ROUTER

CROSS REFERENCE TO RELATED APPLICATION

[0001] The application claims the benefit of US provisional application No. 61/753,250 filed January 16, 2013, which is hereby incorporated by reference herein in its entirety.

FIELD

[0002] Some embodiments relate to communication network elements.

BACKGROUND

[0003] A communications network may include one or more network elements to facilitate the communication of data, for example, between computing devices.

SUMMARY

[0003a] According to a first aspect of the present invention, there is provided an apparatus including: a plurality of network interfaces including at least a first network interface, and a second network interface, wherein the first network interface is configured to a respective first network, and wherein the second network interface is configured to a respective second network, and a plurality of processors including at least a network processor for at least translating data, and a scheduling processor for at least transmitting the translated data by the network processor, the network processor configured to: obtain data received from the first network via the first network interface, perform network address translation on the data such that the data has an address on the second network, and communicate to the scheduling processor the data the network processor has translated from the first network to the second network, and obtain from the scheduling processor data that the scheduling processor has received from the second network via the second network interface, perform network address translation on the data such that the data has an address on the first network, and communicate the data to the first network via the first network interface, wherein the network processor obtains data received from the first network via the first network interface without use of the scheduling processor, and communicates data to the first network via the first network interface without use of the

scheduling processor; and the scheduling processor configured to: obtain from the network processor the data the network processor has translated from the first network to the second network and communicate the data to the second network via the second network interface; and obtain data received from the second network via the second network interface and communicate the data to the network processor for the network processor to perform network address translation on such that the data has an address on the first network, obtain data received from the second network work via the second network interface without use of the network processor, and communicates data to the second network via the second network interface without use of the network processor, and enable the scheduling processor to process interrupts from network interfaces that are configured to communicate with the scheduling processor, but disable the scheduling processor to process interrupts from network interfaces configured to communicate with the network processor.

[0003b] According to a second aspect of the present invention, there is provided a non-transitory computer-readable medium having instructions stored thereon that when executed by at least one processor comprising a scheduling processor and a network processor, direct: a network processor to at least translate data and a scheduling processor to at least transmit the translated data by the network processor, the network processor is configured to: obtain data received from a first network via a first network interface of a plurality of network interfaces, perform network address translation on the data such that the data has an address on a second network, and communicate to the scheduling processor the data the network processor has translated from the first network to the second network, and obtain from the scheduling processor data that the scheduling processor has received from the second network via a second network interface of the plurality of network interfaces, perform network address translation on the data such that the data has an address on the first network, and communicate the data to the first network via the first network interface, wherein the network processor obtains data received from the first network via the first network interface without use of the scheduling processor, and communicates data to the first network via the first network interface without use of the scheduling processor; the scheduling processor is configured to: obtain from the network processor the data the network processor has translated from the first network to the second network and communicate the data to the second network via the second network interface; and obtain data received from the second network via the second network interface and communicate the data to the network processor for the network processor to perform network address translation on such that the data has an address on the first network, obtain data received from the second network work via the

second network interface without use of the network processor, and communicates data to the second network via the second network interface without use of the network processor, enable the scheduling processor to process interrupts from network interfaces that are configured to communicate with the scheduling processor, but disable the scheduling processor to process interrupts from network interfaces configured to communicate with the network processor, wherein the first network interface is configured to be connected to a respective first network and the second network interface is configured to be connected to a respective second network.

BRIEF DESCRIPTION OF THE FIGURES

[0004] Figure 1A shows an example system according to some embodiments;

[0005] Figure IB shows an example configuration of the system of Figure 1 A;

[0006] Figure 2 shows another example system according to some embodiments; and

[0007] Figure 3 shows an example network element according to some embodiments.

DETAILED DESCRIPTION

[0008] Referring to Figure 1A, there is shown an example system 100. System 100 may include a plurality of entities, including entity 110 and a plurality of entities 130a-n (one of which is shown in detail in Figure 1A), one or more of which may be interconnected via network 103. Entity 110 may be, for example, a service provider that provides services, and each entity 130 may be, for example, a customer/user (e.g., such as a company, such as banks, investment funds, trading firm, etc.) of the services provided by service provider 110. For description purposes only, entity 110 will be referred to herein as a service provider and entity(s) 130 will be referred to as a user(s)/customer(s). Nonetheless, these terms are intended to be non- limiting and other example entities are possible. In addition, entity 110 being a service provider that provides services to entities 130 is also an example and other relationships between entities 110 and 130 are possible.

[0009] As one example, service provider 110 may provide one or more electronic marketplaces for the trading/buying-selling/matching of items (such as, for example, financial instruments, real-estate, bets/wagers, tangible goods, services, etc.) and as such, may provide

CLAIMS

1. An apparatus comprising:

a plurality of network interfaces including at least a first network interface, and a second network interface,

wherein the first network interface is configured to a respective first network, and

wherein the second network interface is configured to a respective second network, and

a plurality of processors including at least a network processor for at least translating data, and a scheduling processor for at least transmitting the translated data by the network processor,

the network processor configured to:

obtain data received from the first network via the first network interface, perform network address translation on the data such that the data has an address on the second network, and communicate to the scheduling processor the data the network processor has translated from the first network to the second network, and

obtain from the scheduling processor data that the scheduling processor has received from the second network via the second network interface, perform network address translation on the data such that the data has an address on the first network, and communicate the data to the first network via the first network interface,

wherein the network processor obtains data received from the first network via the first network interface without use of the scheduling processor, and communicates data to the first network via the first network interface without use of the scheduling processor; and

the scheduling processor configured to:

obtain from the network processor the data the network processor has translated from the first network to the second network and communicate the data to the second network via the second network interface; and

obtain data received from the second network via the second network interface and communicate the data to the network processor for the network processor to perform network address translation on such that the data has an address on the first network,

obtain data received from the second network work via the second network interface without use of the network processor, and communicates data to the second network via the second network interface without use of the network processor, and

enable the scheduling processor to process interrupts from network interfaces that are configured to communicate with the scheduling processor, but disable the scheduling processor to process interrupts from network interfaces configured to communicate with the network processor.

2. The apparatus of claim 1, further comprising at least a third network interface configured to a third network, and at least a third processor,

wherein the third processor is configured to:

obtain data received from the third network via the third network interface, perform network address translation on the data such that the data has an address on the second network, and communicate to the scheduling processor the data the third processor has translated from the third network to the second network, and

obtain from the scheduling processor data the scheduling processor has received from the second network via the second network interface, perform network address translation on the data such that the data has an address on the third network, and communicate the data to the third network via the third network interface,

wherein the third processor obtains data received from the third network work via the third network interface without use of the scheduling processor, and communicates data to the third network via the third network interface without use of the scheduling processor; and

wherein the scheduling processor is further configured to:

obtain from the third processor the data the third processor has translated from the third network to the second network and communicate the data to the second network via the second network interface; and

obtain data received from the second network via the second network interface and communicate the data to the third processor for the third processor to perform network address translation on such that the data has an address on the third network,

wherein the scheduling processor obtains data received from the second network work via the second network interface without use of the third processor, and communicates data to the second network via the second network interface without use of the third processor.

3. The apparatus of claim 2, wherein the apparatus is configured such that:

all data received by the first network interface from the first network is communicated from the first network interface only to the network processor; and

all data received by the third network interface from the third network is communicated from the third network interface only to the third processor.

4. The apparatus of claim 3, wherein the apparatus is re-configured such that:

all data received by the first network interface from the first network is communicated from the first network interface only to the third processor; and

all data received by the third network interface from the third network is communicated from the third network interface only to the network processor.

5. The apparatus of claim 1, wherein the network processor is further configured to perform port translation on data.

6. The apparatus of claim 1,

wherein a shared memory circular queue is associated with the network processor and the scheduling processor, the shared memory access queue having indexes associated therewith,

wherein to communicate by the network processor to the scheduling processor the data the network processor has translated from the first network to the second network includes to place by the network processor the data into the shared memory access queue,

wherein to obtain by the scheduling processor from the network processor the data the network processor has translated from the first network to the second network includes to read by the scheduling processor the data from shared memory access queue, and

wherein the network and scheduling processors update the indexes associated with the shared memory access queue to reflect data being placed into and read out of the shared memory access queue.

7. The apparatus of claim 6,

wherein another shared memory circular queue is associated with the network processor and the scheduling processor, the another shared memory access queue having indexes associated therewith,

wherein to communicate by the scheduling processor to the network processor the data the scheduling processor has received from the second network via the second network interface includes to place by the scheduling processor the data into the another shared memory access queue,

wherein to obtain by the network processor from the scheduling processor the data the scheduling processor has received from the second network via the second network interface includes to read by the network processor the data from the another shared memory access queue, and

wherein the network and scheduling processors update the indexes associated with the another shared memory access queue to reflect data being placed into and read out of the another shared memory access queue.

8. The apparatus of claim 3,

wherein for all data received by the first network interface from the first network to be communicated from the first network interface only to the network processor, and for all data received by the third network interface from the third network to be communicated from the third network interface only to the third processor includes to:

configure interrupts such that the network processor receives interrupts from the first network interface but not the third network interface, and

configure interrupts such that the third processor receives interrupts from the third network interface but not the first network interface.

9. The apparatus of claim 1, further comprising a semiconductor chip that has a plurality of cores, wherein a first of the cores comprises the network processor, and a second different one of the cores comprises the scheduling processor.

10. The apparatus of claim 1 further comprising:

a third network interface configured to a third network,

a fourth network interface configured to a fourth network,

a third processor, and

a fourth processor,

wherein the third processor is configured to:

obtain data received from the third network via the third network interface, perform network address translation on the data such that the data has an address on the fourth network, and communicate to the fourth processor the data the third processor has translated from the third network to the fourth network, and

obtain from the fourth processor data the fourth processor has received from the fourth network via the fourth network interface, perform network address translation on the data such that the data has an address on the third network, and communicate the data to the third network via the third network interface,

wherein the third processor obtains data received from the third network work via the third network interface without use of the fourth processor, and communicates data to the third network via the third network interface without use of the fourth processor; and

wherein the fourth processor is configured to:

obtain from the third processor the data the third processor has translated from the third network to the fourth network and communicate the data to the fourth network via the fourth network interface; and

obtain data received from the fourth network via the fourth network interface and communicate the data to the third processor for the third processor to perform network address translation on such that the data has an address on the third network,

wherein the fourth processor obtains data received from the fourth network work via the fourth network interface without use of the third processor, and communicates data to the fourth network via the fourth network interface without use of the third processor.

11. The apparatus of claim 10, further comprising a first and a second semiconductor chip each of which has a plurality of cores, wherein a first of the cores of the first chip comprises the network processor, a second different one of the cores of the first chip comprises the scheduling processor, a first of the cores of the second chip comprises the third processor, a second different one of the cores of the second chip comprises the fourth processor.

12. A non-transitory computer-readable medium having instructions stored thereon that when executed by at least one processor comprising a scheduling processor and a network processor, direct:

a network processor to at least translate data and a scheduling processor to at least transmit the translated data by the network processor,

the network processor is configured to:

obtain data received from a first network via a first network interface of a plurality of network interfaces, perform network address translation on the data such that the data has an address on a second network, and communicate to the scheduling processor the data the network processor has translated from the first network to the second network, and

obtain from the scheduling processor data that the scheduling processor has received from the second network via a second network interface of the plurality of network interfaces, perform network address translation on the data such that the data has an address on the first network, and communicate the data to the first network via the first network interface,

wherein the network processor obtains data received from the first network via the first network interface without use of the scheduling processor, and communicates data to the first network via the first network interface without use of the scheduling processor;

the scheduling processor is configured to:

obtain from the network processor the data the network processor has translated from the first network to the second network and communicate the data to the second network via the second network interface; and

obtain data received from the second network via the second network interface and communicate the data to the network processor for the network processor to perform network address translation on such that the data has an address on the first network,

obtain data received from the second network work via the second network interface without use of the network processor, and communicates data to the second network via the second network interface without use of the network processor,

enable the scheduling processor to process interrupts from network interfaces that are configured to communicate with the scheduling processor, but disable the scheduling processor to process interrupts from network interfaces configured to communicate with the network processor,

wherein the first network interface is configured to be connected to a respective first network and the second network interface is configured to be connected to a respective second network.

13. The non-transitory computer-readable medium of claim 12, further comprising instructions stored thereon that when executed by at least one processor comprising a scheduling processor and a network processor, direct:

at least a third network interface configured to a third network, and at least a third processor,

wherein the third processor is configured to:

obtain data received from the third network via the third network interface, perform network address translation on the data such that the data has an address on the second network, and communicate to the scheduling processor the data the third processor has translated from the third network to the second network, and

obtain from the scheduling processor data the scheduling processor has received from the second network via the second network interface, perform network address translation on the data such that the data has an address on the third network, and communicate the data to the third network via the third network interface,

wherein the third processor obtains data received from the third network work via the third network interface without use of the scheduling processor, and communicates data to the third network via the third network interface without use of the scheduling processor; and

wherein the scheduling processor is further configured to:

obtain from the third processor the data the third processor has translated from the third network to the second network and communicate the data to the second network via the second network interface; and

obtain data received from the second network via the second network interface and communicate the data to the third processor for the third processor to perform network address translation on such that the data has an address on the third network,

wherein the scheduling processor obtains data received from the second network work via the second network interface without use of the third processor, and communicates data to the second network via the second network interface without use of the third processor.

14. The non-transitory computer-readable medium of claim 13, wherein the medium having instructions stored thereon that when executed by at least one processor comprising a scheduling processor and a network processor, direct:

all data received by the first network interface from the first network is communicated from the first network interface only to the network processor; and

all data received by the third network interface from the third network is communicated from the third network interface only to the third processor.

15. The non-transitory computer-readable medium of claim 14, wherein the medium having instructions stored thereon that when executed by at least one processor comprising a scheduling processor and a network processor, direct:

all data received by the first network interface from the first network is communicated from the first network interface only to the third processor; and

all data received by the third network interface from the third network is communicated from the third network interface only to the network processor.

16. The non-transitory computer-readable medium of claim 12, wherein the medium having instructions stored thereon that when executed by at least one processor comprising a scheduling processor and a network processor, direct:

the network processor is further configured to perform port translation on data.

17. The non-transitory computer-readable medium of claim 12, wherein the medium having instructions stored thereon that when executed by at least one processor comprising a scheduling processor and a network processor, direct:

a shared memory circular queue is associated with the network processor and the scheduling processor, the shared memory access queue having indexes associated therewith,

wherein to communicate by the network processor to the scheduling processor the data the network processor has translated from the first network to the second network includes to place by the network processor the data into the shared memory access queue,

wherein to obtain by the scheduling processor from the network processor the data the network processor has translated from the first network to the second network includes to read by the scheduling processor the data from shared memory access queue, and

wherein the network and scheduling processors update the indexes associated with the shared memory access queue to reflect data being placed into and read out of the shared memory access queue.

18. The non-transitory computer-readable medium of claim 17, the medium having instructions stored thereon that when executed by at least one processor comprising a scheduling processor and a network processor, direct:

another shared memory circular queue is associated with the network processor and the scheduling processor, the another shared memory access queue having indexes associated therewith,

wherein to communicate by the scheduling processor to the network processor the data the scheduling processor has received from the second network via the second network interface includes to place by the scheduling processor the data into the another shared memory access queue,

wherein to obtain by the network processor from the scheduling processor the data the scheduling processor has received from the second network via the second network interface includes to read by the network processor the data from the another shared memory access queue, and

wherein the network and scheduling processors update the indexes associated with the another shared memory access queue to reflect data being placed into and read out of the another shared memory access queue.

19. The non-transitory computer-readable medium of claim 14, the medium having instructions stored thereon that when executed by at least one processor comprising a scheduling processor and a network processor, direct:

wherein for all data received by the first network interface from the first network to be communicated from the first network interface only to the network processor, and for all data received by the third network interface from the third network to be communicated from the third network interface only to the third processor includes to:

configure interrupts such that the network processor receives interrupts from the first network interface but not the third network interface, and

configure interrupts such that the third processor receives interrupts from the third network interface but not the first network interface.

20. The non-transitory computer-readable medium of claim 12, the medium having instructions stored thereon that when executed by at least one processor comprising a scheduling processor and a network processor, direct:

a third network interface configured to a third network,

a fourth network interface configured to a fourth network,

a third processor, and

a fourth processor,

wherein the third processor is configured to:

obtain data received from the third network via the third network interface, perform network address translation on the data such that the data has an address on the fourth network, and communicate to the fourth processor the data the third processor has translated from the third network to the fourth network, and

obtain from the fourth processor data the fourth processor has received from the fourth network via the fourth network interface, perform network address translation on the data such that the data has an address on the third network, and communicate the data to the third network via the third network interface,

wherein the third processor obtains data received from the third network work via the third network interface without use of the fourth processor, and communicates data to the third network via the third network interface without use of the fourth processor; and

wherein the fourth processor is configured to:

obtain from the third processor the data the third processor has translated from the third network to the fourth network and communicate the data to the fourth network via the fourth network interface; and

obtain data received from the fourth network via the fourth network interface and communicate the data to the third processor for the third processor to perform network address translation on such that the data has an address on the third network,

wherein the fourth processor obtains data received from the fourth network work via the fourth network interface without use of the third processor, and communicates data to the fourth network via the fourth network interface without use of the third processor.