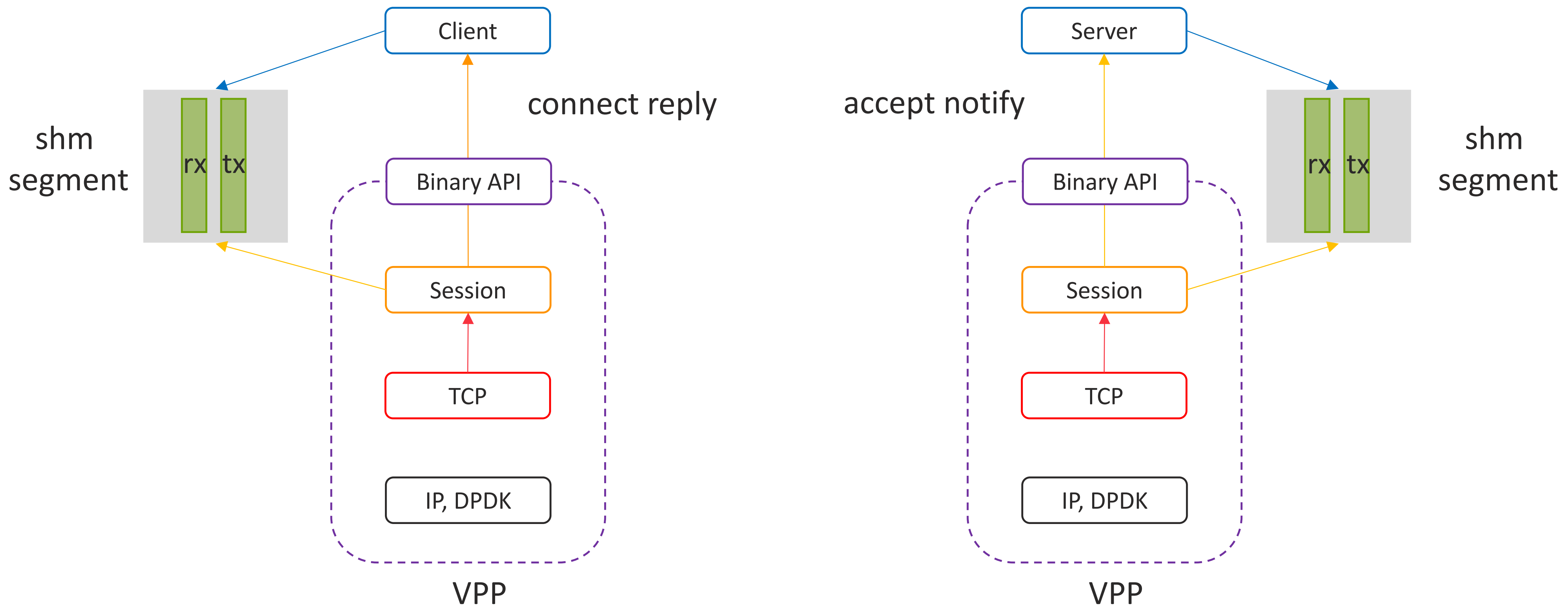
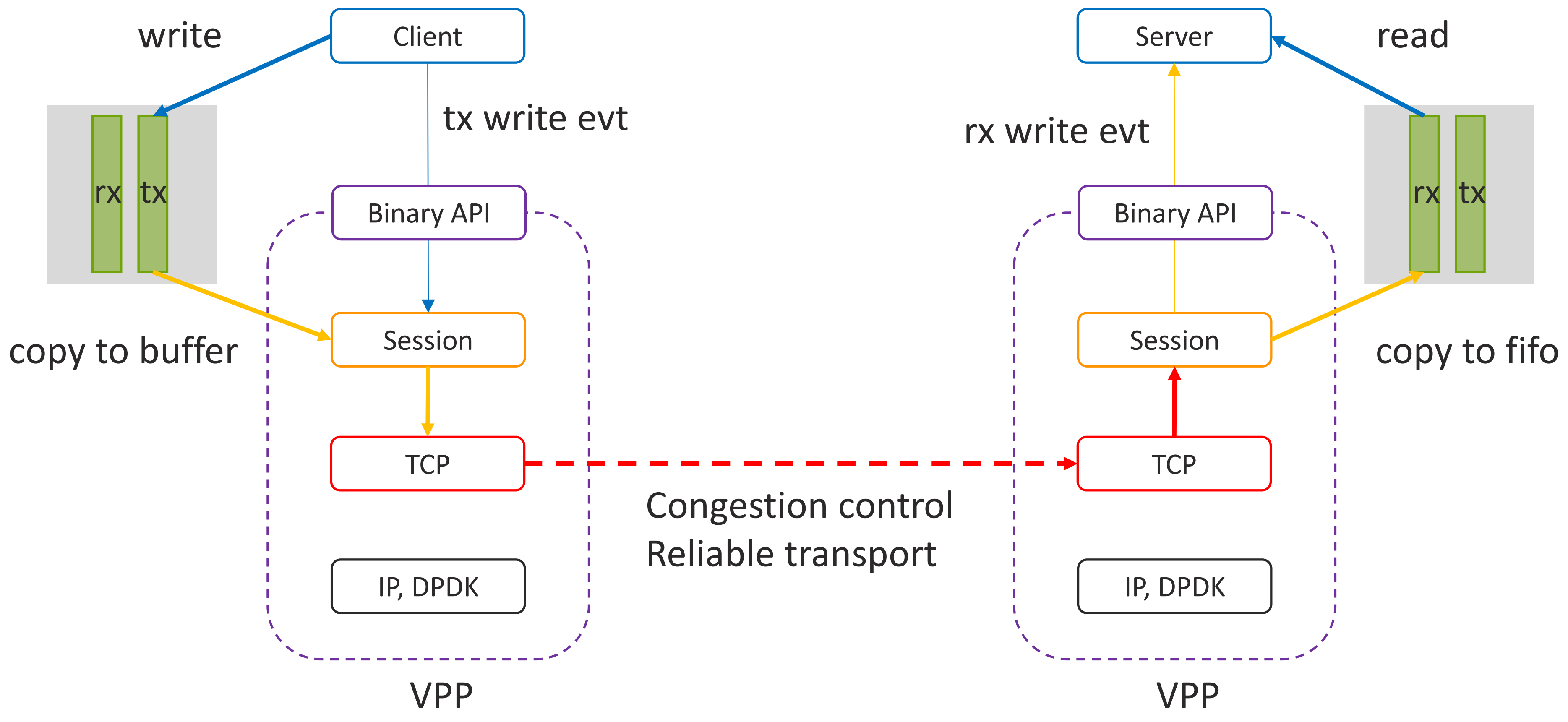


Data Transfer



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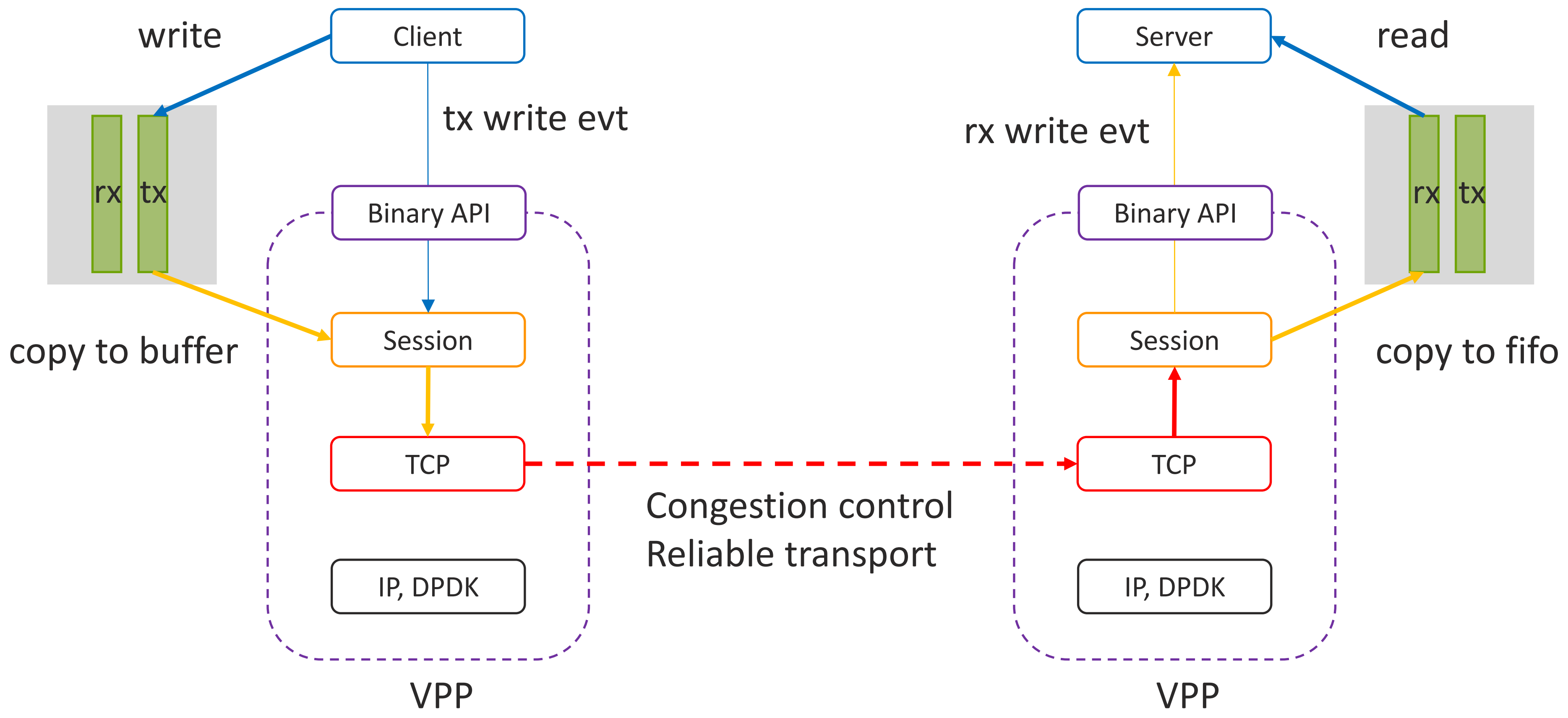
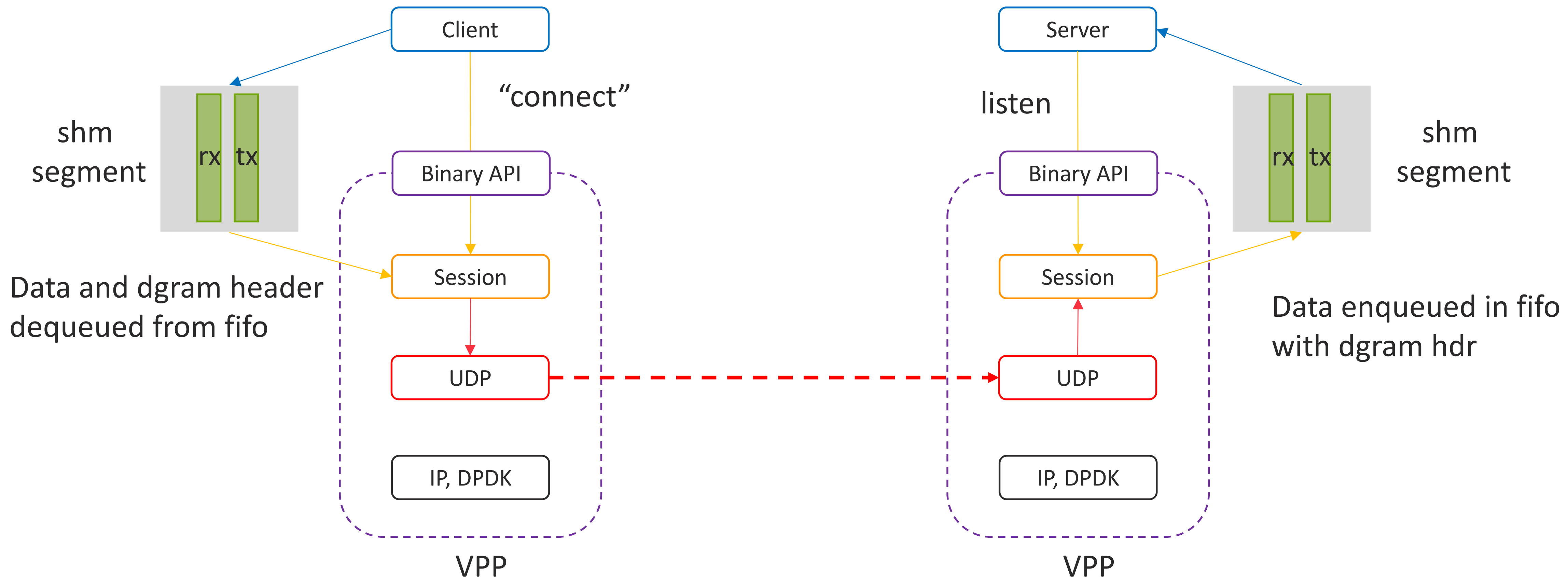
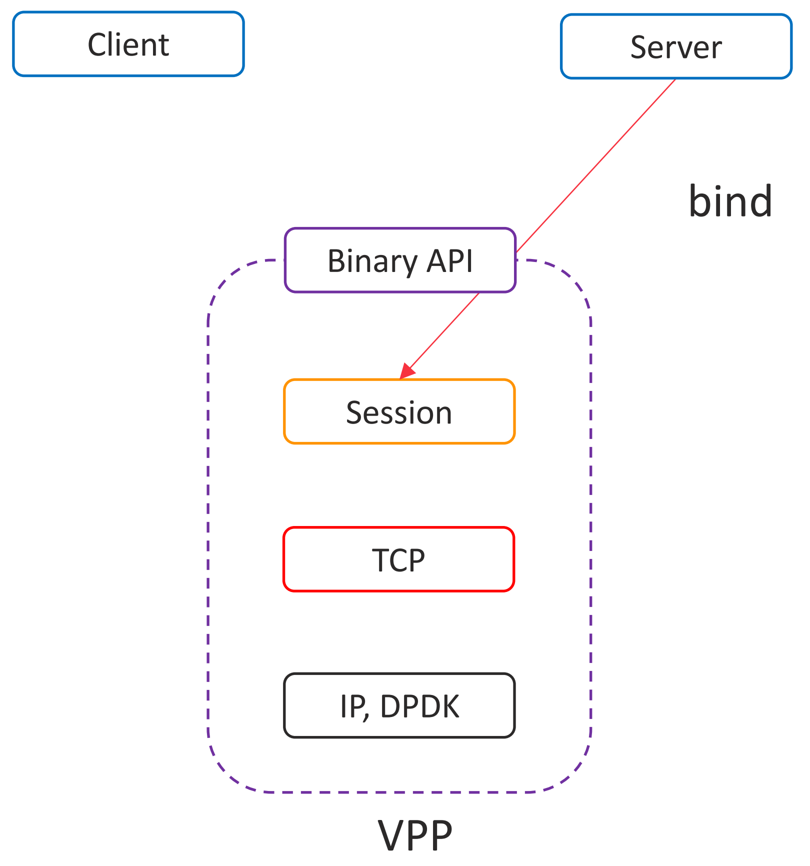


Some rough numbers on a E2699: ~12Gbps/core (1.5k MTU), ~20Gbps/core (9k MTU), ~185k CPS!

Data Transfer: Dgram Transports



Redirected Connections (Cut-through)



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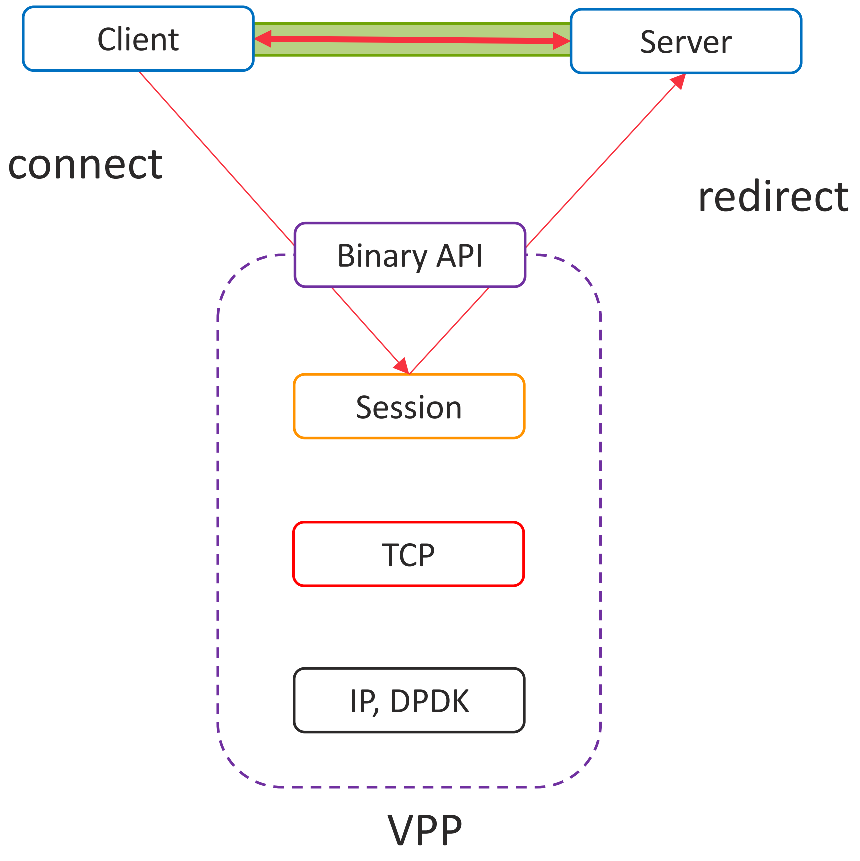

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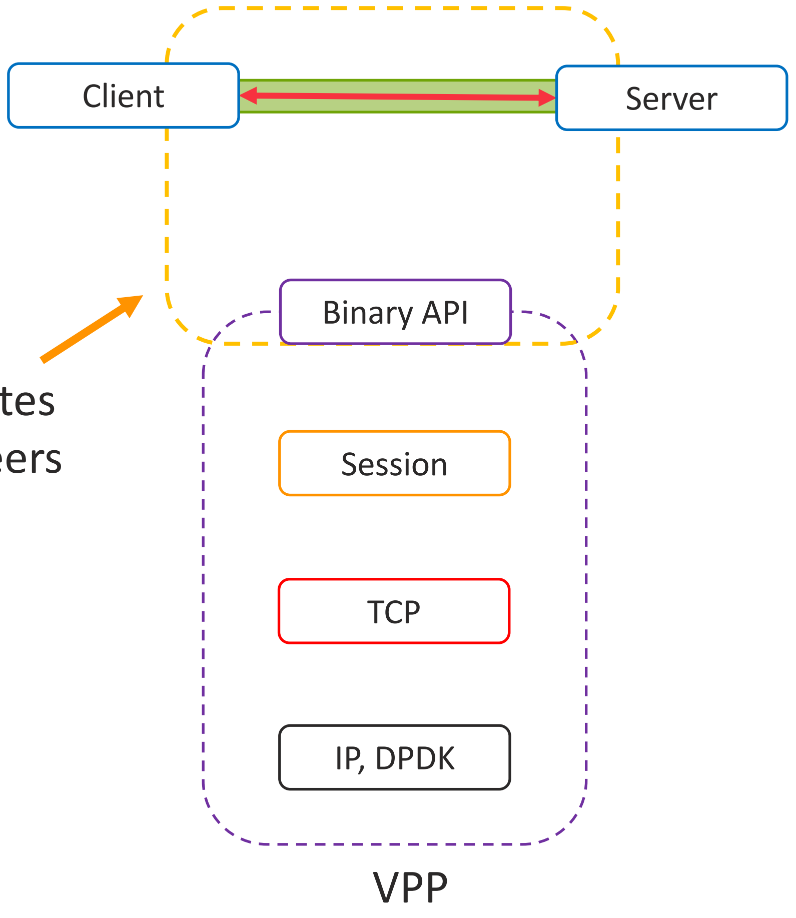
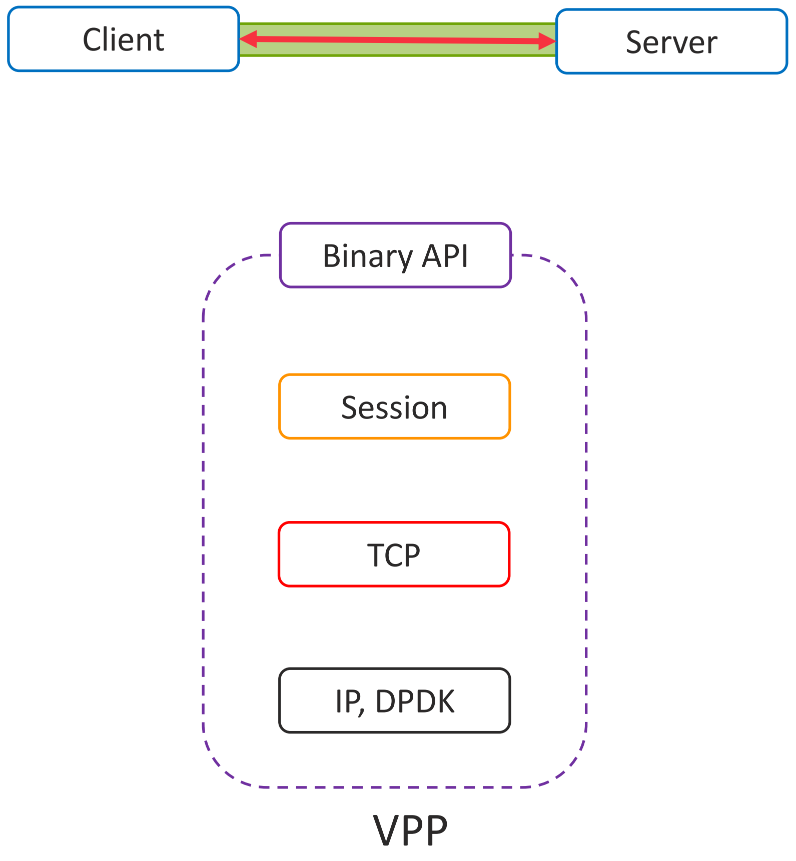


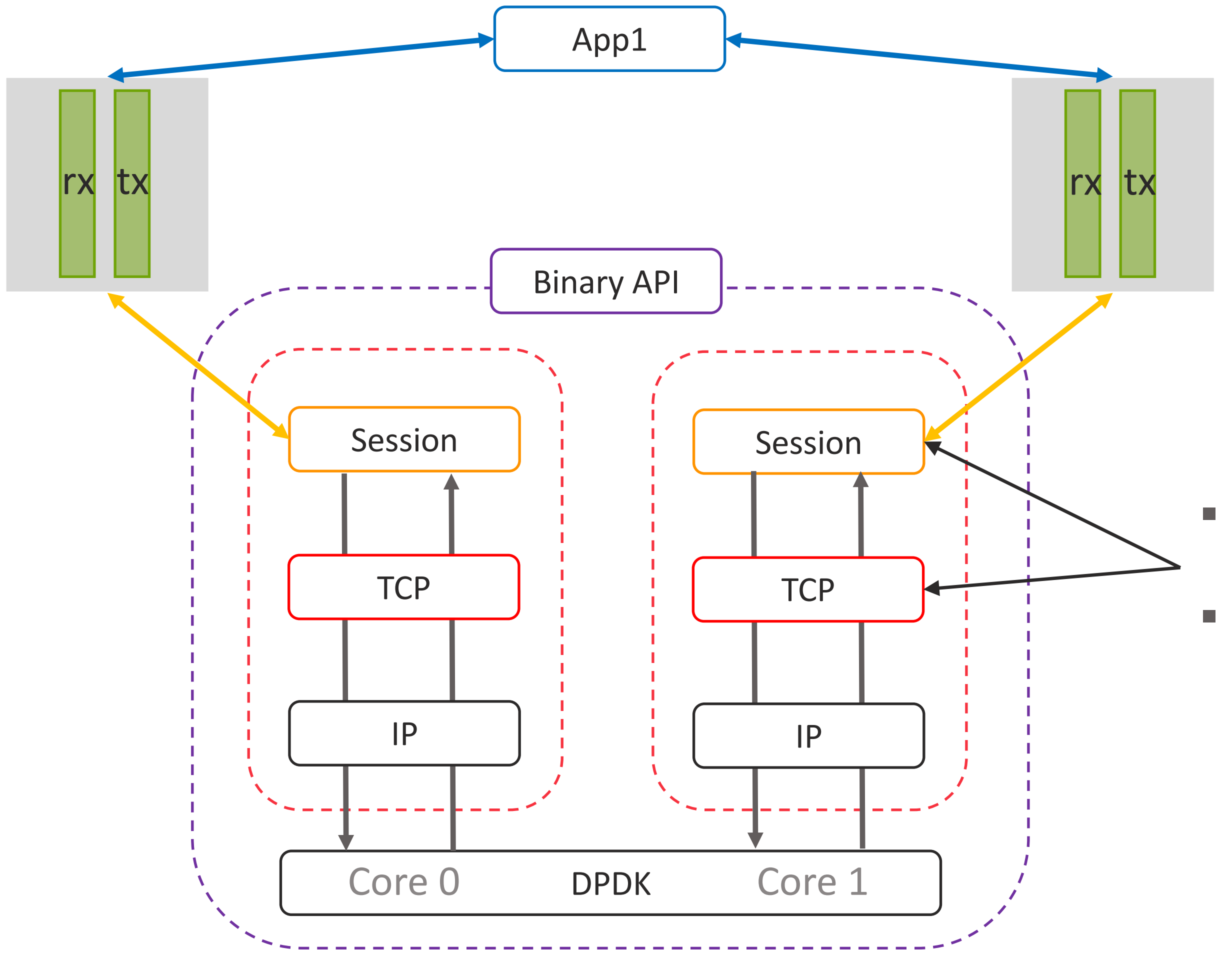
VPP tracks these sessions, allocates ssvm segments and asks both peers to map them.

Redirected Connections (Cut-through)

Throughput is memory bandwidth constrained: ~120Gbps!



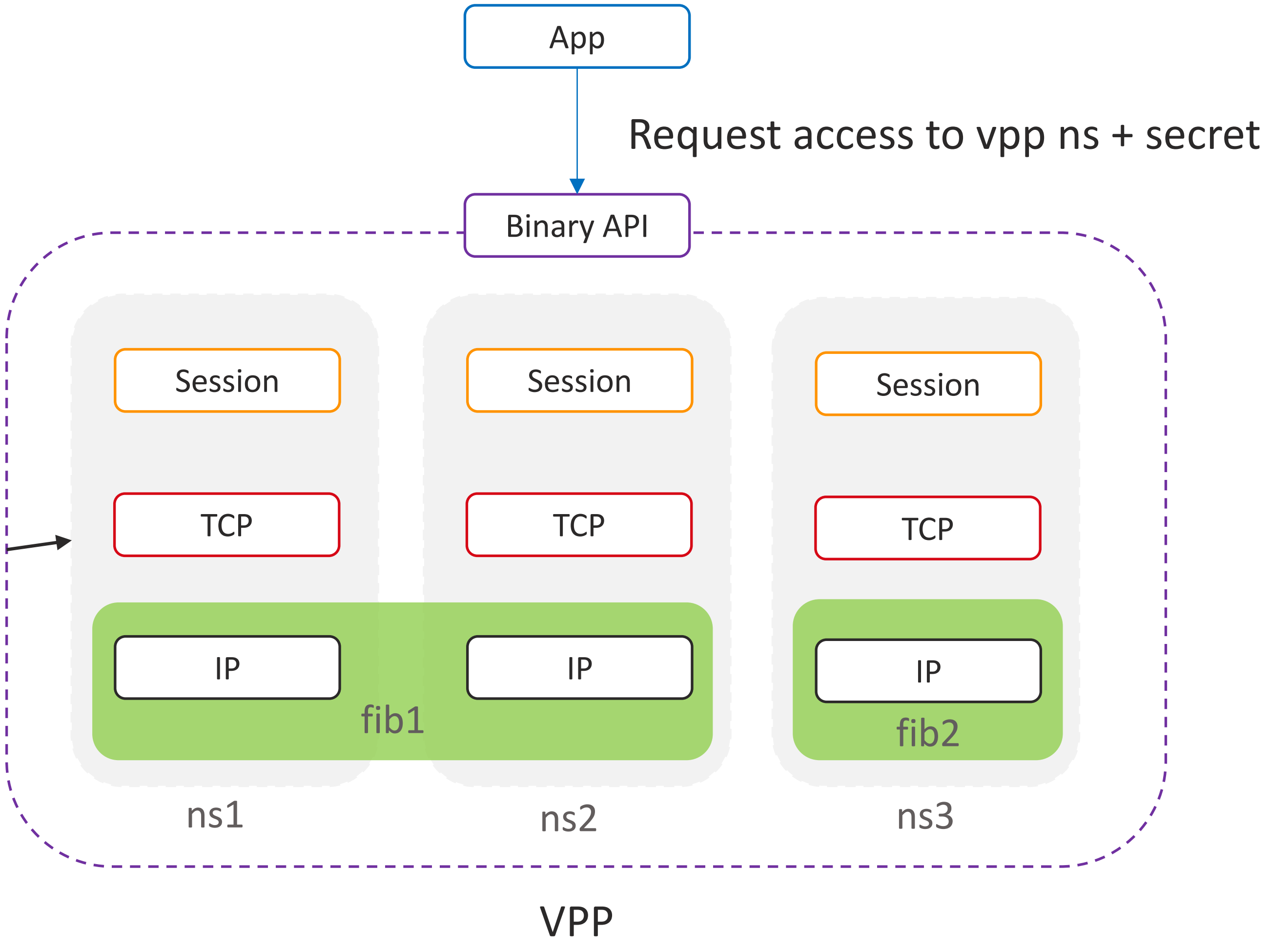
Multi-threading for stream connections



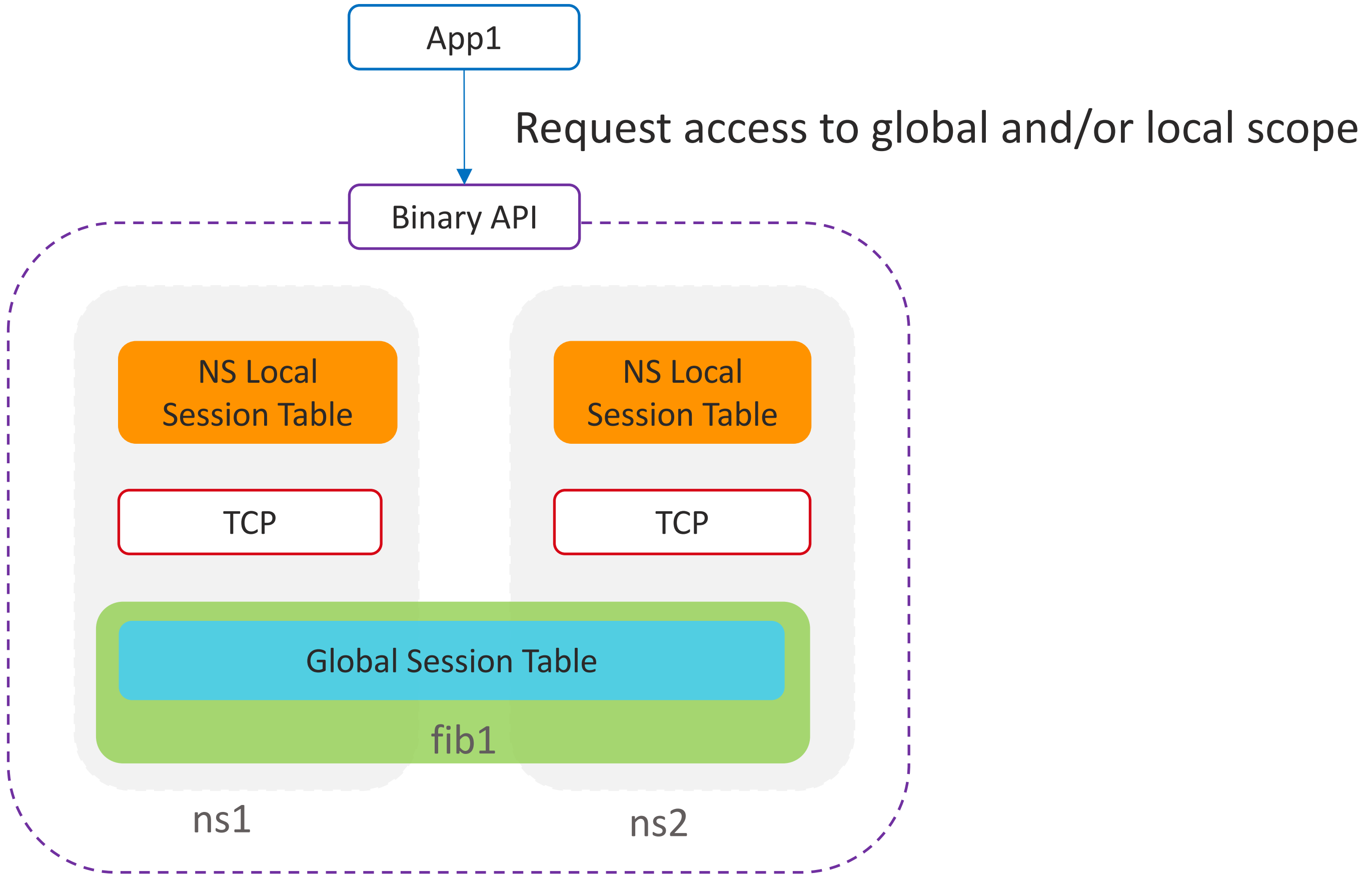
- Connections/sessions 'pinned' to a thread
- Per-thread data structures/state

Features: Namespaces

Namespaces are configured independently and associate applications to network layer resources like interfaces and fib tables



Features: Session Tables



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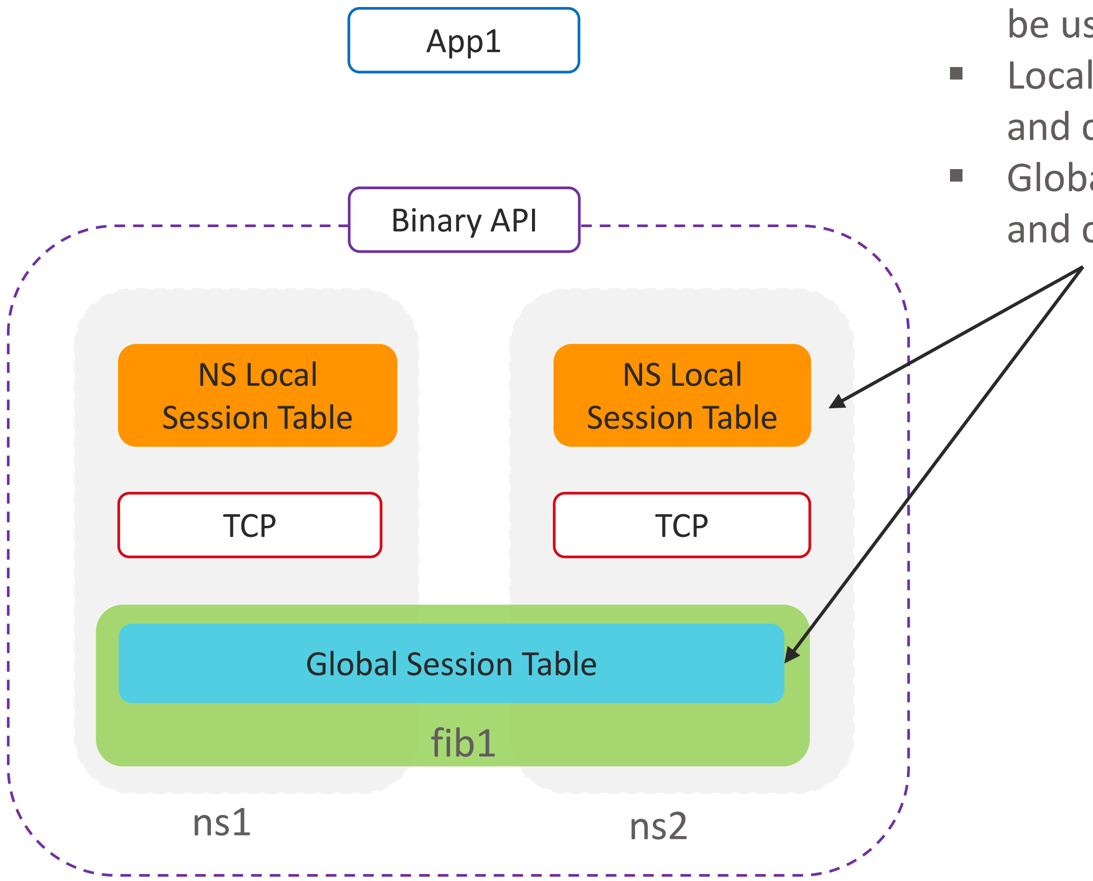
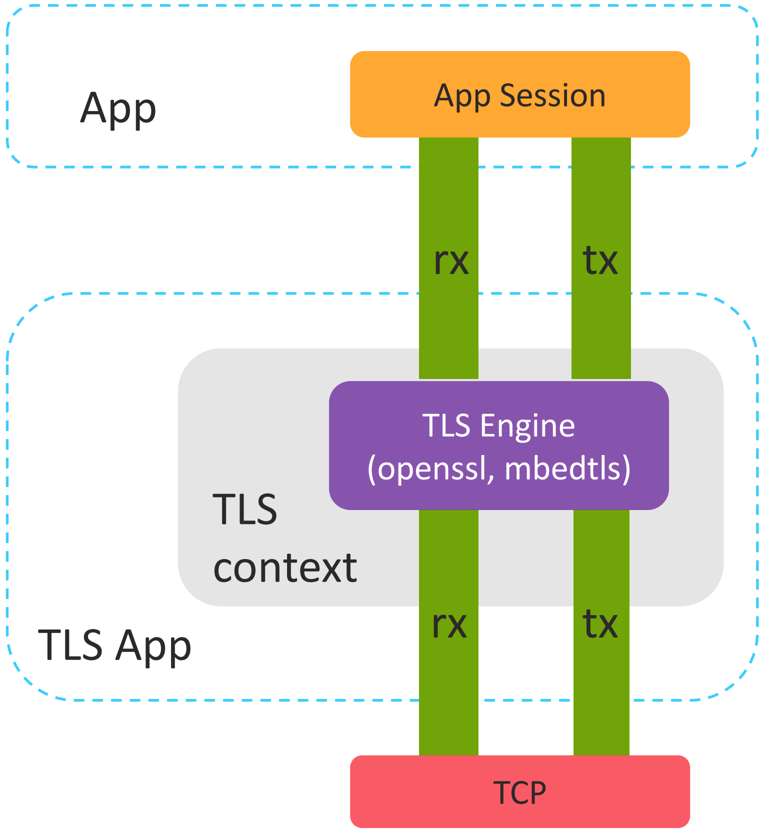


- Both table have “rules table” that can be used for filtering
- Local tables are namespace specific and can be used for egress filtering
- Global tables are fib table specific and can be used for ingress filtering

TLS App



- TLS App registers as transport at VPP init time
- TLS protocol implementation handled by plugin “engines”. We support openssl and mbedtls
- Client app registers key and certificate via api and requests tls as session transport
- CA certs read at TLS app init time. Defaults to reading /etc/ssl/certs/ca-certificates.crt
- Ping and Ray from Intel working on accelerating the openssl engine with QAT cards

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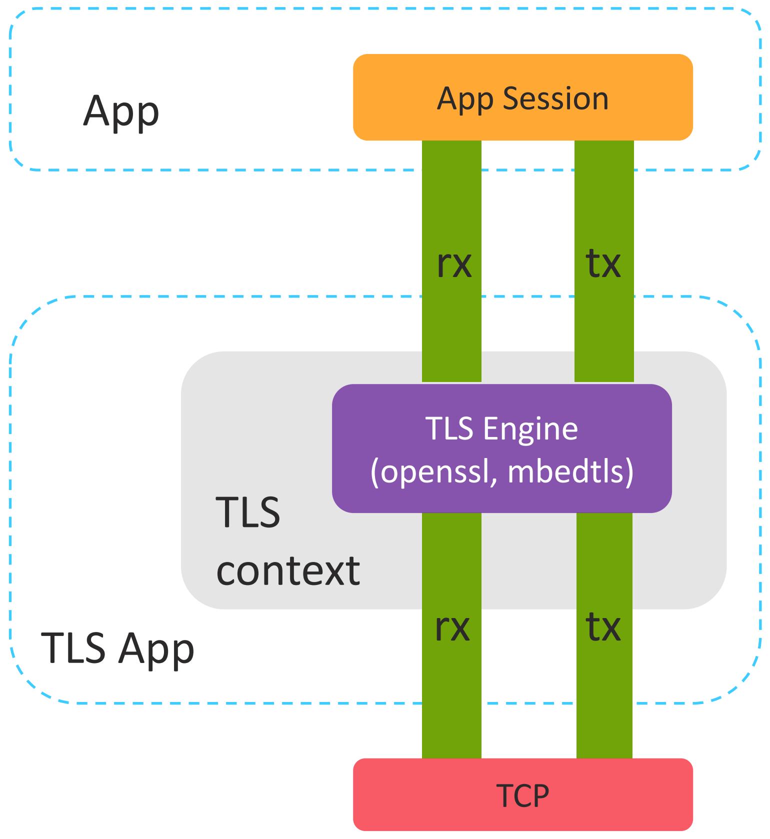

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Some rough OpenSSL numbers on a E2699: ~1Gbps/core (no hw accel)

Ongoing work

- Overall integration with k8s
  - Istio/Envoy
- TCP
  - Rx policer/tx pacer
  - TSO
  - New congestion control algorithms
  - PMTU discovery
  - Optimization/hardening/testing

Next steps – Get involved

- Get the Code, Build the Code, Run the Code
  - Session layer: src/vnet/session
  - TCP: src/vnet/tcp
  - SVM: src/svm
  - VCL: src/vcl
- Read/Watch the Tutorials
- Read/Watch VPP Tutorials
- Join the Mailing Lists

Thank you!

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