

WHAT IS CLAIMED IS:

1. A virtual network device, comprising:
a framing circuit to receive a plurality of input frames, examine the plurality of
5 input frames to determine a frame type for each input frame, determine a virtual exit
device associated with each input frame based on the frame type, and encapsulate
the plurality of input frames to form a plurality of first encapsulated frames, each
virtual exit device having a receive virtual port, the plurality of first encapsulated
frames having a plurality of headers, the plurality of headers identifying a plurality of
10 virtual exit devices associated with the plurality of input frames;
a plurality of transmit virtual ports coupled to the framing circuit, the plurality
of transmit virtual ports to determine a plurality of next hops in a virtual network for
the plurality of first encapsulated frames based on the virtual exit devices in the
headers of the plurality of first encapsulated frames, and encapsulate the plurality of
15 first encapsulated frames to form a plurality of second encapsulated frames, each
second encapsulated frame having a header, the header of a second encapsulated
frame identifying a next hop of the second encapsulated frame based on a next hop
of a first encapsulated frame, and the receive virtual port of the associated virtual
exit device of an input frame; and
20 a transmit virtual switch coupled to the plurality of transmit virtual ports, the
transmit virtual switch to selectively couple the transmit virtual ports to a network
physical port.
2. The virtual network device of claim 1 wherein the transmit virtual
25 switch cycles through the plurality of transmit virtual ports sequentially forwarding a
second encapsulated frame from each transmit virtual port in a fixed repeating order
to output a series of second encapsulated frames.

3. The virtual network device of claim 1 wherein the transmit virtual switch receives a full signal from a transmit virtual port, and forwards a frame from the transmit virtual port that output the full signal to the network physical port.

5 4. The virtual network device of claim 1 wherein the framing circuit includes:
a virtual switch that determines a route for a frame to a transmit virtual port based on the frame type, and outputs the frame towards the transmit virtual port;
and
10 a framer coupled to the virtual switch, the framer to encapsulate the input frames.

5. The virtual network device of claim 4 wherein the framer executes a protocol from a group of protocols that include a provider backbone bridge-traffic engineering (PBB-TE) protocol and a transfer multiprotocol listing switch (T-MPLS) protocol.
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6. The virtual network device of claim 1 wherein the transmit virtual ports include a first portion of a shared memory.
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7. The virtual network device of claim 6 and further comprising:
a receive physical port that receives a plurality of third encapsulated frames, examines the plurality of third encapsulated frames to determine a plurality of frame destinations, compares the plurality of frame destinations to a stored destination,
25 and forwards the third encapsulated frames with matching destinations as matching encapsulated frames, the plurality of third encapsulated frames and matching encapsulated frames having a plurality of headers, the plurality of headers having a plurality of receive virtual port identifiers;

a receive virtual switch coupled to the receive physical port, the receive virtual switch to switchably pass the matching encapsulated frames based on the receive virtual port identifiers in the headers of the matching encapsulated frames;

- 5 a plurality of receive virtual ports coupled to the receive virtual switch, the plurality of receive virtual ports to unpack the switchably-passed matching encapsulated frames to extract a plurality of fourth encapsulated frames from the plurality of matching encapsulated frames such that each receive virtual port unpacks a matching encapsulated frame to extract a fourth encapsulated frame, the receive virtual ports including a second portion of the shared memory; and
- 10 a de-framing circuit coupled to the plurality of receive virtual ports, the de-framing circuit to unpack the plurality of fourth encapsulated frames to extract a plurality of output frames from the plurality of fourth encapsulated frames, the plurality of output frames having a plurality of frame types, each output frame having a header that identifies a destination router/switch.

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8. The virtual network device of claim 7 wherein the de-framing circuit includes a de-framer that receives the fourth encapsulated frames from the plurality of receive virtual ports, and unpacks the fourth encapsulated frames to extract the input frames.

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9. The virtual network device of claim 8 wherein the framing circuit outputs the input frames to a local router/switch.

- 25 10. A method of operating a virtual network device, the method comprising:
receiving a plurality of input frames;
examining the plurality of input frames to determine a frame type for each input frame;
determining a virtual exit device associated with each input frame based on the frame type, each virtual exit device having a receive virtual port;

encapsulating the plurality of input frames to form a plurality of first encapsulated frames, the plurality of first encapsulated frames having a plurality of headers, the plurality of headers identifying a plurality of virtual exit devices associated with the plurality of input frames;

- 5 determining a plurality of next hops in a virtual network for the plurality of first encapsulated frames based on the virtual exit devices in the headers of the plurality of first encapsulated frames;

- encapsulating a plurality of first encapsulated frames in a plurality of transmit virtual ports to form a plurality of second encapsulated frames, each second
10 encapsulated frame having a header, the header of a second encapsulated frame identifying a next hop of the second encapsulated frame based on a next hop of a first encapsulated frame, and the receive virtual port of the associated virtual exit device of an input frame; and

 selectively coupling the transmit virtual ports to a network physical port.

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11. The method of claim 10, further comprising cycling through the plurality of transmit virtual ports sequentially forwarding a second encapsulated frame from each transmit virtual port in a fixed repeating order to output a series of second encapsulated frames.

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12. The method of claim 10, further comprising receiving a full signal from a transmit virtual port, and forwarding a frame from the transmit virtual port that output the full signal to the network physical port.

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13. The method of claim 10, further comprising determining a route for a frame to a transmit virtual port based on the frame type, and outputting the frame towards the transmit virtual port.

14. The method of claim 10 wherein the plurality of input frames is encapsulated with a protocol from a group of protocols that include a provider backbone bridge-traffic engineering (PBB-TE) protocol and a transfer multiprotocol listing switch (T-MPLS) protocol.

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15. The method of claim 10 wherein the transmit virtual ports include a first portion of a shared memory.

16. The method of claim 15, further comprising:
- 10 receiving a plurality of third encapsulated frames;
examining the plurality of third encapsulated frames to determine a plurality of frame destinations;
comparing the plurality of frame destinations to a stored destination;
forwarding the third encapsulated frames with matching destinations as
- 15 matching encapsulated frames, the plurality of third encapsulated frames and matching encapsulated frames having a plurality of headers, the plurality of headers having a plurality of receive virtual port identifiers;
switchably passing the matching encapsulated frames based on the receive virtual port identifiers in the headers of the matching encapsulated frames;
- 20 unpacking the switchably-passed matching encapsulated frames in a plurality of receive virtual ports to extract a plurality of fourth encapsulated frames from the plurality of matching encapsulated frames such that each receive virtual port unpacks a matching encapsulated frame to extract a fourth encapsulated frame, the receive virtual ports including a second portion of the shared memory; and
- 25 unpacking the plurality of fourth encapsulated frames to extract a plurality of output frames from the plurality of fourth encapsulated frames, the plurality of output frames having a plurality of frame types, each output frame having a header that identifies a destination router/switch.

17. A non-transitory computer-readable storage medium having embedded therein program instructions, which when executed by a processor causes the processor to execute a method of operating a virtual network device, the method comprising:

- 5 receiving a plurality of input frames;
examining the plurality of input frames to determine a frame type for each input frame;
determining a virtual exit device associated with each input frame based on the frame type, each virtual exit device having a receive virtual port;
- 10 encapsulating the plurality of input frames to form a plurality of first encapsulated frames, the plurality of first encapsulated frames having a plurality of headers, the plurality of headers identifying a plurality of virtual exit devices associated with the plurality of input frames;
determining a plurality of next hops in a virtual network for the plurality of
- 15 first encapsulated frames based on the virtual exit devices in the headers of the plurality of first encapsulated frames;
encapsulating a plurality of first encapsulated frames in a plurality of transmit virtual ports to form a plurality of second encapsulated frames, each second encapsulated frame having a header, the header of a second encapsulated frame
- 20 identifying a next hop of the second encapsulated frame based on a next hop of a first encapsulated frame, and the receive virtual port of the associated virtual exit device of an input frame; and
selectively coupling the transmit virtual ports to a network physical port.

- 25 18. The medium of claim 17, wherein the method further comprises cycling through the plurality of transmit virtual ports sequentially forwarding a second encapsulated frame from each transmit virtual port in a fixed repeating order to output a series of second encapsulated frames.

19. The medium of claim 17, wherein the method further comprises receiving a full signal from a transmit virtual port, and forwarding a frame from the transmit virtual port that output the full signal to the network physical port.

- 5 20. The medium of claim 19, wherein the method further comprises:
receiving a plurality of third encapsulated frames;
examining the plurality of third encapsulated frames to determine a plurality
of frame destinations;
comparing the plurality of frame destinations to a stored destination;
10 forwarding each third encapsulated frame with a matching destination as a
matching encapsulated frame to forward a plurality of matching encapsulated frames,
the plurality of third encapsulated frames and matching encapsulated frames having
a plurality of headers, the plurality of headers having a plurality of receive virtual
port identifiers;
15 switchably passing the matching encapsulated frames based on the receive
virtual port identifiers in the headers of the matching encapsulated frames;
unpacking the switchably-passed matching encapsulated frames in a plurality
of receive virtual ports to extract a plurality of fourth encapsulated frames from the
plurality of matching encapsulated frames such that each receive virtual port unpacks
20 a matching encapsulated frame to extract a fourth encapsulated frame, the receive
virtual ports including a second portion of the shared memory; and
unpacking the plurality of fourth encapsulated frames to extract a plurality of
output frames from the plurality of fourth encapsulated frames, the plurality of
output frames having a plurality of frame types, each output frame having a header
25 that identifies a destination router/switch.