

Invalidity search report

U.S. Patent 11,563,655 B2 — claim 1
Examiner Search · Patent invalidity and prior-art search
2026-10-21

Sample report — not prepared for a client. This is a sample of our signed invalidity search report. It reports a real search, run on a closed public record: our search of U.S. Patent 11,563,655 B2 for a public prior-art contest, which closed in October 2026. There is no client and no engagement, and nothing in it is confidential. It is published to show the form of the signed deliverable (here one claim; the signed tiers chart every independent claim, or every asserted claim with its dependents). It is not signed. It is a search report, not an opinion on validity or infringement.

1 Matter

Patent searched	U.S. Patent 11,563,655 B2, "Network monitoring apparatus and method thereof in programmable network virtualization" (inventors Gyeongsik Yang, Minkoo Kang, Hyuck Yoo)
Claim charted	Claim 1 (this sample). Independent claims: 1, 8, 10 and 12.
Application / dates	Application 17/128,353, filed 2020-12-21; foreign priority KR 10-2020-0051783, filed 2020-04-28; issued 2023-01-24.
Prior-art cutoff	Before 2020-04-28 (the priority date, taken as the effective filing date). Examined under the AIA (first inventor to file): §102(a)(1) for documents published before that date; §102(a)(2) for earlier-filed U.S. applications.
Expiry	2040-12-21 (20 years from the U.S. filing date, as listed by Google Patents; term adjustment not checked)
Ownership	Korea University Research and Business Foundation (original assignee) → IP3 2023, Series 923 of Allied Security Trust I (recorded 2024-02-06) → Arc Link LLC (recorded 2026-06-04, per Google Patents)
Examination	Examiner Kyung H. Shin, Art Unit 2452. Art applied: Mehta (US 2018/0287905 A1, §102), Porat (US 2006/0250959 A1) and Kuan (US 9,935,854 B2).
Search conducted	2026-09-04 to 2026-10-04
Prepared for	No client. Sample of the signed report, from our own closed contest search.

2 Bottom line

Claim 1 was allowed on 2022-10-26, after a final rejection over Mehta, a Juniper application that stores per-session traffic statistics for an administrator. The applicant's argument was about who receives the

statistics: "Nothing in these or any other portion of Mehta suggests providing statistics to the 'first virtual network' as recited by claim 1." The amendment before allowance added "based on the at least one physical resource" to the virtual-port-statistics clause. None of the three references below was before the Office. The examiner searched U.S. and foreign patent collections and the IBM Technical Disclosure Bulletin, which do not include the conference and technical-report literature where FlowVisor was published.

US '983 (Nicira, filed 2014-04-28) describes the statistics side of the claim: tenants' logical networks running on shared physical switches; flow-entry statistics tagged by logical entity, exported by each switch and totalled per logical entity; and logical-port statistics "collected indirectly through the tagged flow statistics" of the physical switches. It provides them to a network administrator. It says "logical" where the claim says "virtual".

FlowVisor (Stanford University, Nicira and Deutsche Telekom; technical report of 2009-10-14, OSDI paper of October 2010) describes the network hypervisor and delivery to each virtual network: one controller per slice; "Guest controllers only receive messages that are relevant to their network slice"; port statistics edited per slice; and a per-switch and per-port test of whether a resource is in a slice.

Every limitation is charted in full and split into its components, and each component is matched to a quoted passage. The weakest points are 1.c and 1.d: no document found tests whether a physical resource is shared between two virtual networks, or makes the statistics provided depend on that test. They are stated in Section 8. Documents identified but not obtained are listed in the box in Section 9.

Claim	Primary combination	Every element quoted	Weakest element
'655 claim 1	US '983 + FlowVisor TR + FlowVisor OSDI	Yes, across 3 references; none alone	1.c and 1.d: no document found tests whether a physical resource is shared between two virtual networks, or makes the statistics provided depend on that test. FlowVisor tests membership of a switch, port or flow in a slice; '983 states the switches are shared and separates statistics by tag for every flow (Section 8).

Factual statements of what the documents show, element by element; this report expresses no opinion on anticipation or obviousness. Each claim's statement of what each reference shows is at the head of its chart (Section 7).

3 The prosecution record

Date	Event	What it means here
2020-12-21	Application filed (priority KR 2020-04-28).	Examined under the AIA, first-inventor-to-file provisions.

Date	Event	What it means here
2021-11-26	Non-final rejection: claims 1-4 and 8 under §102 over Mehta; other claims under §103 with Porat and Kuan. The search record lists U.S. pre-grant publications, U.S. patents, EPO, JPO, Derwent and the IBM Technical Disclosure Bulletin.	No journal, conference or technical-report literature was searched. FlowVisor was published as a technical report and a conference paper.
2022-06-29	Final rejection: claims 1-4 and 8-11 under §102 over Mehta; the arguments of 2022-03-22 found unpersuasive.	Mehta was held to show the request, the statistics and their provision; the examiner did not accept the first response.
2022-08-29 / 09-15	After-final response; advisory action: the amendment was not entered because it raised new issues that would require further consideration and/or search.	—
2022-09-22	Telephone interview (summary of 2022-09-26): "After further search, allowance would be considered."	—
2022-09-29	RCE and amendment. Claim 1: "based on the at least one physical resource" added to the virtual-port-statistics clause. Remarks: Mehta stores its records in an analytics database "for use by an administrator of the cloud data center"; "Nothing in these or any other portion of Mehta suggests providing statistics to the 'first virtual network' as recited by claim 1."	The point of distinction was the recipient: statistics provided to the virtual network itself, isolated, rather than to an administrator. In this report that is element 1.d; '983 alone has the administrator gap, and FlowVisor supplies the delivery to each slice.
2022-10-26	Notice of allowance. The examiner's reasons restate claim 1 in full: the request, the determination whether at least one physical resource is shared, isolated provision based on that determination, and the flow-entry and port statistics.	The reasons do not single out one limitation; the shared-resource determination and the isolated provision (i.e., 1.d) are the parts no document found states as such (Section 8).

4 Claim elements

US 11,563,655 claim 1

Label	Limitation
1.pre	A computing apparatus implemented with a network hypervisor implementing software defined network (SDN)-based network virtualization, the computing apparatus comprising:
1.a	a statistics virtualization module configured to

Label	Limitation
1.b	receive a request for individual physical resource consumption statistics for a first virtual network of multiple separately managed virtual networks;
1.c	determine whether the at least one physical resource is shared between the first virtual network and at least one other of the multiple separately managed virtual networks, and
1.d	isolatedly provide individual physical resource consumption statistics to the first virtual network based on the determination whether the at least one physical resource is shared;
1.e	wherein the statistics virtualization module provides respective virtual flow entry statistics to the first virtual network, including:
1.f	provision of virtual flow entry statistics for the first virtual network,
1.g	provision of virtual port statistics based on the at least one physical resource for the first virtual network.

5 References relied on

Name in the charts	Full name	Where published	Date proof	Prior-art date basis	Role
US '983	U.S. Patent 9,893,983 B2 (S. Behera, H. Mai et al.; Nicira, Inc., now VMware), "Network virtualization operations using a scalable statistics collection framework"	USPTO patent	Filed 2014-04-28; issued 2018-02-13	Issued more than one year before the effective filing date — §102(a)(1); also an earlier-filed U.S. application — §102(a)(2)	Primary
FlowVisor TR	R. Sherwood, G. Gibb, K.-K. Yap, G. Appenzeller, M. Casado, N. McKeown, G. Parulkar, "FlowVisor: A Network Virtualization Layer", OpenFlow Technical Report OPENFLOW-TR-2009-1 (Deutsche Telekom Inc. R&D Lab, Stanford University, Nicira Networks)	openflowswitch.org / openflow.org (technical reports)	Dated 2009-10-14 on its face; Internet Archive capture 2012-04-17	Published more than one year before the effective filing date — §102(a)(1)	Primary
FlowVisor OSDI	R. Sherwood, G. Gibb, K.-K. Yap, G. Appenzeller, M. Casado, N. McKeown, G. Parulkar, "Can the Production Network Be the Testbed?", Proceedings of the 9th USENIX Symposium on Operating Systems Design and Implementation (OSDI '10)	usenix.org (conference proceedings)	OSDI '10, Vancouver, October 2010; Internet Archive capture 2011-09-11	Published more than one year before the effective filing date — §102(a)(1)	Primary

Primary = part of the claim's primary combination; there are no supporting references in this chart. None of the references relied on was before the Office: the examiner's art was Mehta, Porat and Kuan, and none of the three appears among the references cited on the patent. The two FlowVisor documents are by the same authors and describe the same system; each is charted with its own date. The "Prior-art date basis" column states only why each document qualifies as prior art by its date; whether one document or several together show each claim element is shown in the Bottom line and the claim chart. Capture dates link to the archived copy.

6 Coverage

US 11,563,655 claim 1

Element	US '983	Flow-Visor TR	Flow-Visor OSDI	Primary together
1. pre	P	E	P	E
1. a	E			E
1. b	E	P	P	E
1. c	P	P	P	C
1. d	P	P	P	C
1. e	P	P		C
1. f	E			E
1. g	E	E	P	E

E = that reference's quotations show every component of the element · P = some of its components · blank = not cited for that element · shaded columns = the claim's primary combination. "Primary together": E = one primary reference alone shows every component; C (combined) = every component is shown, but only by taking parts from different references (see Section 8); P = some components are not shown even together. Computed from the chart, component by component.

7 Claim charts

US 11,563,655 — claim 1

'655 claim 1. Each element is matched to a quoted passage in at least one of US '983, FlowVisor TR and FlowVisor OSDI (chart below). No single reference contains passages for every element. Whether and how the references combine is for counsel; the weakest match is stated in Section 8.

- **US '983:** the statistics framework: tenant logical networks on shared physical switches, flow-entry statistics tagged by logical entity, exported from each switch and totalled per logical network, and logical-port statistics derived from the physical switches (1.pre, 1.a, 1.b, 1.c, 1.d, 1.e, 1.f, 1.g)
- **FlowVisor TR:** the network virtualization layer that sits like a hypervisor, one controller per slice, the decision which slice (or slices) traffic belongs to, and messages and port statistics delivered to each slice separately (1.pre, 1.b, 1.c, 1.d, 1.e, 1.g)
- **FlowVisor OSDI:** the per-switch and per-port test of membership in a slice before messages reach the slice's controller (1.pre, 1.b, 1.c, 1.d, 1.g)

Reasons stated in the documents: US '983: “To retrieve logical port stats, a network administrator has to figure out which physical ports correspond to which logical ports”; FlowVisor TR: “In this paper we present a new approach to switch virtualization in which the same hardware forwarding plane can be shared among multiple logical networks, each with distinct forwarding logic”.

Weakest element: 1.c and 1.d: no document found tests whether a physical resource is shared between two virtual networks, or makes the statistics provided depend on that test. FlowVisor tests membership of a switch, port or flow in a slice; '983 states the switches are shared and separates statistics by tag for every flow (Section 8).

Reference and location	Verbatim text
1.pre A computing apparatus implemented with a network hypervisor implementing software defined network (SDN)-based network virtualization, the computing apparatus comprising:	
FlowVisor TR <i>p. 10 (PDF p. 11)</i>	“All network devices are pointed to a single FlowVisor instance, running on a 3.0GHz quad-core Intel Xeon with 2 GB of ram.”
IN PLAIN TERMS FlowVisor runs on a computer: the computing apparatus. Shows: A computing apparatus	
FlowVisor TR <i>p. 2 (PDF p. 3)</i>	“Much as a hypervisor resides between software and hardware on a PC, the FlowVisor uses OpenFlow as a hardware abstraction layer to sit logically between control and forwarding paths on a network device.”
IN PLAIN TERMS FlowVisor is a hypervisor for the network: it sits between the control software and the forwarding hardware, using OpenFlow (the standard SDN protocol). Shows: implemented with a network hypervisor · implementing software defined network (SDN)-based network virtualization	
FlowVisor TR <i>p. 2 (PDF p. 3)</i>	“In this paper, we describe FlowVisor: A network virtualization layer that we built and deployed in our network.”
IN PLAIN TERMS FlowVisor is a network virtualization layer. Shows: implementing software defined network (SDN)-based network virtualization	
FlowVisor OSDI <i>p. 5 (PDF p. 5)</i>	“By design, FlowVisor is a slicing layer interposed between data and control planes of each device in the network.”
IN PLAIN TERMS FlowVisor sits between the data plane and the control plane of every switch: the position of a network hypervisor. Shows: implemented with a network hypervisor	

Reference and location	Verbatim text
US '983 <i>col. 10</i>	“As shown, the system includes a network virtualization platform (NVP) 795 and a physical forwarding element (PFE) 715.”
IN PLAIN TERMS '983's system is a network virtualization platform. Shows: implementing software defined network (SDN)-based network virtualization	
US '983 <i>col. 12</i>	“The NVP controller 720 of some embodiments pushes flows to the OVS daemon 765 through a particular channel (e.g. OpenFlow channel) using a particular protocol (e.g., OpenFlow protocol).”
IN PLAIN TERMS Its controller programs the switches' flows over OpenFlow, the software-defined networking protocol. Shows: implementing software defined network (SDN)-based network virtualization	
NOTE FlowVisor calls itself a network virtualization layer that sits like a hypervisor between control and forwarding; '983 uses "hypervisor" for the host on which a software switch runs. None of the three documents uses the phrase "network hypervisor".	
1. a a statistics virtualization module configured to	
US '983 <i>col. 1</i>	“Embodiments described herein provide a system that includes (1) a set of tools to define a set of one or more logical forwarding elements from a number of physical forwarding elements and (2) a scalable framework to retrieve statistics relating each logical forwarding element.”
IN PLAIN TERMS A framework that turns the physical switches' statistics into statistics of each logical (virtual) switch: a statistics virtualization module, under another name. Shows: a statistics virtualization module	
US '983 <i>col. 26</i>	“wherein each forwarding element comprises a flow stats exporter to export flow statistics of each tagged flow entry in the set of flow entries”
IN PLAIN TERMS Each physical switch has an exporter that sends out the statistics of each tagged flow entry. Shows: a statistics virtualization module	
US '983 <i>col. 25</i>	“to aggregate the statistics for the particular logical entity from the statistics for said subsets of flow entries comprising tags identifying the particular logical entity in order to provide total statistics relating to the particular logical entity”
IN PLAIN TERMS An aggregator totals the tagged flow-entry statistics per logical entity and provides them. Shows: a statistics virtualization module	
NOTE '983 does not use the words "statistics virtualization module". Its exporter-and-aggregator framework converts physical-switch statistics into statistics of logical (virtual) switches and ports.	
1. b receive a request for individual physical resource consumption statistics for a first virtual network of multiple separately managed virtual networks;	
US '983 <i>col. 13</i>	“For instance, when there is a request for statistic relating to a logical port or an aggregated entity, the aggregator in some such embodiments queries the storage to retrieve the requested statistics.”
IN PLAIN TERMS The system receives a request for statistics of one logical entity (a logical port, or a group such as a customer's machines) and retrieves them. Shows: receive a request · for a first virtual network	
US '983 <i>col. 13</i>	“For instance, in the example of FIG. 7, a network administrator's aggregated entity stats request is initially received at the stats request API.”

Reference and location	Verbatim text
IN PLAIN TERMS The request arrives at a "stats request API". Here it comes from a network administrator, not from the tenant (see the note). Shows: receive a request	
US '983 <i>col. 1</i>	"Such total statistics are useful because they can be used to determine the amount of traffic one or more machines of a customer is generating and possibly charge overages based on the amount of traffic."
IN PLAIN TERMS The statistics measure how much traffic one customer's machines generate, so that customer can be billed: the customer's own consumption. Shows: for individual physical resource consumption statistics	
US '983 <i>col. 1</i>	"The network hosts are related to one another because, typically, they belong to a single entity, such as a user, customer, or tenant."
IN PLAIN TERMS Each logical network belongs to one user, customer or tenant: a first virtual network. Shows: for a first virtual network	
US '983 <i>col. 4, ll. 49-53</i>	"The PFEs 115 and 120 may implement multiple LFEs (e.g., logical switches or logical routers) for different logical networks of different tenants, users, departments, etc. that use the same shared computing and networking resources."
IN PLAIN TERMS Physical switches (PFEs) carry several logical switches or routers (LFEs), one set per tenant's logical network, all on the same shared hardware. Shows: of multiple separately managed virtual networks	
FlowVisor TR <i>p. 5 (PDF p. 6)</i>	"The read-only rules allow slices to receive OpenFlow control messages and query switch statistics, but not to insert entries into the forwarding table."
IN PLAIN TERMS A slice can send FlowVisor a query for switch statistics: a request made for that slice. Shows: receive a request	
FlowVisor TR <i>p. 8 (PDF p. 9)</i>	"A port status request is a message sent by the controller to the switch to query the byte and packet counters for a specific port."
IN PLAIN TERMS A slice's controller requests the byte and packet counters of a physical switch port: statistics of a physical resource. Shows: receive a request · for individual physical resource consumption statistics	
FlowVisor TR <i>p. 3 (PDF p. 4)</i>	"FlowVisor hosts multiple guest OpenFlow controllers, one controller per slice, making sure that a controller can observe and control its own slice, while isolating one slice from another (both the datapath traffic belonging to the slice, and the control of the slice)."
IN PLAIN TERMS Each slice (virtual network) has its own controller, managed separately; FlowVisor keeps the slices isolated from one another. Shows: of multiple separately managed virtual networks	
FlowVisor OSDI <i>p. 4 (PDF p. 4)</i>	"Each slice has its own distinct, programmable control logic, that manages how packets are forwarded and rewritten for traffic in the slice's flowspace."
IN PLAIN TERMS Each slice is managed separately, by its own control logic. Shows: of multiple separately managed virtual networks	
NOTE In '983 the request comes from a network administrator; in FlowVisor it comes from the slice's own controller. The claim recites a request for statistics for the first virtual network and does not say who makes it.	

Reference and location	Verbatim text
1.c determine whether the at least one physical resource is shared between the first virtual network and at least one other of the multiple separately managed virtual networks, and	
FlowVisor TR <i>p. 4 (PDF p. 5)</i>	“FlowVisor can decide which flow-space contains it, and therefore which slice (or slices) it belongs to.”
IN PLAIN TERMS For any traffic, FlowVisor decides which slice it belongs to, and recognises that it may belong to more than one slice. Shows: determine whether · between the first virtual network and at least one other of the multiple separately managed virtual networks	
FlowVisor TR <i>p. 4 (PDF p. 5)</i>	“FlowVisor can isolate two slices by making sure their flow-spaces don't overlap anywhere in the topology; or it can decide which switches can be used to communicate from one slice to another.”
IN PLAIN TERMS FlowVisor checks whether two slices' traffic definitions overlap anywhere in the network, and decides which switches the slices may share for communication. Shows: determine whether · between the first virtual network and at least one other of the multiple separately managed virtual networks	
FlowVisor TR <i>p. 4 (PDF p. 5)</i>	“It can also allow a packet to belong to two or more slices; for example, if one slice is used to monitor other slices.”
IN PLAIN TERMS Traffic can belong to two or more slices at once. Shows: between the first virtual network and at least one other of the multiple separately managed virtual networks	
FlowVisor TR <i>p. 3 (PDF p. 4)</i>	“FlowVisor partitions the flow-table in each switch by keeping track of which flow-entries belong to each guest controller.”
IN PLAIN TERMS FlowVisor divides each switch's flow table among the slices and tracks which entries belong to which slice. Shows: determine whether	
FlowVisor OSDI <i>p. 6 (PDF p. 6)</i>	“First, FlowVisor only sends control plane messages to a slice controller if the source switch is actually in the slice's topology.”
IN PLAIN TERMS FlowVisor tests, switch by switch, whether a physical switch belongs to a slice before passing that switch's messages to the slice. Shows: determine whether	
FlowVisor OSDI <i>p. 6 (PDF p. 6)</i>	“Second, FlowVisor rewrites OpenFlow feature negotiation messages so that the slice controller only sees the physical switch ports that appear in the slice.”
IN PLAIN TERMS Port by port, FlowVisor decides which physical ports belong to a slice and shows the slice only those. Shows: determine whether	
US '983 <i>col. 4, ll. 55–56</i>	“Conceptually, a single PFE can be used to define multiple LFEs.”
IN PLAIN TERMS One physical switch can serve several tenants' logical switches: that physical resource is shared between logical networks. Shows: the at least one physical resource is shared	
US '983 <i>col. 4, ll. 49–53</i>	“The PFEs 115 and 120 may implement multiple LFEs (e.g., logical switches or logical routers) for different logical networks of different tenants, users, departments, etc. that use the same shared computing and networking resources.”

Reference and location	Verbatim text
IN PLAIN TERMS '983 states that the tenants' logical networks run on the same shared resources. Shows: the at least one physical resource is shared	
NOTE The weakest element. No document found states a test of whether a physical resource is shared between two virtual networks. FlowVisor tests whether a switch, a port or a flow belongs to a slice, checks that slices do not overlap, and allows traffic to belong to two or more slices; '983 states that the physical switches are shared by tenants but makes no determination about it (Section 8).	
1.d isolatedly provide individual physical resource consumption statistics to the first virtual network based on the determination whether the at least one physical resource is shared;	
FlowVisor TR p. 8 (PDF p. 9)	“the FlowVisor has to edit the message per slice to remove statistics for ports that do not appear in a slices virtual topology.”
IN PLAIN TERMS FlowVisor edits the switch's port-statistics reply separately for each slice, removing ports that are not in that slice. Shows: isolatedly provide · individual physical resource consumption statistics	
FlowVisor TR p. 5 (PDF p. 6)	“Guest controllers only receive messages that are relevant to their network slice.”
IN PLAIN TERMS Each slice's own controller receives only the messages for its own slice: delivery to the virtual network, kept separate. Shows: isolatedly provide · to the first virtual network	
FlowVisor TR p. 3 (PDF p. 4)	“FlowVisor hosts multiple guest OpenFlow controllers, one controller per slice, making sure that a controller can observe and control its own slice, while isolating one slice from another (both the datapath traffic belonging to the slice, and the control of the slice).”
IN PLAIN TERMS Each controller sees and controls only its own slice; slices are isolated from one another. Shows: isolatedly provide · to the first virtual network	
FlowVisor OSDI p. 6 (PDF p. 6)	“First, FlowVisor only sends control plane messages to a slice controller if the source switch is actually in the slice's topology.”
IN PLAIN TERMS Messages from a switch reach a slice's controller only after FlowVisor has tested that the switch is in the slice. Shows: to the first virtual network · based on the determination whether the at least one physical resource is shared	
US '983 col. 1	“Such total statistics are useful because they can be used to determine the amount of traffic one or more machines of a customer is generating and possibly charge overages based on the amount of traffic.”
IN PLAIN TERMS The statistics measure how much traffic one customer's machines generate, so that customer can be billed: the customer's own consumption. Shows: individual physical resource consumption statistics	
FlowVisor TR p. 8 (PDF p. 9)	“A port status request is a message sent by the controller to the switch to query the byte and packet counters for a specific port.”
IN PLAIN TERMS The statistics in question are the byte and packet counters of a physical port. Shows: individual physical resource consumption statistics	
NOTE FlowVisor delivers each slice's messages, including port statistics edited per slice, to that slice's own controller, according to whether the switch or port is in the slice. It does not apportion a shared counter among slices. '983 computes per-tenant statistics, for every flow by its tag, and provides them to an administrator. No document found makes the statistics provided depend on whether the resource is also used by another virtual network (Section 8).	

Reference and location	Verbatim text
1.e wherein the statistics virtualization module provides respective virtual flow entry statistics to the first virtual network, including:	
US '983 <i>cols. 24-25</i>	“wherein statistics for a subset of flow entries in the set of flow entries comprise statistics for a particular logical entity, wherein each flow entry in the subset of flow entries comprise at least one tag identifying the particular logical entity”
IN PLAIN TERMS Claim 1 of '983: the flow-entry statistics of one logical entity are kept apart by a tag on each of its flow entries. Shows: provides respective virtual flow entry statistics	
US '983 <i>col. 11</i>	“The flow stats exporter can export all the different flow statistics that are associated with different tags.”
IN PLAIN TERMS Flow-entry statistics are exported separately for each tag, that is, for each logical entity; respective statistics. Shows: provides respective virtual flow entry statistics	
FlowVisor TR <i>p. 5 (PDF p. 6)</i>	“Guest controllers only receive messages that are relevant to their network slice.”
IN PLAIN TERMS Each slice's controller receives the messages for its own slice; the channel by which statistics reach the virtual network. Shows: to the first virtual network	
NOTE '983 provides the flow-entry statistics to an administrator; FlowVisor delivers each slice's messages to that slice, but its papers describe port statistics per slice, not flow-entry statistics. The element is matched only by taking parts from both.	
1.f provision of virtual flow entry statistics for the first virtual network,	
US '983 <i>col. 26</i>	“wherein each forwarding element comprises a flow stats exporter to export flow statistics of each tagged flow entry in the set of flow entries”
IN PLAIN TERMS Each physical switch exports the statistics of each tagged flow entry. Shows: provision of virtual flow entry statistics	
US '983 <i>col. 25</i>	“to aggregate the statistics for the particular logical entity from the statistics for said subsets of flow entries comprising tags identifying the particular logical entity in order to provide total statistics relating to the particular logical entity”
IN PLAIN TERMS Those statistics are totalled and provided for one particular logical entity, such as one tenant's logical network. Shows: for the first virtual network	
US '983 <i>col. 5</i>	“The flow stats exporter of some embodiments sends flow statistics to the aggregator periodically or when triggered.”
IN PLAIN TERMS The flow statistics are provided periodically or on demand. Shows: provision of virtual flow entry statistics	
1.g provision of virtual port statistics based on the at least one physical resource for the first virtual network.	
US '983 <i>col. 7</i>	“indicate that logical port statistics are collected indirectly through the tagged flow statistics”
IN PLAIN TERMS Statistics of the logical (virtual) ports are derived from the tagged flow statistics collected on the physical switches. Shows: provision of virtual port statistics · based on the at least one physical resource	

Reference and location	Verbatim text
US '983 <i>col. 3, ll. 45-50</i>	"As an example, the system of some embodiments allows a network administrator to retrieve a total packet count and byte count for one or more logical ports of the logical forwarding element, even though the logical ports may be distributed across multiple physical forwarding elements."
IN PLAIN TERMS Packet and byte counts are provided for the logical ports of one logical switch, although those ports sit on several physical switches. Shows: provision of virtual port statistics · based on the at least one physical resource · for the first virtual network	
FlowVisor TR <i>p. 8 (PDF p. 9)</i>	"the FlowVisor has to edit the message per slice to remove statistics for ports that do not appear in a slices virtual topology."
IN PLAIN TERMS Port statistics of the physical switch are edited for each slice's own view of the network. Shows: provision of virtual port statistics · for the first virtual network	
FlowVisor TR <i>p. 8 (PDF p. 9)</i>	"A port status request is a message sent by the controller to the switch to query the byte and packet counters for a specific port."
IN PLAIN TERMS The port statistics are the counters of a physical switch port. Shows: based on the at least one physical resource	
FlowVisor OSDI <i>p. 10 (PDF p. 10)</i>	"message per slice to remove statistics for ports that do not appear in a sliced topology."
IN PLAIN TERMS The 2010 paper repeats the per-slice editing of port statistics. Shows: provision of virtual port statistics · for the first virtual network	
NOTE This is the phrase added by the amendment of 2022-09-29 ("based on the at least one physical resource"). '983 derives logical-port statistics from the physical switches; FlowVisor edits the physical switch's port statistics per slice.	

Every quotation above was checked by script against the saved text of the cited document before this report was generated; a quotation not found verbatim is refused. The script also checks that each limitation is printed exactly as it appears in the issued claim, and that every component of every limitation is shown by at least one citation.

Sources quoted

- VM983 — US 9,893,983 B2 (Nicira, Inc.; now VMware), "Network virtualization operations using a scalable statistics collection framework", filed 2014-04-28, issued 2018-02-13
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- FV-TR — R. Sherwood, G. Gibb, K.-K. Yap, G. Appenzeller, M. Casado, N. McKeown, G. Parulkar, "FlowVisor: A Network Virtualization Layer", OpenFlow Technical Report OPENFLOW-TR-2009-1, dated October 14, 2009 (Deutsche Telekom Inc. R&D Lab, Stanford University, Nicira Networks). Page numbers are those printed on the report (the cover page is unnumbered). Internet Archive capture 2012-04-17.
<https://web.archive.org/web/20120417091830/http://www.openflow.org:80/downloads/technicalreports/openflow-tr-2009-1-flowvisor.pdf>
- FV-OSDI — R. Sherwood, G. Gibb, K.-K. Yap, G. Appenzeller, M. Casado, N. McKeown, G. Parulkar, "Can the Production Network Be the Testbed?", Proceedings of the 9th USENIX Symposium on Operating Systems Design and Implementation (OSDI '10), Vancouver, October 2010. Page numbers are the paper's own (1-14). Internet Archive capture 2011-09-11.
https://web.archive.org/web/20110911171337/http://www.usenix.org/events/osdi10/tech/full_papers/Sherwood.pdf

8 Open points

Point	Detail	Assessment
Whether a physical resource is shared (1.c)	No document found states a test of whether a physical resource is shared between two virtual networks. FlowVisor tests whether a switch is "actually in the slice's topology", shows each slice "only ... the physical switch ports that appear in the slice", checks that slices' flowspace do not overlap, and allows traffic to belong "to two or more slices". '983 states that the switches serve tenants "that use the same shared computing and networking resources", but makes no determination about it. The determination is membership in one slice, not sharing between two.	Not stated as such in any document; the point most open to dispute
Statistics provided according to that determination (1.d)	FlowVisor delivers each slice's messages, and edits port statistics per slice, according to whether the switch or port is in that slice; it does not divide a shared counter among slices. '983 separates statistics by a tag on every flow, unconditionally, and gives the totals to an administrator. No document found makes the statistics provided depend on whether the resource is also used by another virtual network.	Combination; second weakest
Who receives the statistics (1.b, 1.d, 1.e)	The applicant distinguished Mehta on the recipient (an administrator). '983 has the same recipient. FlowVisor supplies delivery to each slice's own controller, but its papers describe port statistics only; flow-entry statistics per virtual network come from '983.	Combination
Flow-entry statistics (1.e, 1.f)	Only '983 shows flow-entry statistics per logical entity. FlowVisor counts each slice's flow entries to enforce a limit, not as statistics given to the slice; that passage is not relied on.	Shown by '983
"Network hypervisor" (1.pre)	None of the three documents uses the phrase. FlowVisor describes itself as a network virtualization layer that sits "much as a hypervisor" between control and forwarding; '983 uses "hypervisor" for the host of a software switch.	Wording differs
"Logical" and "virtual"	'983 speaks of logical forwarding elements, logical networks and logical ports; the claim speaks of virtual networks, virtual flow entries and virtual ports. The specification of the '655 patent was not compared term by term.	Construction point
Dates of the FlowVisor documents	The technical report is dated 2009-10-14 on its face; the earliest Internet Archive capture found is 2012-04-17. The OSDI paper is in the October 2010 proceedings; capture 2011-09-11. For use in litigation, an Internet Archive affidavit or the USENIX publication record should be obtained.	Procedural

9 What was not found, and how hard we looked

No document dated before 2020-04-28 was found that tests whether a physical resource is shared between two virtual networks and provides statistics according to the result. U.S. and foreign patent literature, the network-

hypervisor research literature (including a survey of about thirty network hypervisors), the OpenFlow specification and the citation trees of the documents charted were searched for it; every zero result was checked against a control. Several of the examiner's own searches in the claim's terms also returned zero results.

Worth obtaining. Documents identified during the search but not obtained. Each row states what it may show, where it can be obtained, the effort involved, and why it was not obtained for this report. None of them is relied on in the chart.

Item	What it may show	Where to obtain it	Cost / effort	Why not obtained
DFVisor: Liao, Leung & Nasiopoulos, "DFVisor: Scalable network virtualization for QoS management in cloud computing" (CNSM 2014), and Liao, Shami & Leung (IET Networks, 2015)	A distributed FlowVisor whose database, as described in a 2016 survey, keeps each slice's state "e.g., flow statistics" and acts as an interface to the slices' controllers. May bear on flow-entry statistics delivered to the virtual network (1.e) and on 1.d.	IEEE Xplore (CNSM 2014); IET Digital Library (IET Networks 2015, listed as open access)	About \$15-35 (CNSM); free (IET), download by hand in a browser	The publisher sites refused automated download, and the survey's description alone is not relied on.
OpenVirteX: "OpenVirteX: Make Your Virtual SDNs Programmable" (HotSDN 2014)	A network hypervisor that virtualizes topology, addresses and flow tables per tenant; may describe statistics returned to each tenant (1.d-1.g).	ACM Digital Library	About \$15, or a library	Identified late in the search period; the 4-page ONS 2014 abstract was read and has no statistics.
Flow-table virtualization papers: "PVFlow: Flow-Table Virtualization in POF-based vSDN Hypervisor" (ICNC 2018); "Soft Partitioning Flow Tables for Virtual Networking in Multi-Tenant SDNs" (IEEE TNSM 2017)	Per-tenant virtual flow tables in a network hypervisor; may bear on flow-entry statistics per virtual network (1.e, 1.f).	IEEE Xplore	About \$15-35 each	Behind publisher paywalls; not purchased for this sample.

The closest patent documents either assume the sharing and separate statistics by tag, or test something else: whether to apply a service, whether a device is authorized, or which host sent a packet. They are listed, with the reason each was set aside, in Appendix B.

10 Search record

2,687 database queries were recorded automatically between 2026-09-04 17:58 and 2026-10-04 17:26 US Central time, across 15 sources; 53 USPTO queries returned zero. Searches run by hand outside the query log are summarised by source below.

Source	Queries	Hits	Returned for review
USPTO Patent Public Search (US patents and publications, full text)	2,544	347,949,453	59,535
arXiv (preprints)	17	86	86
Crossref (scholarly literature)	15	169	169
OpenAlex (scholarly literature)	15	159	159
IETF RFC series	12	250	250
Europe PMC	11	37	37
YouTube	11	109	109
Semantic Scholar (scholarly literature)	10	0	0
ClinicalTrials.gov	10	0	0
Web search	10	13	13
Internet Archive (texts)	9	164	164
Google Books	9	71	71
Product manuals and vendor literature (archived)	6	2,582	2,582
Google Patents (worldwide, full text)	5	15,872	200
EPO Open Patent Services (worldwide, incl. CN/JP/KR abstracts)	3	32	18

Sources searched

Source	Coverage	Result
US patents and publications	Full text, to the 2020-04-28 cutoff, for every element of claim 1; zero results checked with controls	US '983 and its sibling; no document with the shared-resource test
Worldwide patent literature	EP, WO, JP, CN and KR families and abstracts	No closer document
Citation trees	Backward and forward citations of US '983 and of the patent searched	US '983's family; nothing closer
Prosecution record	The file wrapper: rejections, responses, advisory action, interview summary, allowance and the examiner's search notes	Allowance reasons; recipient argument over Mehta
Network-hypervisor research literature	Conference papers, technical reports and surveys on network virtualization and SDN hypervisors (FlowVisor, OpenVirteX, DFVisor and others)	FlowVisor technical report and OSDI paper; DFVisor and others not obtained (Section 9)
Standards and specifications	OpenFlow switch specification; IETF RFC series	Statistics messages per switch only
Scholarly indexes	Crossref, OpenAlex, Semantic Scholar, arXiv	Measurement study (2017); paywalled flow-table papers (Section 9)

Source	Coverage	Result
Books, video and archived web pages	Google Books, Internet Archive texts, YouTube, product documentation	Nothing closer

The full query log is kept on file.

11 Limitations and basis

- This is a sample of the signed report. It is not signed, and it was not prepared for a client. It is not a legal opinion on validity or infringement, and it states no conclusion on patentability.
- Every quotation in the chart was checked by script against the saved text of the cited document; patent locations were derived from the printed patent and page numbers from the printed papers. Locations given as a column only are within that column.
- Exhibits are not attached to this sample. In the signed report each archived document is printed with its capture banner, stamped, and pin-cited from the chart.
- Prepared on the public record. Products of the original assignee or of others were not investigated for prior public use or sale.
- The search was run for a public prior-art contest on this patent and closed with it (2026-10). Later documents and later events affecting the patent are not covered.

Sample — not signed. In a signed report the searcher states here: "I conducted the searches described in this report, read in full each reference charted, and checked every quotation against the cited document. The report states what the documents say; it expresses no opinion on validity."

Sample — not signed

Michael W. Smith
Examiner Search
2026-10-21

Appendix A — claims as granted

US 11,563,655 B2 — claim 1

1. A computing apparatus implemented with a network hypervisor implementing software defined network (SDN)-based network virtualization, the computing apparatus comprising: a statistics virtualization module configured to receive a request for individual physical resource consumption statistics for a first virtual network of multiple separately managed virtual networks; determine whether the at least one physical resource is shared between the first virtual network and at least one other of the multiple separately managed virtual networks, and isolatedly provide individual physical resource consumption statistics to the first virtual network based on the determination whether the at least one physical resource is shared; wherein the statistics virtualization module provides respective virtual flow entry statistics to the first virtual network, including: provision of virtual flow entry statistics for the first virtual network, provision of virtual port statistics based on the at least one physical resource for the first virtual network.

Appendix B — references set aside

Reference	Why it was set aside	Where to check
US 10,320,672 B2 (Cisco, filed 2016)	Shared services for multiple tenants in a data-center fabric. Its "determine whether" decides whether to apply a shared service to a packet, not whether a resource is shared.	Claims; description https://patents.google.com/patent/US10320672B2/en
US 8,688,552 B1 (Juniper, filed 2011)	Separate accounting and billing for each customer of a shared customer device. The sharing is a premise; nothing tests for it.	Description https://patents.google.com/patent/US8688552B1/en
US 9,917,769 B2 (Ericsson, filed 2014)	Virtualizes flow tables in an SDN system; no statistics provided per tenant.	Description https://patents.google.com/patent/US9917769B2/en
US 10,469,342 B2 (Nicira, filed 2014)	Logical network traffic analysis; same field, no test of whether a resource is shared.	Description https://patents.google.com/patent/US10469342B2/en
US 9,893,964 B2 (Nicira, filed 2014)	Same specification as US '983 (sibling patent); adds nothing to it.	Description https://patents.google.com/patent/US9893964B2/en
US 9,749,251 B2 (Pluribus, 2010 priority)	Branches on packet handling in a network device; no virtual networks to share between.	Description https://patents.google.com/patent/US9749251B2/en
US 9,137,154 B2 (Lenovo, filed 2012)	Routing tables shared by logical switch partitions; the branches concern table management, not statistics.	Description https://patents.google.com/patent/US9137154B2/en
US 9,577,898 B1 (Narus, filed 2013)	Attributes traffic behind a shared address to individual hosts; host identification, not statistics.	Description https://patents.google.com/patent/US9577898B1/en
US 9,887,892 B2 (Xian Zhongxing, 2013 priority)	Traffic statistics collection; no attribution per virtual network.	Description https://patents.google.com/patent/US9887892B2/en
US 2019/0289647 A1 (Huawei, 2016 priority)	Network slice control; not a statistics document.	Description https://patents.google.com/patent/US20190289647A1/en
Blenk et al., survey of network hypervisors for SDN (IEEE Communications Surveys & Tutorials, 2016)	Survey of about thirty network hypervisors; credits per-slice statistics only to DFVisor (Section 9). A secondary source; not charted.	DFVisor entry
Measurement study of FlowVisor and OpenVirteX (arXiv 1704.08958, 2017)	Confirms that both hypervisors handle port-statistics requests per tenant; adds nothing beyond FlowVisor.	Port-statistics measurements https://arxiv.org/abs/1704.08958