CLAIMS

1. A network element to perform hierarchical control packet rate limiting, comprising:

a control card including,

a set of one or more protocol modules to process control packets received from a plurality of line cards; and

the plurality of line cards coupled with the control card, each line card including,

a packet parsing engine to receive and parse control packets and write packet data into a buffer memory of the line card, the packet data including a set of one or more identifier keys associated with each of the control packets,

an identifier key based rate limiter module to perform identifier key rate based limiting on the control packets per the set of identifier keys of those control packets, wherein the identifier key based rate limiter module is to perform the following for each control packet,

compare an identifier key packet count value associated with the set of identifier keys for that packet with a identifier key rate limit value associated with that set of identifier keys, wherein the identifier key packet count value represents a number of control packets accepted for processing in a first time interval having that set of identifier keys,

drop the control packet if the identifier key packet count value exceeds the identifier key rate limit value for that first time interval;

a protocol based rate limiter module to perform protocol based rate limiting on those control packets whose associated identifier key packet count value does not exceed their associated identifier key rate limit value, wherein the protocol based rate limiter module is to perform the following for each of those control packets:

compare a protocol packet count value associated with a protocol type of the control packet with a protocol rate limit value associated with that protocol type, wherein the protocol

packet count value represents a number of control packets accepted for processing in a second time interval having that protocol type,

drop the control packet if the protocol packet count value exceeds the protocol rate limit value for that second time interval, and

send the control packet to the control card if the protocol packet count value does not exceed the protocol rate limit value for that given time period.

2. The network element of claim 1, wherein the control card further includes a command line interface module to receive the identifier key rate limit value and the protocol rate limit value from a system operator of the network element, and further receive an amount of time for the first time interval and an amount of time for the second time interval.

3. The network element of claim 1, wherein the identifier key based rate limiter module is to perform the identifier key rate based limiting for those packets which are PADR (PPPoE Active Discovery Request) packets and PADI (PPPoE Active Discovery Initiate) packets separately, wherein the set of identifier keys used in the identifier key based rate limiting for PADR packets and PADI packets includes one or more of a source MAC address, a VLAN (Virtual Local Area Network) identifier, and a port identifier.

4. The network element of claim 1, wherein the control packets include DHCP (Dynamic Host Configuration Protocol) control packets, and wherein the set of identifier keys used for each of the DHCP control packets includes one or more of a source MAC address included in that DCHP control packet,a source IP (Internet Protocol) address in that DHCP control packet, a VLAN (Virtual Local Area Network) identifier in that DHCP control packet, an ATM (Asynchronous Transfer Mode) PVC (Permanent Virtual Circuit) identifier in that DHCP control packet, a GIADDR (Gateway IP Address) in that DHCP control packet, and a port identifier on which the DHCP control packet is received on.

What is claimed is:

1. A network element to perform hierarchical control packet rate limiting, comprising:
a control card including,
a set of one or more protocol modules to process control packets received from a plurality of line cards; and
the plurality of line cards coupled with the control card, each line card including,
a packet parsing engine to receive and parse control packets and write packet data into a buffer memory of the line card, the packet data including a set of one or more identifier keys associated with each of the control packets,
an identifier key based rate limiter module to perform identifier key rate based limiting on the control packets per the set of identifier keys of those control packets, wherein the identifier key based rate limiter module is to perform the following for each control packet,
compare an identifier key packet count value associated with the set of identifier keys for that packet with a identifier key rate limit value associated with that set of identifier keys, wherein the identifier key packet count value represents a number of control packets accepted for processing in a first time interval having that set of identifier keys,
drop the control packet if the identifier key packet count value exceeds the identifier key rate limit value for that first time interval;
a protocol based rate limiter module to perform protocol based rate limiting on those control packets whose associated identifier key packet count value does not exceed their associated identifier key rate limit value, wherein the protocol based rate limiter module is to perform the following for each of those control packets:
compare a protocol packet count value associated with a protocol type of the control packet with a protocol rate limit value associated with that protocol type, wherein the protocol packet count value represents a number of control packets accepted for processing in a second time interval having that protocol type,
drop the control packet if the protocol packet count value exceeds the protocol rate limit value for that second time interval, and
send the control packet to the control card if the protocol packet count value does not exceed the protocol rate limit value for that given time period.

2. The network element of claim 1, wherein the control card further includes a command line interface module to receive the identifier key rate limit value and the protocol rate limit

value from a system operator of the network element, and further receive an amount of time for the first time interval and an amount of time for the second time interval.

3. The network element of claim 1, wherein the identifier key based rate limiter module is to perform the identifier key rate based limiting for those packets which are PADR (PPPoE Active Discovery Request) packets and PADI (PPPoE Active Discovery Initiate) packets separately, wherein the set of identifier keys used in the identifier key based rate limiting for PADR packets and PADI packets includes one or more of a source MAC address, a VLAN (Virtual Local Area Network) identifier, and a port identifier.

4. The network element of claim 1, wherein the control packets include DHCP (Dynamic Host Configuration Protocol) control packets, and wherein the set of identifier keys used for each of the DHCP control packets includes one or more of a source MAC address included in that DCHP control packet, a source IP (Internet Protocol) address in that DHCP control packet, a VLAN (Virtual Local Area Network) identifier in that DHCP control packet, an ATM (Asynchronous Transfer Mode) PVC (Permanent Virtual Circuit) identifier in that DHCP control packet, a GIADDR (Gateway IP Address) in that DHCP control packet, and a port identifier on which the DHCP control packet is received on.

5. A line card for rate limiting control packets, comprising:

a plurality of network processing units (NPUs), each NPU having a separate memory domain, wherein each NPU is coupled with one or more ports of the line card, and each NPU includes the following:

a packet parsing engine to parse control packets to determine a protocol type of each control packet and extract a set of one or more identifier keys from each control packet based on the determined protocol type of that control packet,

a plurality of first level execution units to perform an identifier key based rate limiting for each unique set of extracted identifier keys per protocol type, wherein each of the first level execution units is to drop those control packets which do not pass the identifier key based rate limiting,

a set of one or more second level execution units coupled with the plurality of first level execution units, the set of second level execution units to perform the following:

a protocol based rate limiting for each of those control packets that pass the identifier key based rate limiting for each protocol type,

drop those control packets which do not pass the protocol based rate limiting, and

send each of those control packets which pass the protocol based rate limiting to a central line processor of the line card;

the central line processor coupled with the plurality of NPUs, the central line processor to perform the following:

aggregate those control packets received from the plurality of NPUs that have a same set of identifier keys,

aggregate those control packets received from the plurality of NPUs that have a same protocol type,

perform an aggregate identifier key based rate limiting on the control packets received from the plurality of NPUs for each unique set of identifier keys per protocol type,

drop those control packets that fail the aggregate identifier key based rate limiting,

perform an aggregate protocol based rate limiting for each of those control packets that pass the aggregate identifier key based rate limiting for each unique protocol type,

drop those control packets that fail the aggregate protocol based rate limiting, and

send those packets that pass the aggregate protocol based rate limiting to a control card coupled with the line card.

6. The line card of claim 5, wherein the control packets include PADR (PPPoE Active Discovery Request) packets and PADI (PPPoE Active Discovery Initiate) packets, and wherein the PADR packets and PADI packets are rate limited separately.

7. The line card of claim 5, wherein the control packets includes DHCP (Dynamic Host Configuration Protocol) control packets, and wherein the set of identifier keys used for each of the DHCP control packets includes a source MAC address included in that DCHP control packet, a source IP (Internet Protocol) address in that DHCP control packet, a VLAN (Virtual Local Area Network) identifier in that DHCP control packet, an ATM (Asynchronous Transfer Mode) PVC (Permanent Virtual Circuit) identifier in that DHCP control packet, a GIADDR (Gateway IP Address) in that DHCP control packet, and a port identifier on which the DHCP control packet is received on.