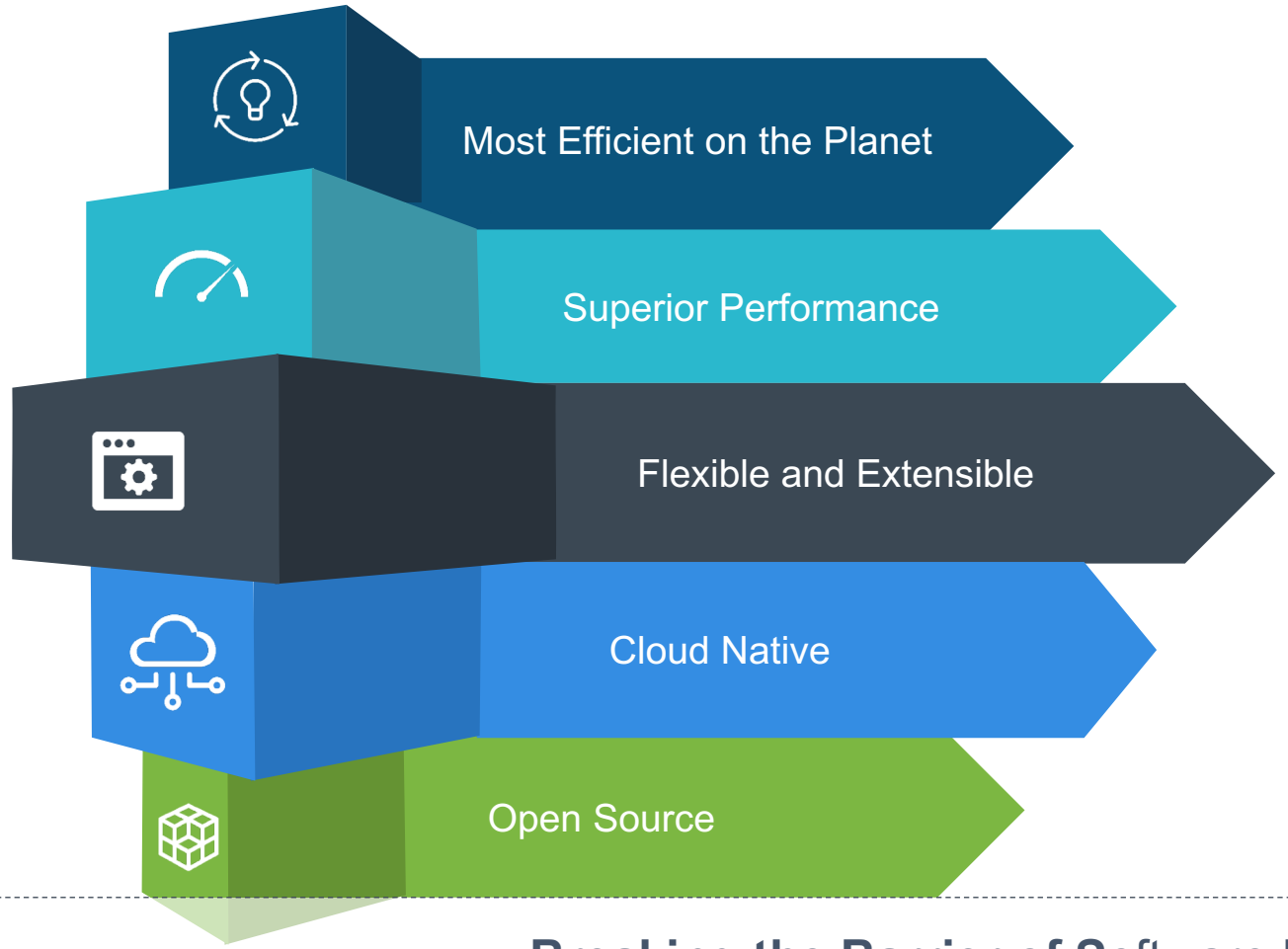
VPP Host Stack

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

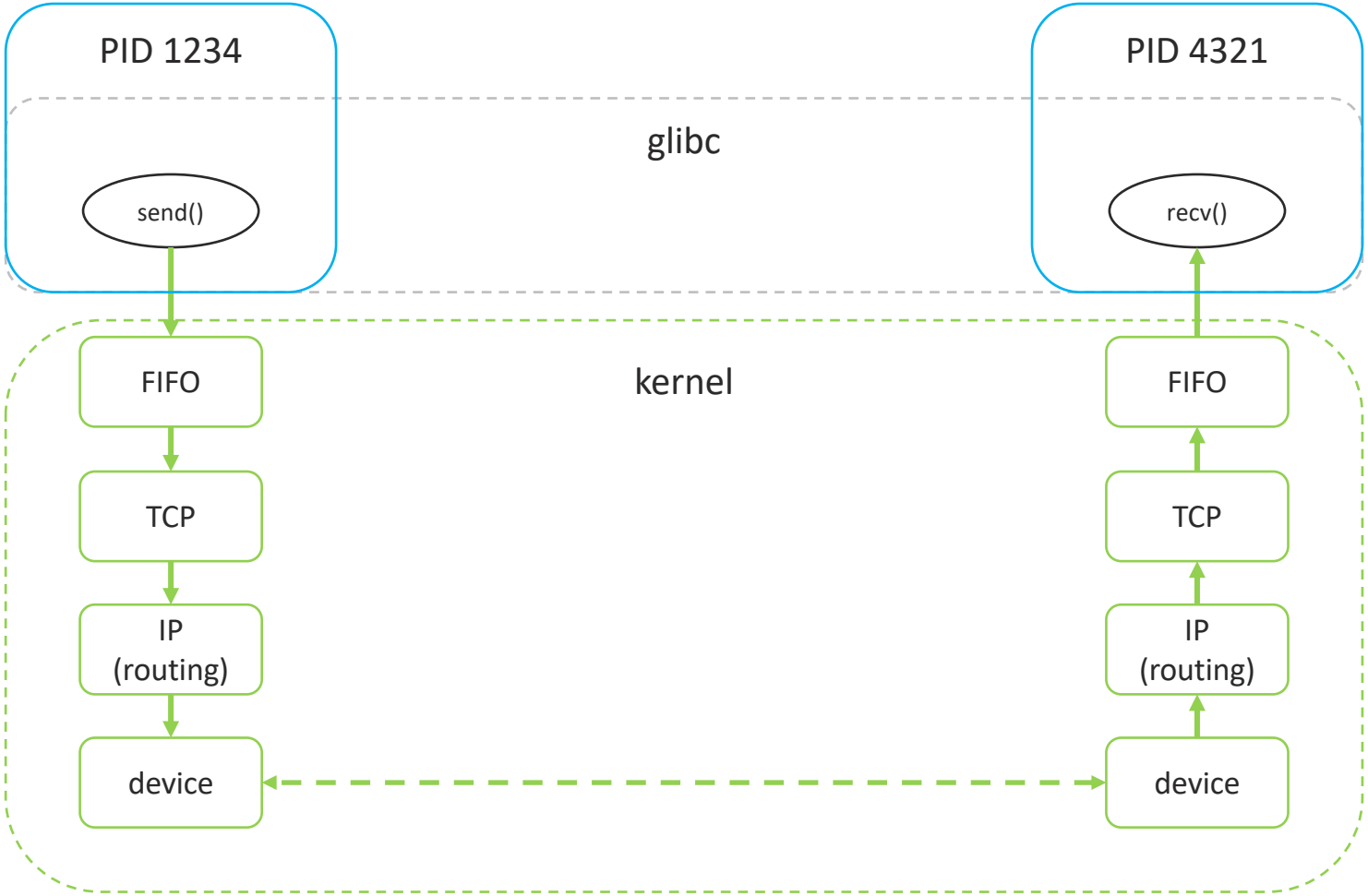
Foundation for cloud native network services

LINUX FOUNDATION

Open source collaborative project in Linux Foundation

Breaking the Barrier of Software Defined Network Services
1 Terabit Services on a Single Intel® Xeon® Server !

Motivation: Container networking



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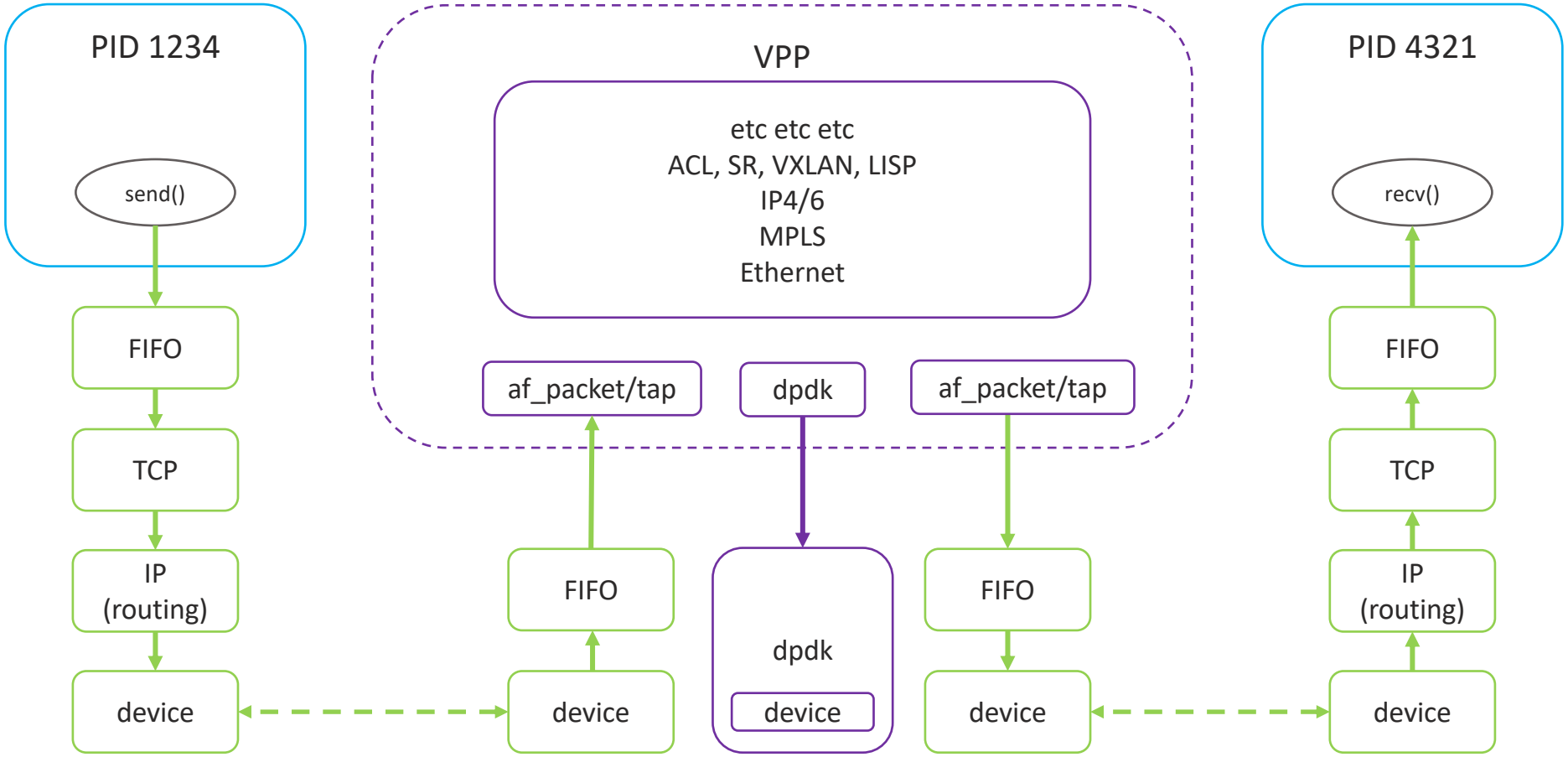
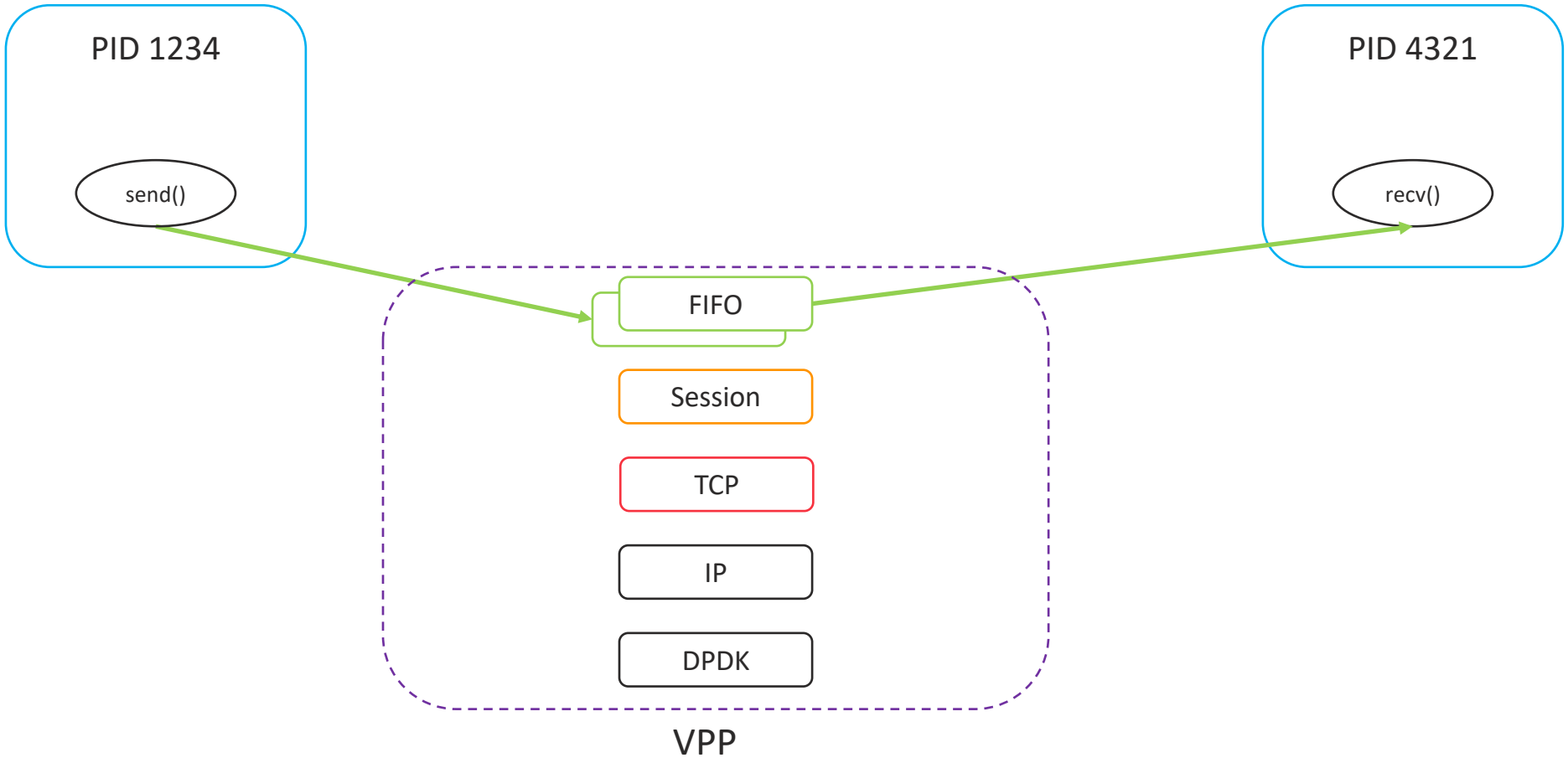
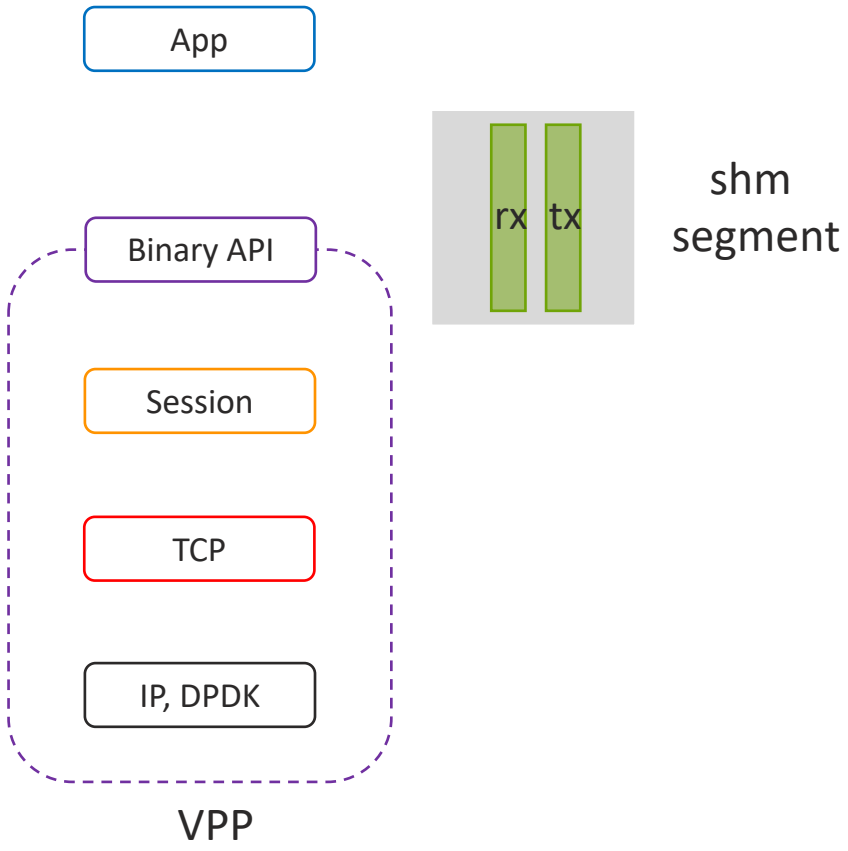


Why not this?



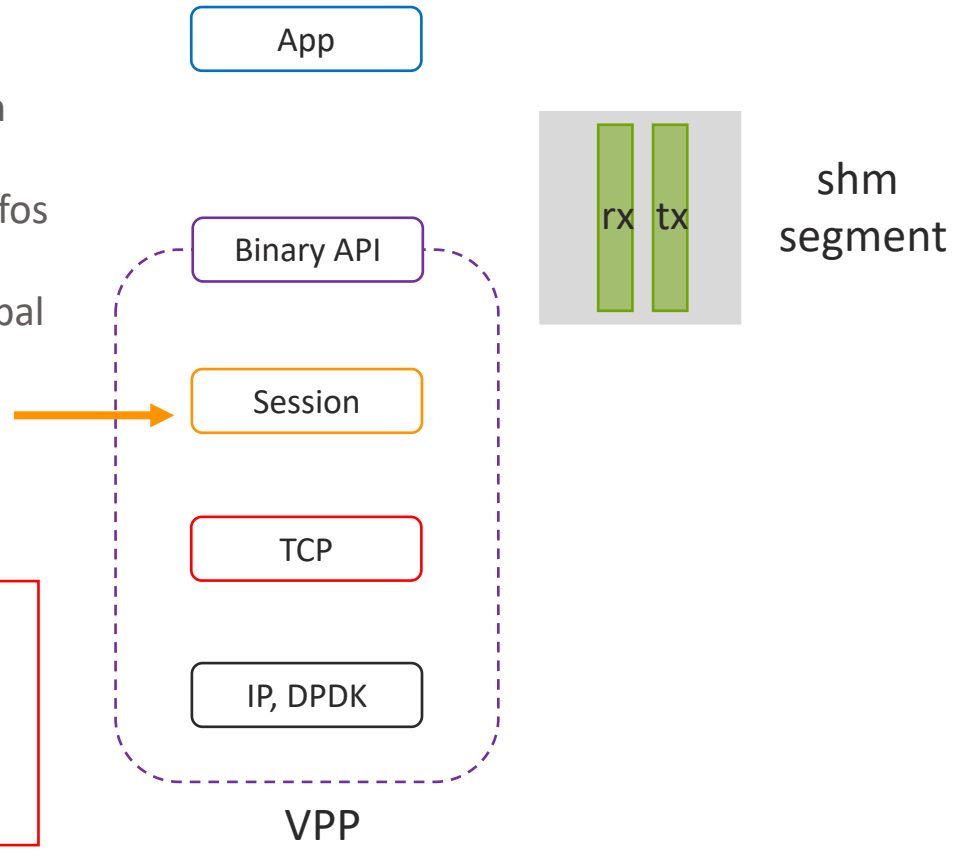
VPP Host Stack



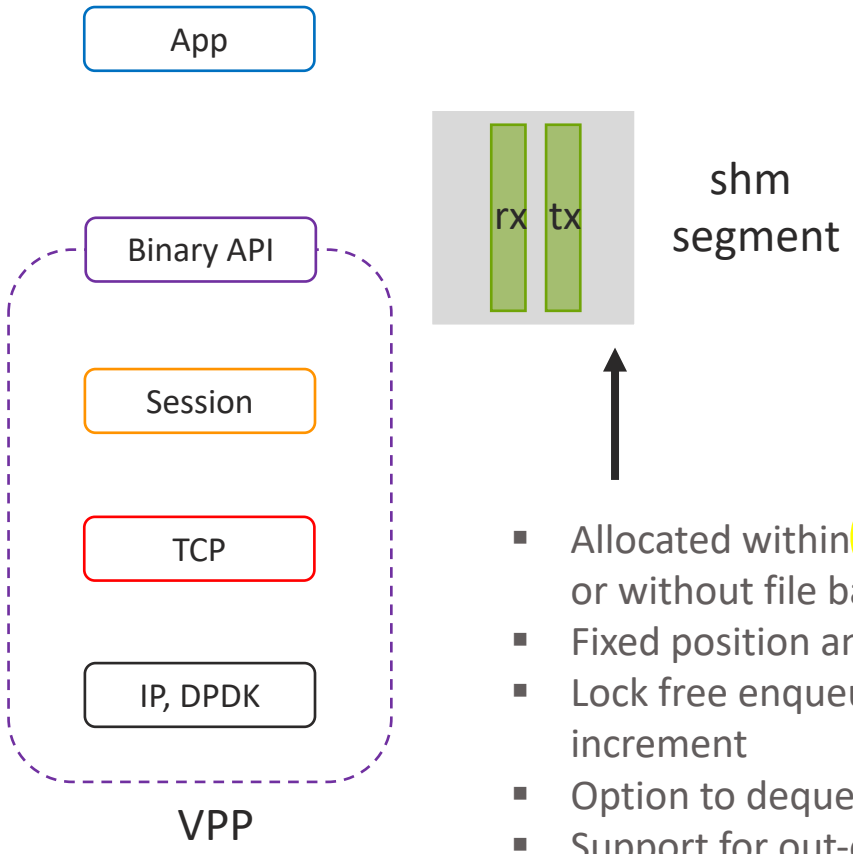
VPP Host Stack: Session Layer

- 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

§ 维护每个应用程序的状态，并往返于会话事件
§ 分配和管理会话/段/ FIFO
§ 通过命名间隔隔离网络资源
§ 会话查找表（5元组）和本地/全局会话规则表（过滤器）
§ 支持可插拔传输协议
§ 外部/内置应用程序的二进制/本机C API



VPP Host Stack: SVM FIFOs

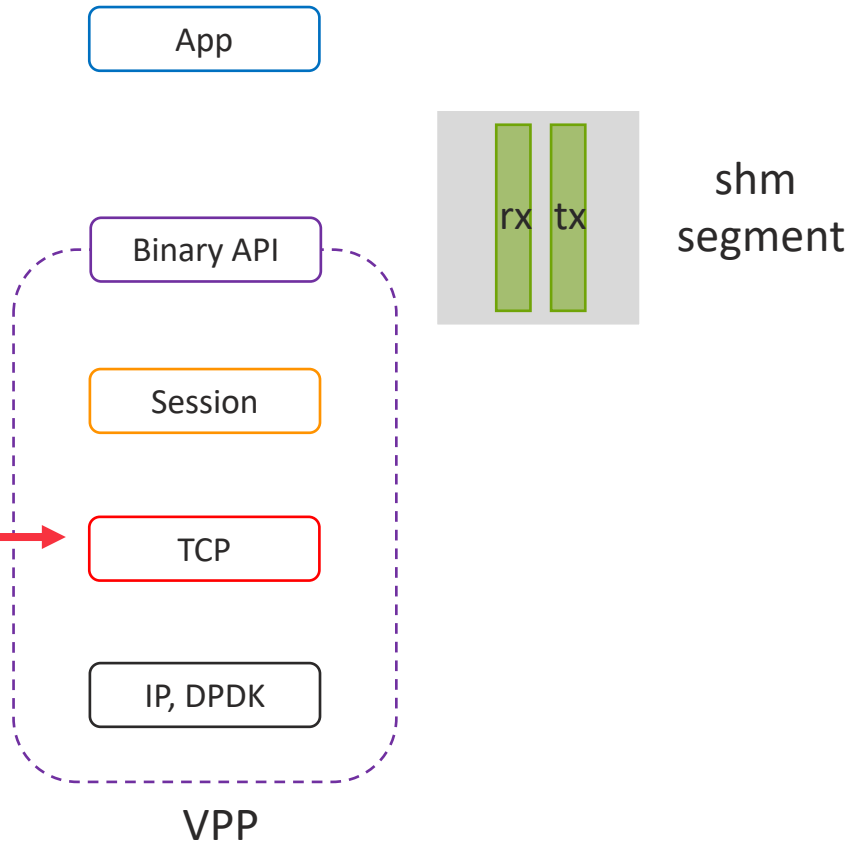


- Allocated within shared memory segments with or without file backing (ssvm/memfd)
- Fixed position and size
- Lock free enqueue/dequeue but atomic size increment
- Option to dequeue/peek data
- Support for out-of-order data enqueues

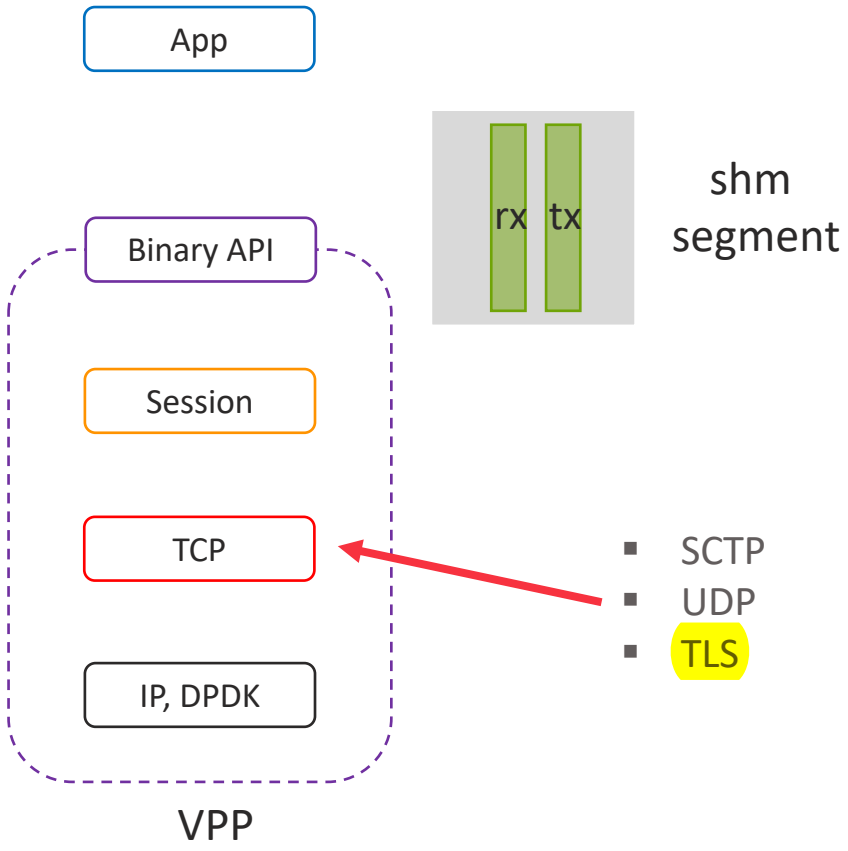
VPP Host Stack: TCP

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

使用IWL TCP协议测试器测试Linux兼容性

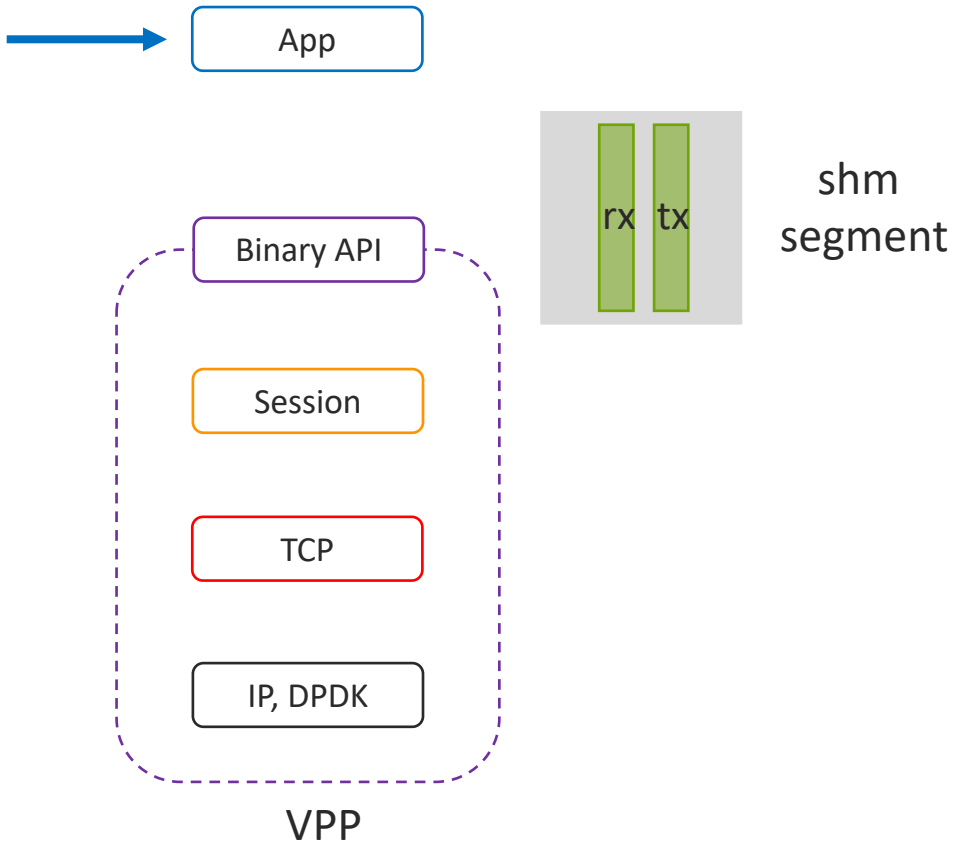


VPP Host Stack: more transports



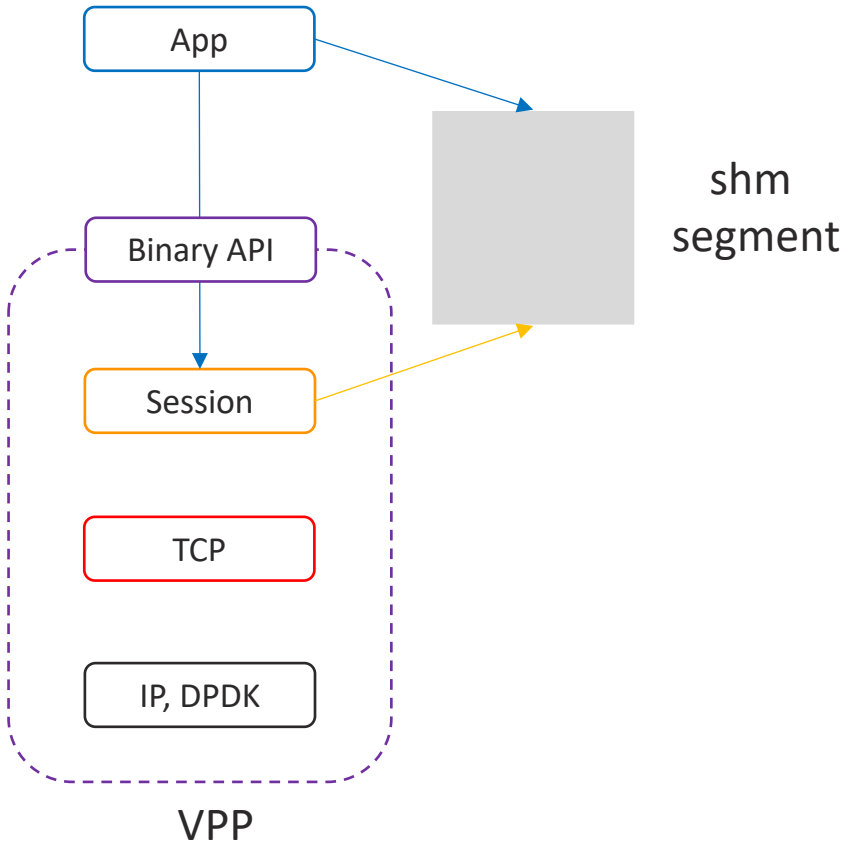
VPP Host Stack: Comms Library (VCL)

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

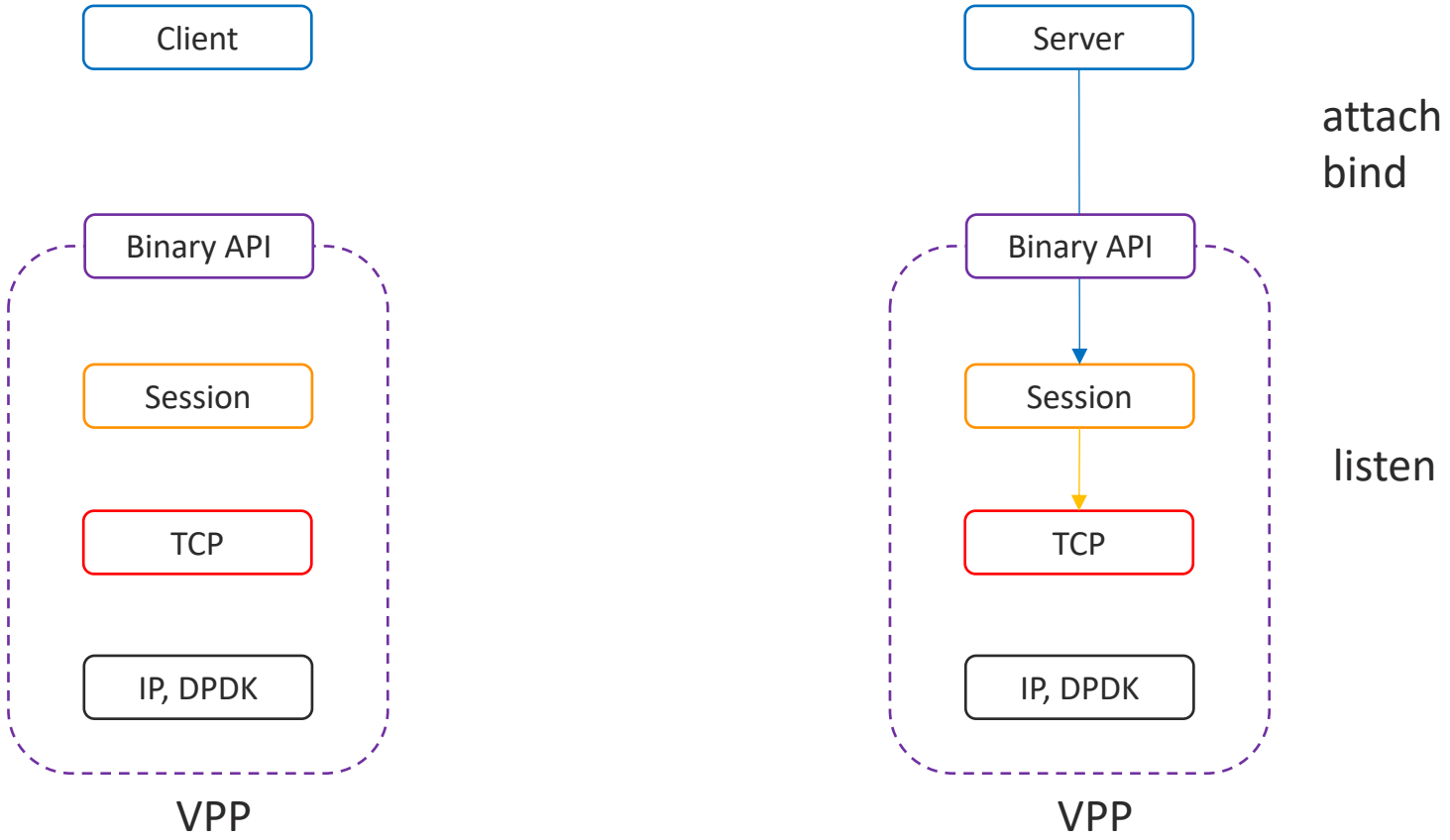


Application Attachment

attach
bind (server)
connect (client)



Session Establishment



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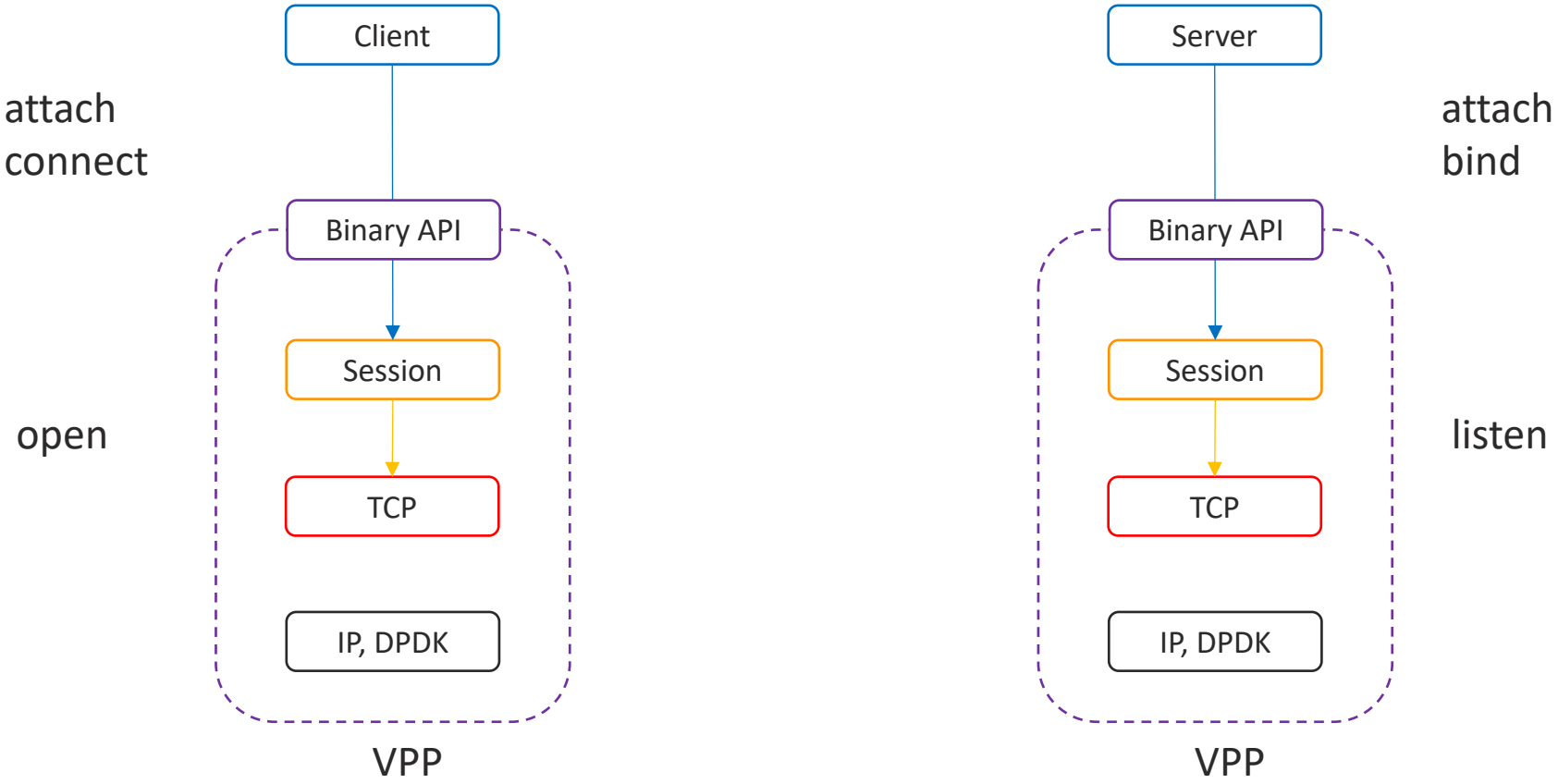

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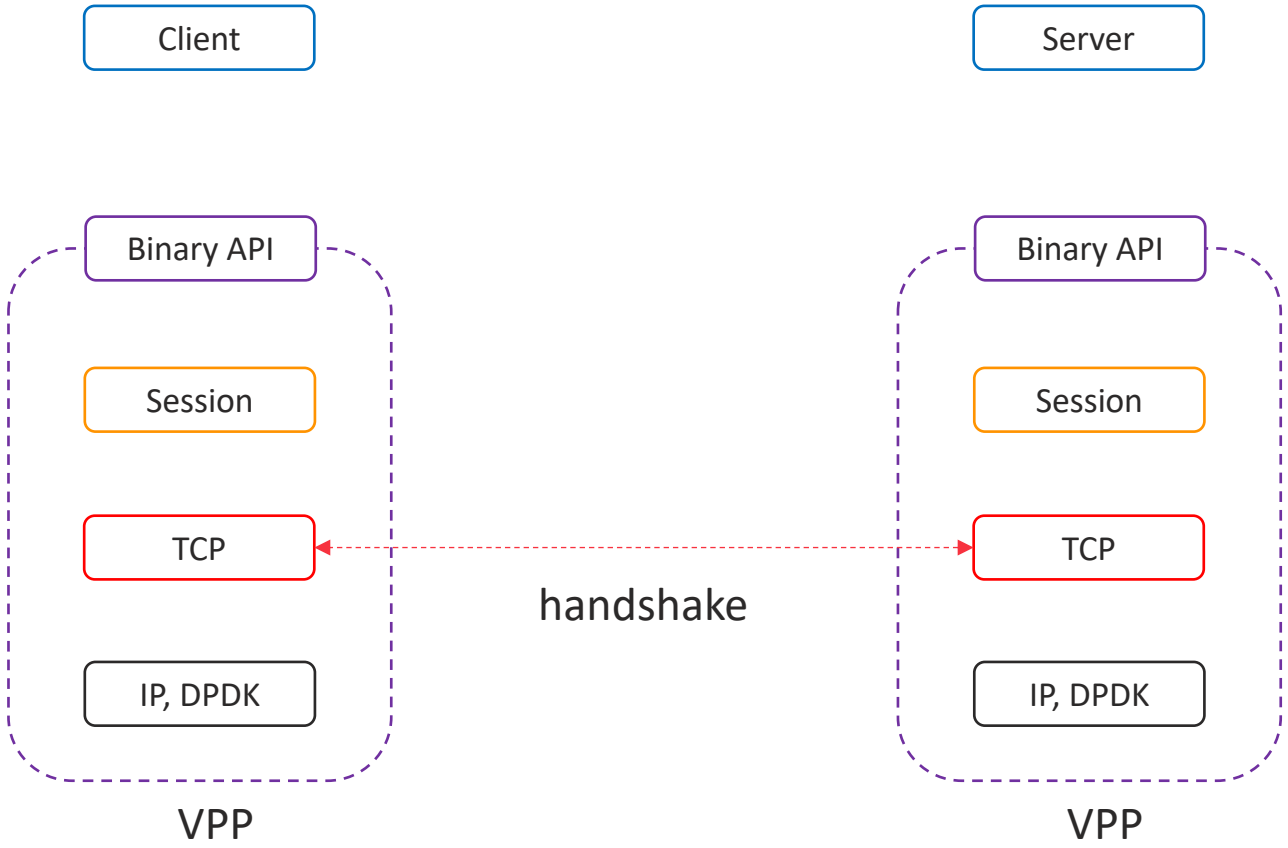

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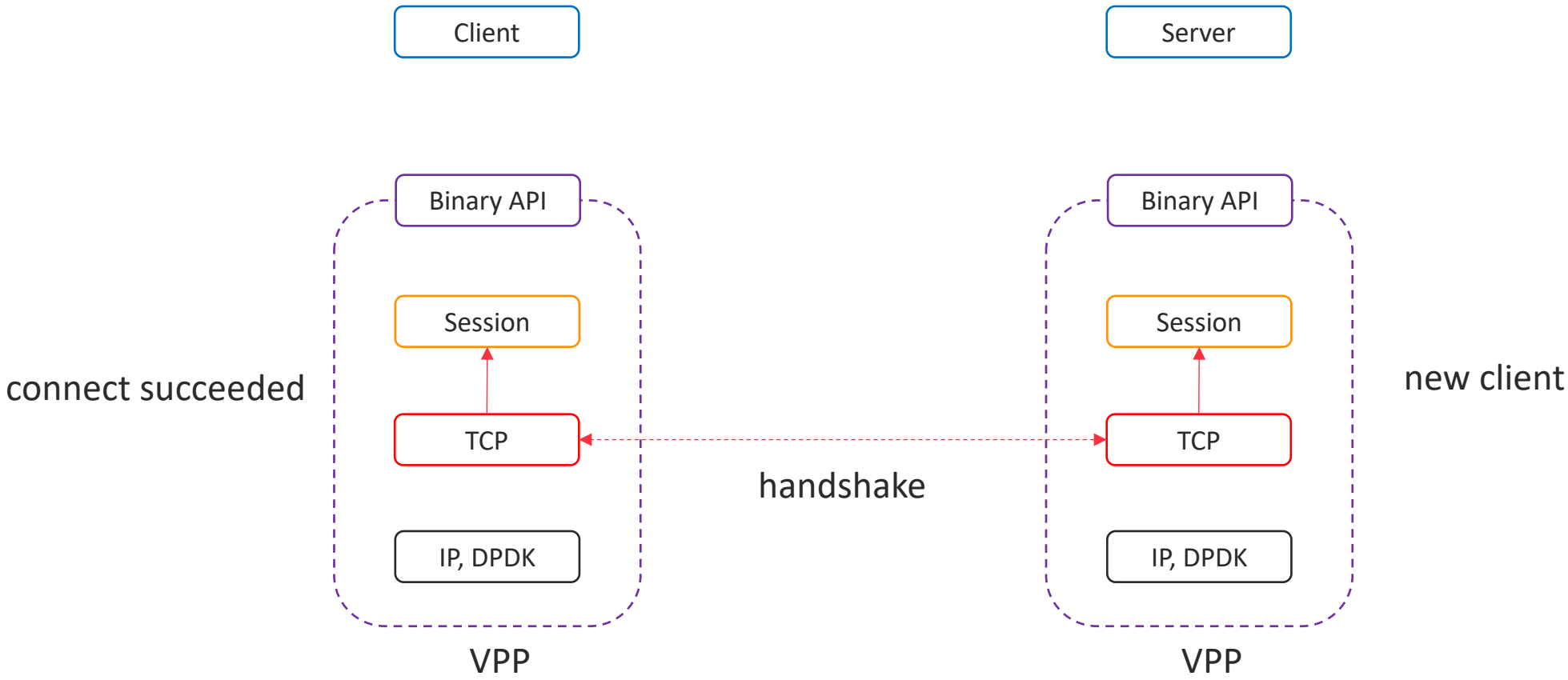

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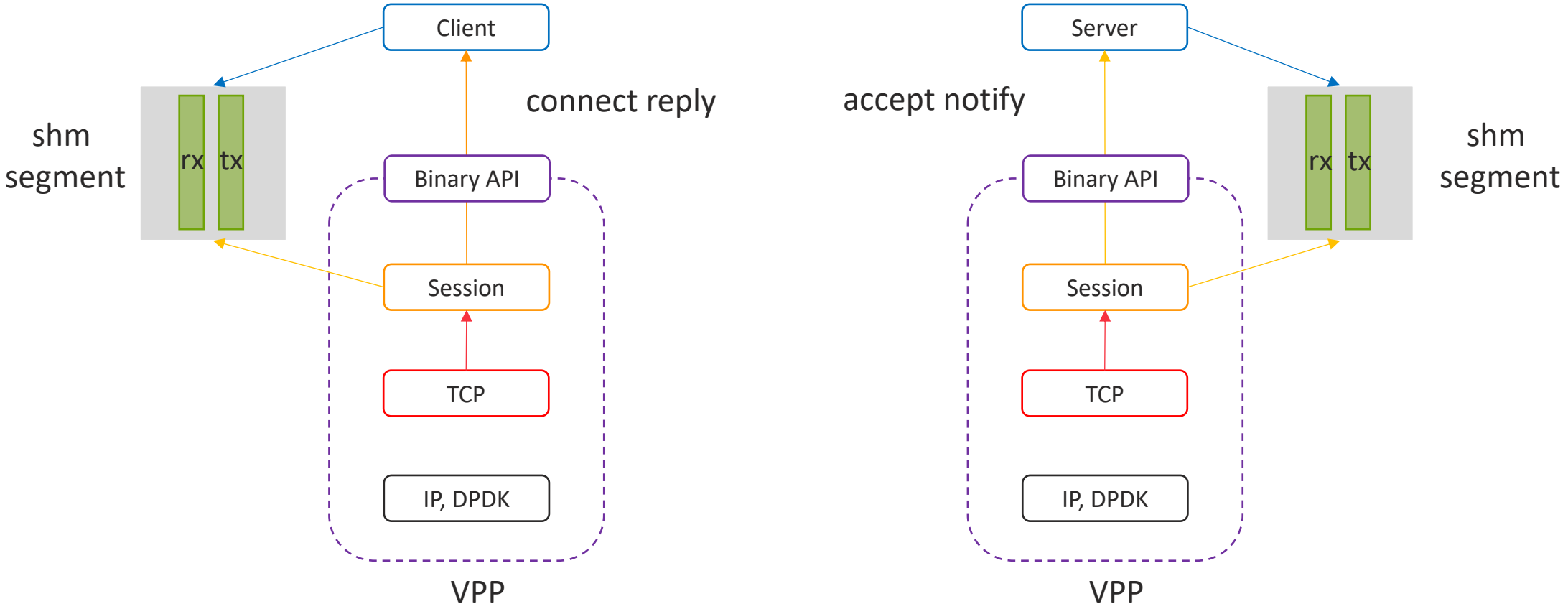
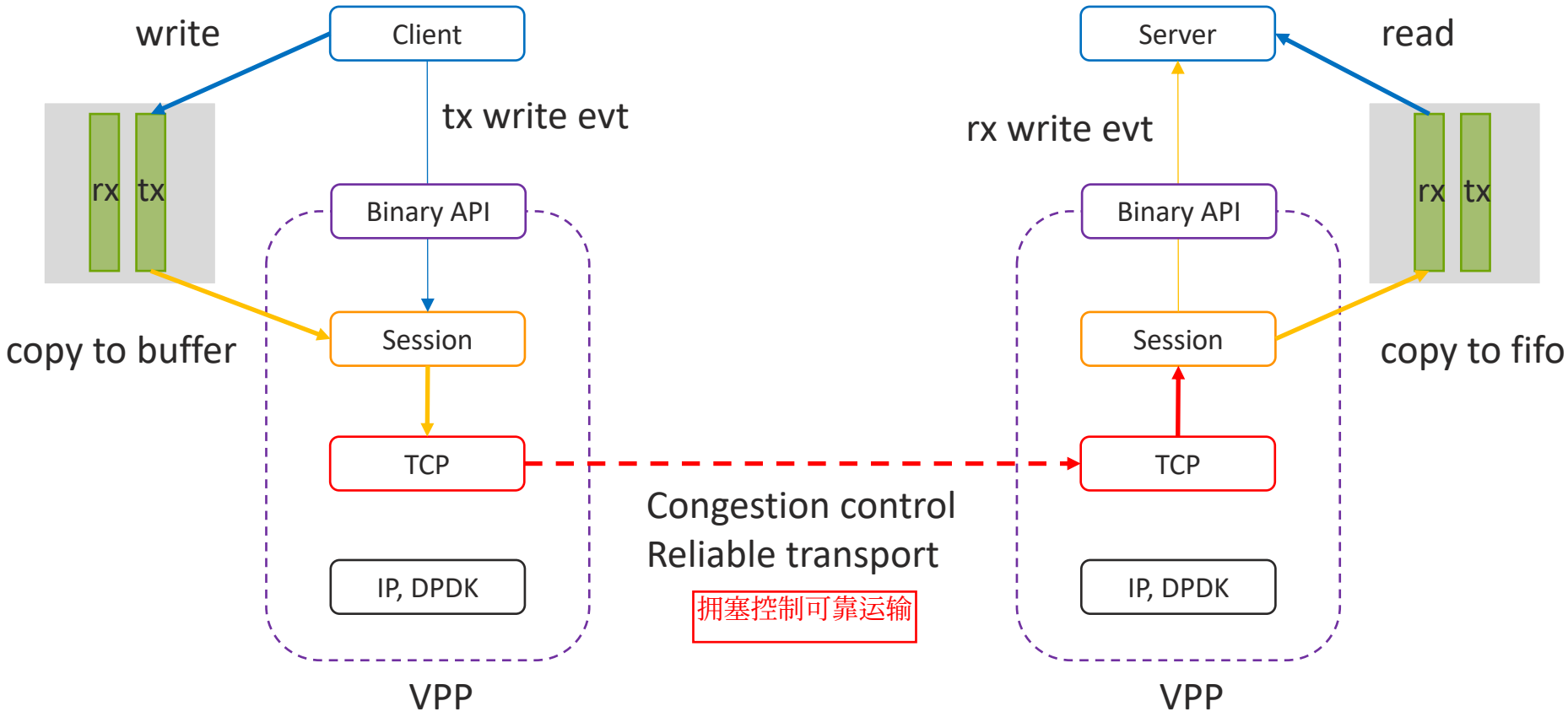


Data Transfer



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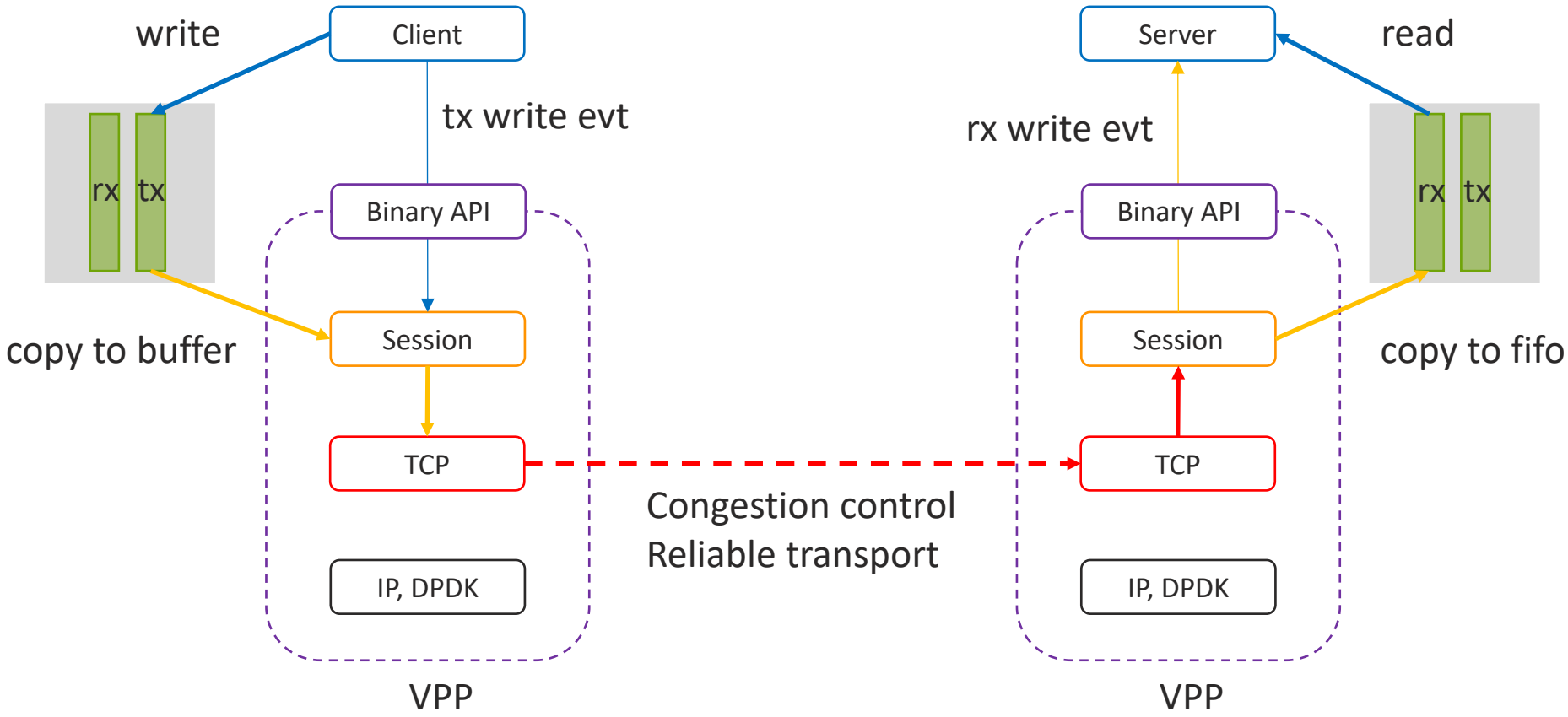
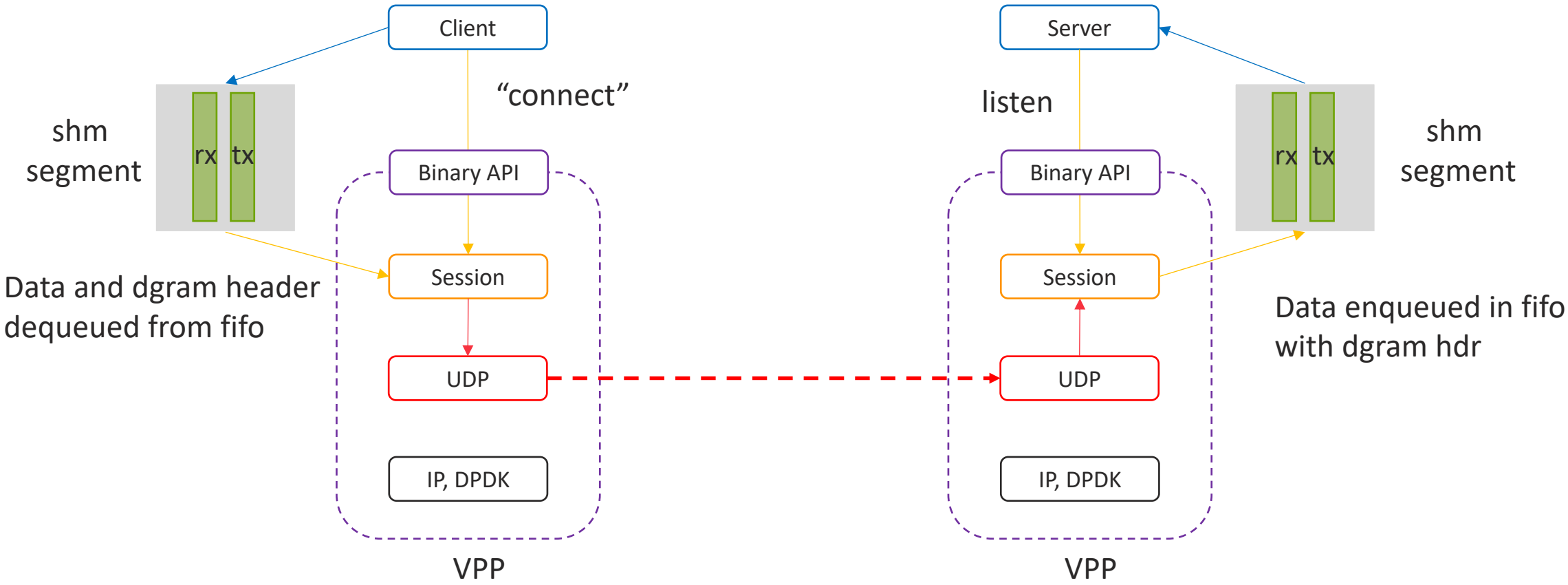
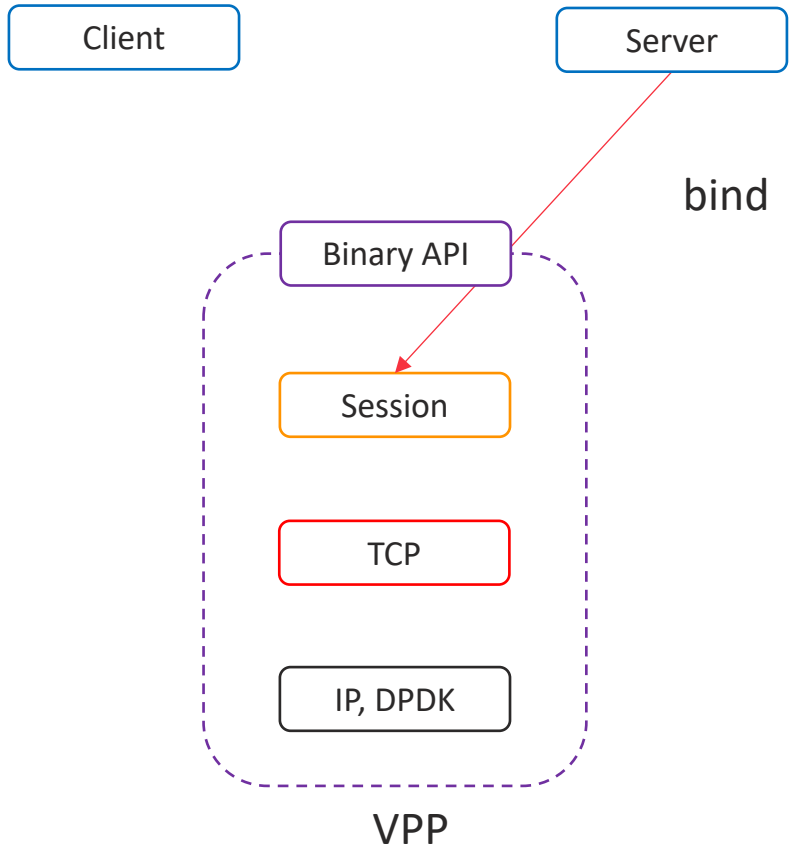


Some rough numbers on a E2699: ~12Gbps/core (1.5k MTU), ~20Gbps/core (9k MTU), ~185k CPS!

Data Transfer: Dgram Transports



Redirected Connections (Cut-through)



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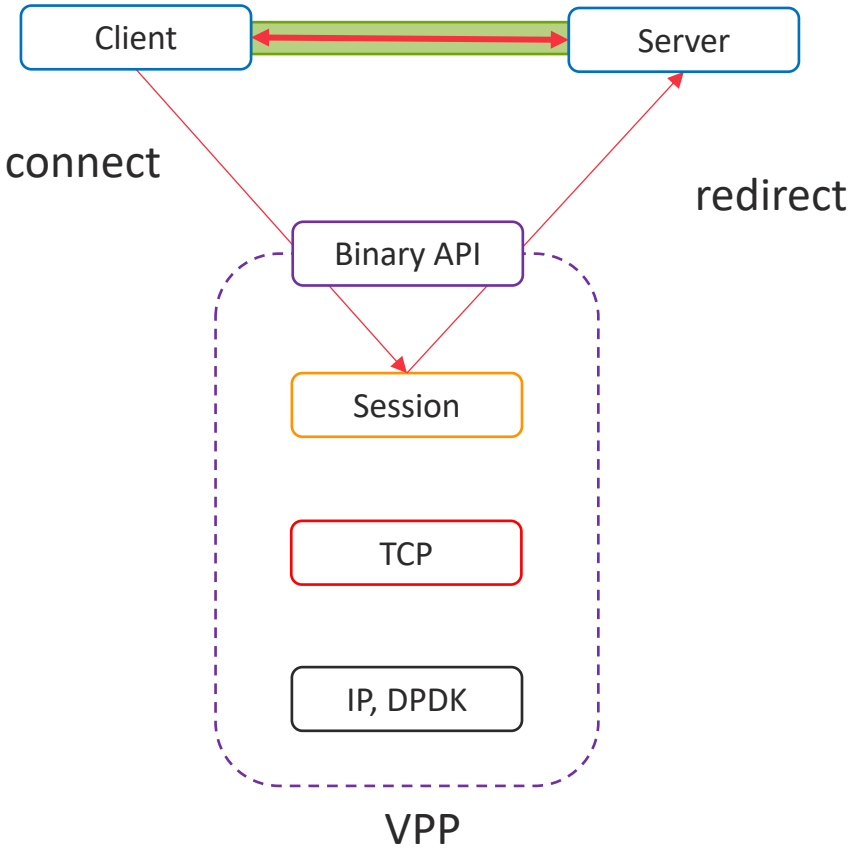
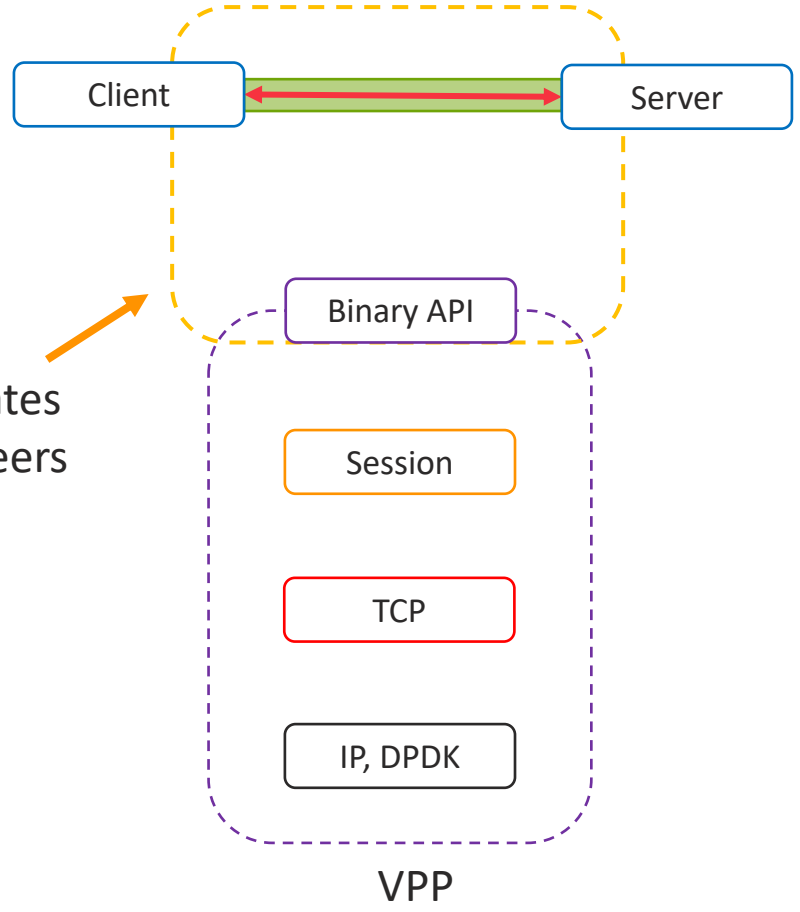


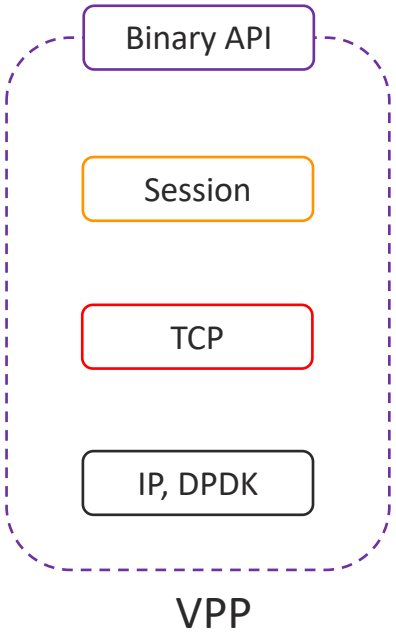
Redirected Connections (Cut-through)

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

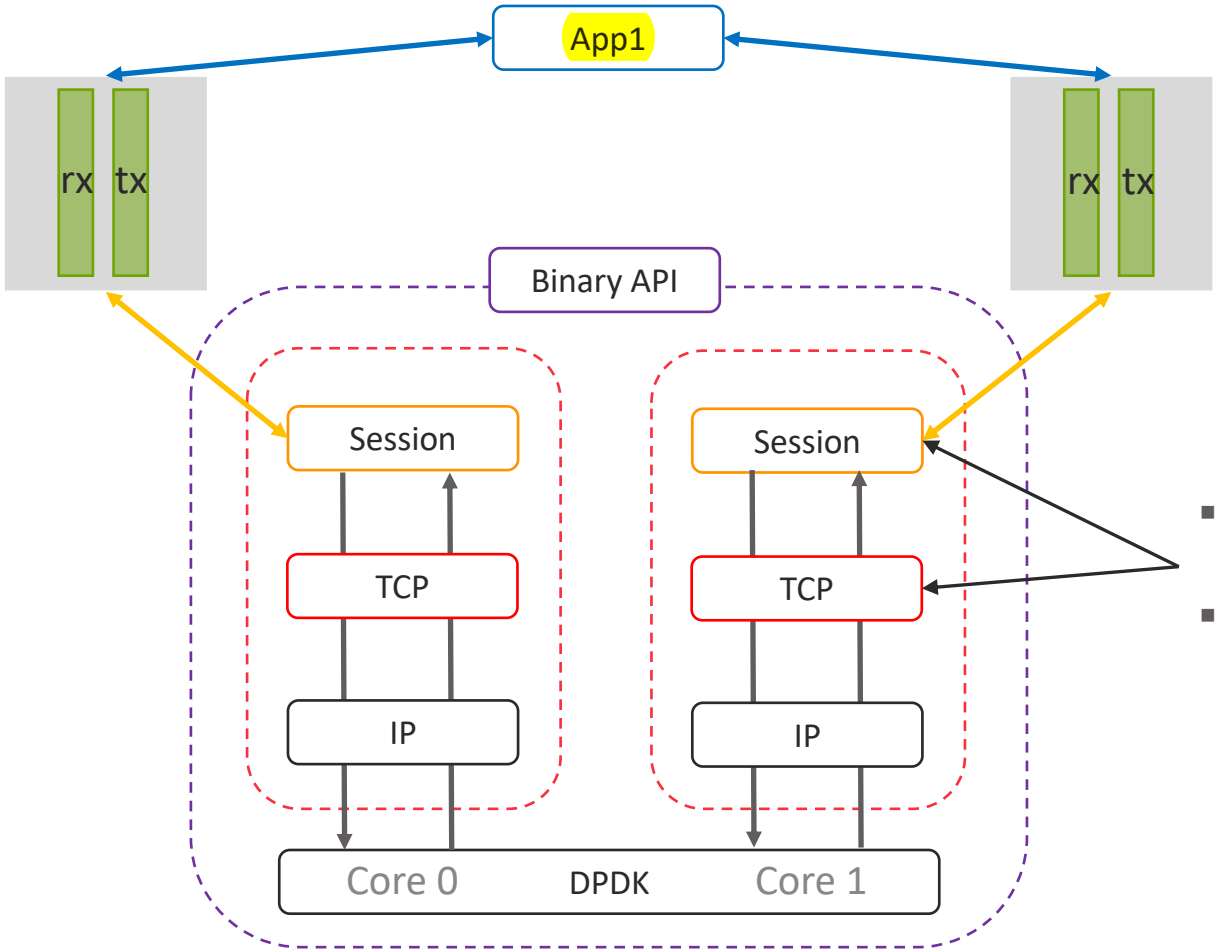


Redirected Connections (Cut-through)

Throughput is memory bandwidth constrained: ~120Gbps!



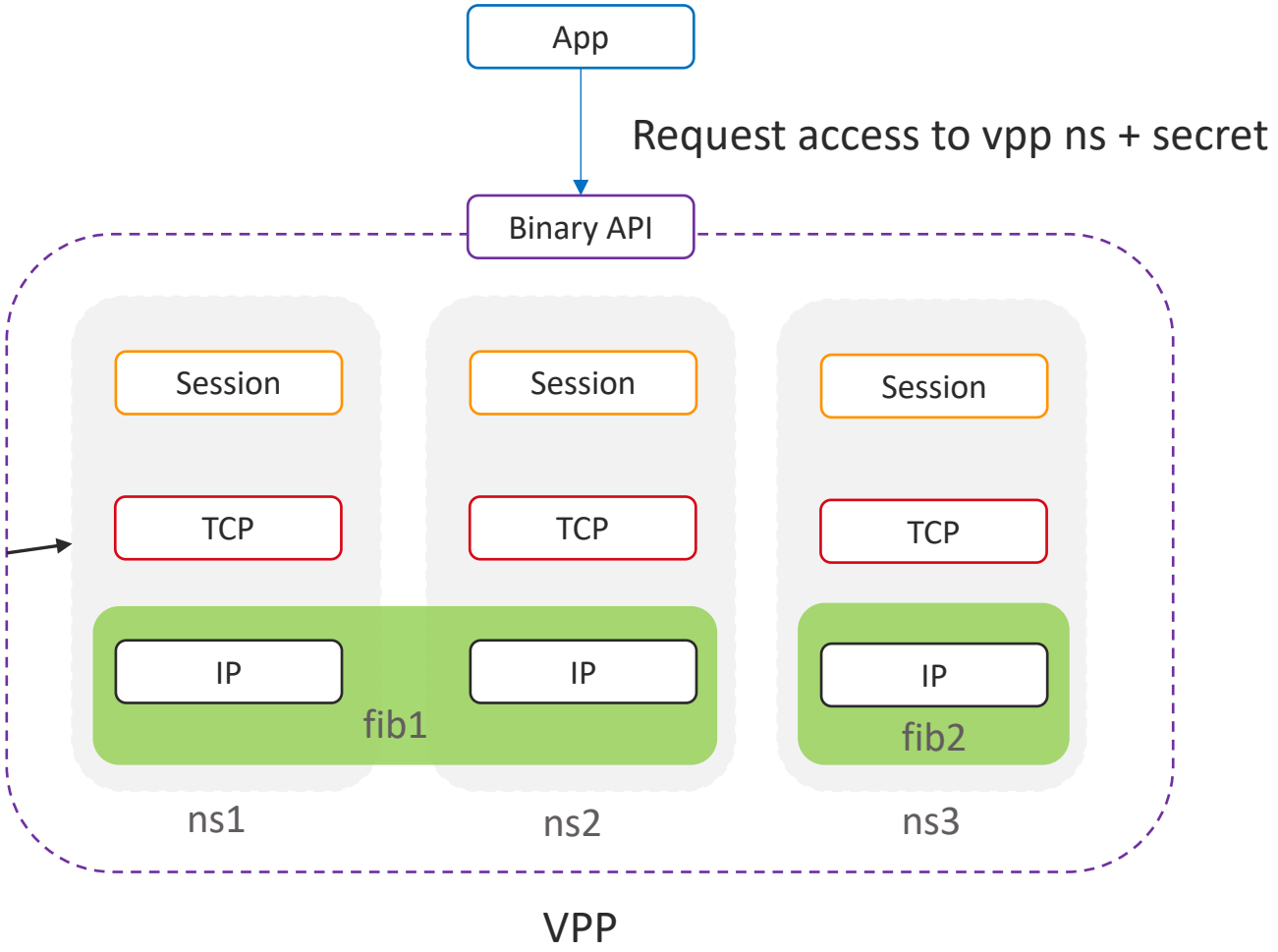
Multi-threading for stream connections



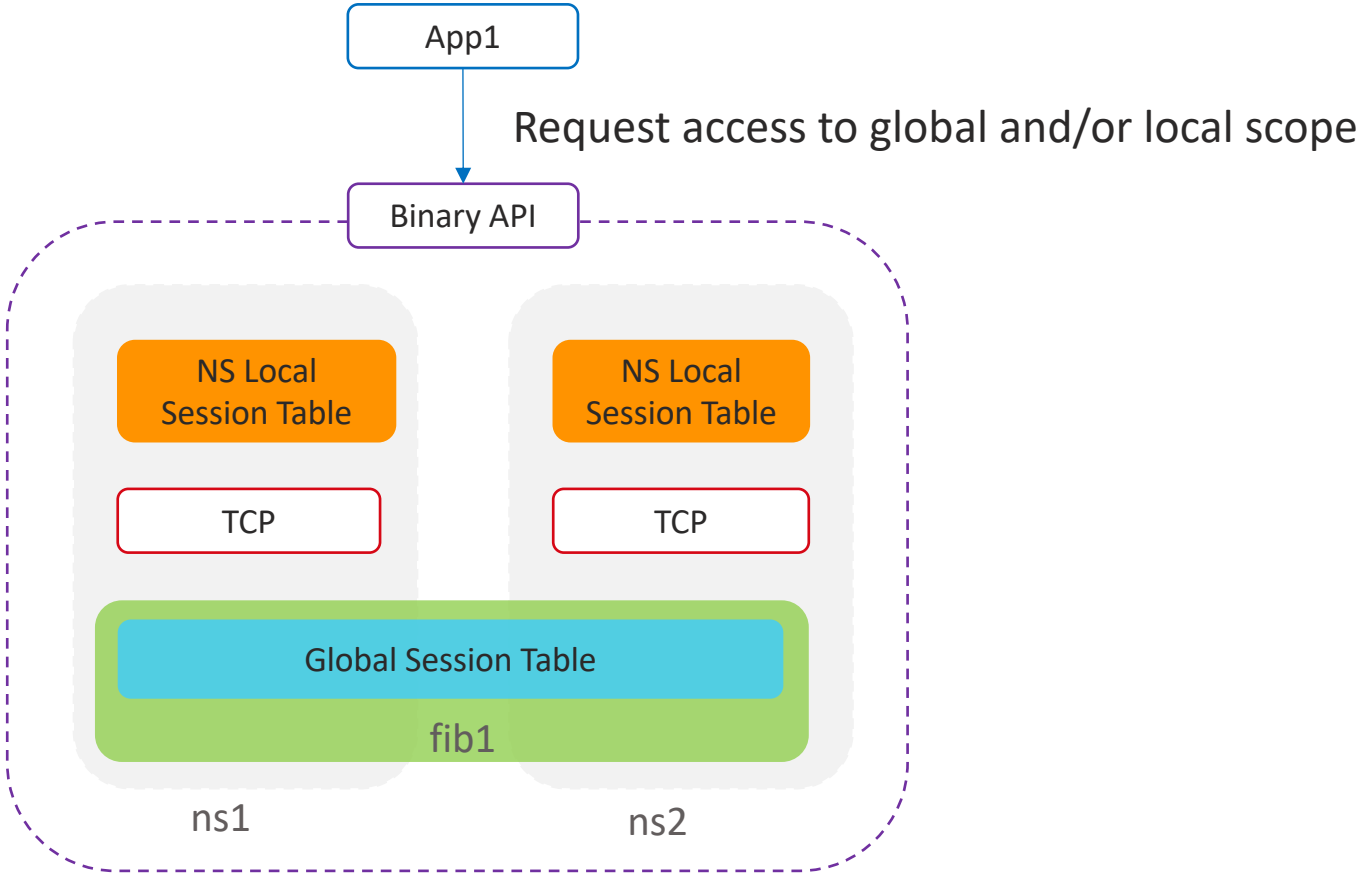
- Connections/sessions 'pinned' to a thread
- Per-thread data structures/state

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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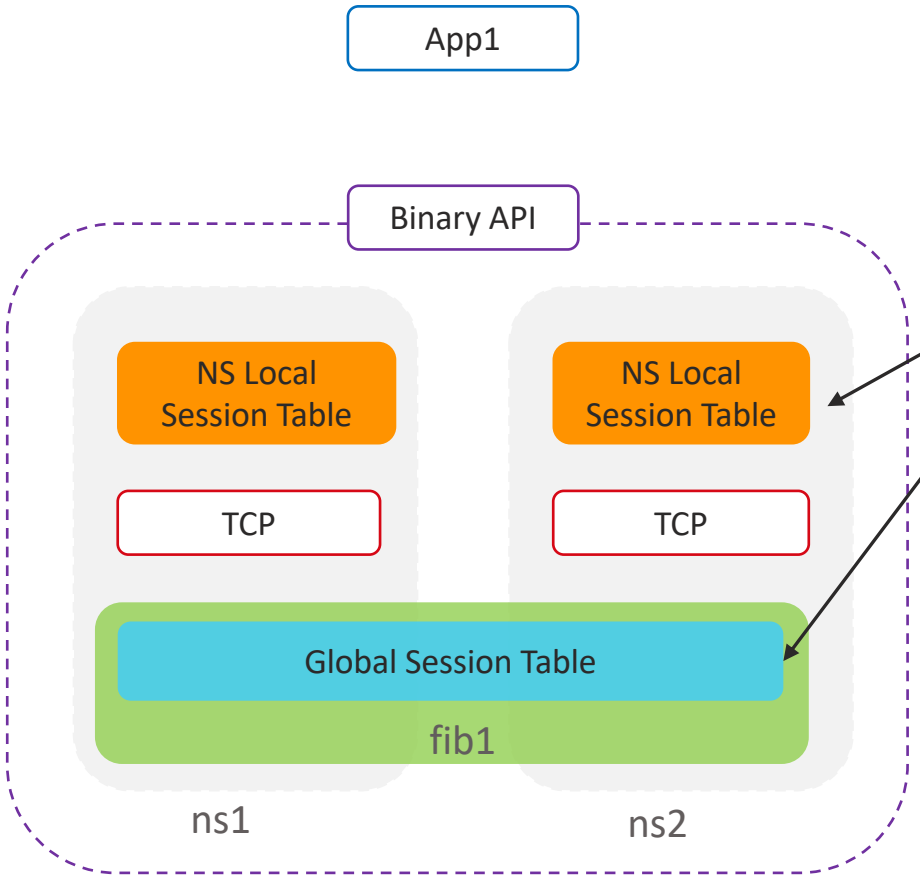
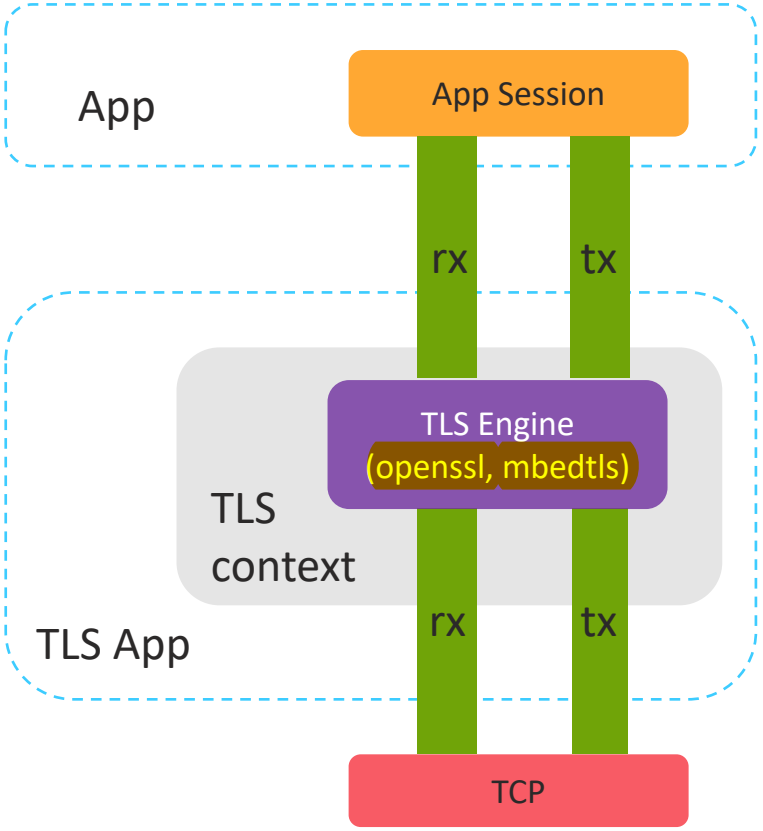


- Both table have “rules table” that can be used for filtering
- Local tables are namespace specific and can be used for egress filtering
- Global tables are fib table specific and can be used for ingress filtering

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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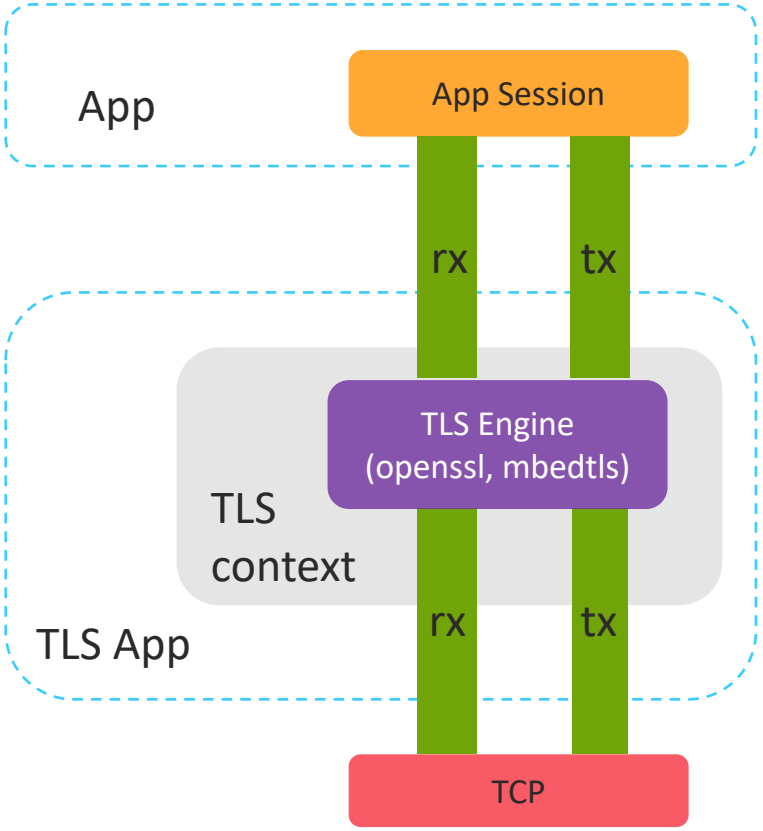

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Some rough OpenSSL numbers on a E2699: ~1Gbps/core (no hw accel)

Ongoing work

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

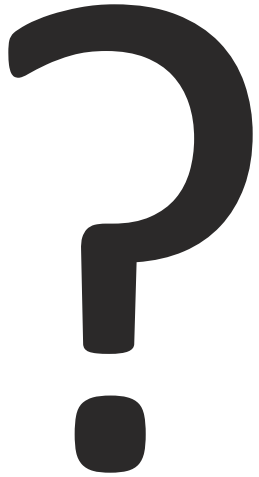
Next steps – Get involved

- 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

覆盖网络引擎（ONE）是一个VPP项目，可启用可编程动态软件定义覆盖。ONE使用扩展的基于LISP的地图辅助控制平面来动态查找覆盖到底层的地址映射以及按需和数据包到达时的转发策略。这包括诸如连接性，加密，流量工程和虚拟拓扑，访问控制和服务链之类的策略。查找的映射和转发策略在本地缓存了TTL周期，直到它们超时为止。然后，将映射和转发策略信息用于封装覆盖包，使其朝向其关联的目的地或下一跳。
ONE可以为叠加层使用和操作多种封装格式，包括GRE，VXLAN-GPE（通用协议扩展）[1]，可以将VXLAN和LISP [2]封装有效地合并为支持多协议有效负载的单一格式，控制平面可用于获取目标的封装功能，作为其映射和转发策略的一部分。
外部开放式SDN控制器将用作映射系统，以存储和提供映射和转发策略。

What is VPP? - An introduction to the open-source Vector Packet Processing (VPP) platform
VPP - Working Environments - Environments/distributions, etc... that VPP builds/run on.
Feature Summary - A list of features included in VPP

Thank you!



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Rong Tao