Our Ref./Docket No: APPT-001-4   Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Sarkissian, *et al.*	Group Art Unit: 2662
Application No.: 09/608266	Examiner: Alan Nguyen
Filed: June 30, 2000	
Title: ASSOCIATIVE CACHE STRUCTURE FOR LOOKUPS AND UPDATES OF FLOW RECORDS IN A NETWORK MONITOR	

RESPONSE TO OFFICE ACTION UNDER 37 CFR 1.111

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

This is a response to the Office Action of September 10, 2003.

Any *amendments to the specification* begin on a new page immediately after these introductory remarks.

Any *amendments to the claims* begin on a new page immediately after such *amendments to the specification*, if any.

Any *amendments to the drawings* begin on a new page immediately after such *amendments to the claims*, if any.

The *Remarks/arguments* begin on a new page immediately after such *amendments to the drawings*, if any.

If there are drawing amendments, an *Appendix* including amended drawings is attached following the *Remarks/arguments.*

AMENDMENT(S) TO THE CLAIMS:

The following listing of claims will replace all prior versions, and listings, of claims on the application. All claims are set forth below with one of the following annotations.

- (Original): Claim filed with the application.

- (Currently amended): Claim being amended in the current amendment paper.

- (Canceled): Claim cancelled or deleted from the application. No claim text is shown.

- (Withdrawn): Claim still in the application, but in a non-elected status.

- (New): Claim being added in the current amendment paper.

- (Previously presented): Claim added or amended in an earlier amendment paper.

- (Not entered): Claim presented in a previous amendment, but not entered or whose entry status unknown. No claim text is shown.

1. (Currently amended) A packet monitor for examining packets passing through a connection point on a computer network, each packets conforming to one or more protocols, the monitor comprising:

    (a) a packet acquisition device coupled to the connection point and configured to receive packets passing through the connection point;

    (b) a memory for storing a database comprising ~~none or more~~ flow-entries for previously encountered conversational flows to which a received packet may belong, a conversational flow being an exchange of one or more packets in any direction as a result of an activity corresponding to the flow;

    (c) a cache subsystem coupled to the flow-entry database memory providing for fast access of flow-entries from the flow-entry database; ~~and~~

    (d) a lookup engine coupled to the packet acquisition device and to the cache subsystem and configured to lookup whether a received packet belongs to a flow-entry in the flow-entry database, the looking up being ~~in~~ the cache subsystem; and

    (e) a state processor coupled to the lookup engine and to the flow-entry-database memory, the state processor being to perform any state operations specified for the state of the flow starting from the last encountered state of the flow in the case that the packet is from an existing flow, and to perform any state operations required for the initial state of the new flow in the case that the packet is from an existing flow.

2.   (Previously presented) A packet monitor according to claim 1, further comprising:

a parser subsystem coupled to the packet acquisition device and to the lookup engine such that the acquisition device is coupled to the lookup engine via the parser subsystem, the parser subsystem configured to extract identifying information from a received packet,

wherein each flow-entry is identified by identifying information stored in the flow-entry, and wherein the cache lookup uses a function of the extracted identifying information.

3.   (Previously presented) A packet monitor according to claim 2, wherein the cache subsystem is an associative cache subsystem including one or more content addressable memory cells (CAMs).

4.   (Previously presented) A packet monitor according to claim 2, wherein the cache subsystem includes:

(i)   a set of cache memory elements coupled to the flow-entry database memory, each cache memory element including an input port to input an flow-entry and configured to store a flow-entry of the flow-entry database;

(ii)   a set of content addressable memory cells (CAMs) connected according to an order of connections from a top CAM to a bottom CAM, each CAM containing an address and a pointer to one of the cache memory elements, and including:

a matching circuit having an input such that the CAM asserts a match output when the input is the same as the address in the CAM cell, an asserted match output indicating a hit,

a CAM input configured to accept an address and a pointer, and

a CAM address output and a CAM pointer output;

(iii) a CAM controller coupled to the CAM set; and

(iv)   a memory controller coupled to the CAM controller, to the cache memory set, and to the flow-entry memory,

wherein the matching circuit inputs of the CAM cells are coupled to the lookup engine such that that an input to the matching circuit inputs produces a match output in any CAM cell that contains an address equal to the input, and

wherein the CAM controller is configured such that which cache memory element a particular CAM points to changes over time.

5.   (Previously presented) A packet monitor according to claim 4, wherein the CAM controller is configured such that the bottom CAM points to the least recently used cache memory element.

6.   (Previously presented) A packet monitor according to claim 5, wherein the address and pointer output of each CAM starting from the top CAM is coupled to the address and pointer input of the next CAM, the final next CAM being the bottom CAM, and wherein the CAM controller is configured such than when there is a cache hit, the address and pointer contents of the CAM that produced the hit are put in the top CAM of the stack, the address and pointer contents of the CAMs above the CAM that produced the asserted match output are shifted down, such that the CAMs are ordered according to recentness of use, with the least recently used cache memory element pointed to by the bottom CAM and the most recently used cache memory element pointed to by the top CAM.

7.–20.   (Cancelled).

21.   (New) A packet monitor for examining packets passing through a connection point on a computer network, each packets conforming to one or more protocols, the monitor comprising:

> a packet acquisition device coupled to the connection point and configured to receive packets passing through the connection point;
>
> an input buffer memory coupled to and configured to accept a packet from the packet acquisition device;
>
> a parser subsystem coupled to the input buffer memory, the parsing subsystem configured to extract selected portions of the accepted packet and to output a parser record containing the selected portions;
>
> a memory to storing a database of one or more flow-entries for any previously encountered conversational flows, each flow-entry identified by identifying information stored in the flow-entry;
>
> a lookup engine coupled to the output of the parser subsystem and to the flow-entry memory and configured to lookup whether the particular packet whose parser record is output by the parser subsystem has a matching flow-entry, the looking up using at least some of the selected packet portions and determining if the packet is of an existing flow
>
> a cache subsystem coupled to and between the lookup engine and the flow-entry database memory providing for fast access of a set of likely-to-be-accessed flow-entries from the flow-entry database; and
>
> a flow insertion engine coupled to the flow-entry memory and to the lookup engine and configured to create a flow-entry in the flow-entry database, the flow-entry including identifying information for future packets to be identified with the new flow-entry,

the lookup engine configured such that if the packet is of an existing flow, the monitor classifies the packet as belonging to the found existing flow; and if the packet is of a new flow, the flow insertion engine stores a new flow-entry for the new flow in the

flow-entry database, including identifying information for future packets to be identified with the new flow-entry,

wherein the operation of the parser subsystem depends on one or more of the protocols to which the packet conforms.

21.   (New) A monitor according to claim 20, wherein the lookup engine updates the flow-entry of an existing flow in the case that the lookup is successful.

22.   (New) A monitor according to claim 20, further including a mechanism for building a hash from the selected portions, wherein the hash is included in the input for a particular packet to the lookup engine, and wherein the hash is used by the lookup engine to search the flow-entry database.

23.   (New) A monitor according to claim 20, further including a memory containing a database of parsing/extraction operations, the parsing/extraction database memory coupled to the parser subsystem, wherein the parsing/extraction operations are according to one or more parsing/extraction operations looked up from the parsing/extraction database.

24.   (New) A monitor according to claim 33, wherein the database of parsing/extraction operations includes information describing how to determine a set of one or more protocol dependent extraction operations from data in the packet that indicate a protocol used in the packet.

25.   (New) A method according to claim 20, further including a state processor coupled to the lookup engine and to the flow-entry-database memory, and configured to perform any state operations specified for the state of the flow starting from the last encountered state of the flow in the case that the packet is from an existing flow, and to perform any state operations required for the initial state of the new flow in the case that the packet is from an existing flow.

26.   (New) A method according to claim 25, wherein the set of possible state operations that the state processor is configured to perform includes searching for one or more patterns in the packet portions.

27.   (New) A monitor according to claim 25, wherein the state processor is programmable, the monitor further including a state patterns/operations memory coupled to the state processor, the state operations memory configured to store a database of protocol dependent state patterns/operations.

28.   (New) A monitor according to claim 25, wherein the state operations include updating the flow-entry, including identifying information for future packets to be identified with the flow-entry.

29.   (New) A method of examining packets passing through a connection point on a computer network, each packets conforming to one or more protocols, the method comprising:

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