

Claim 4 – U.S. Patent No. 11,070,898

<p>A digital network communication method comprises:</p>	<p>This is a method claim, and damages for infringement accrue starting from July 21, 2021, the date U.S. patent 11,070,898 (“the ‘898 patent”) issued, because Company’s use of the claimed method began before then. Notice of infringement is not required to obtain damages for infringement of method claims.</p> <p>Company is an ISP that, to satisfy critical information security considerations and information speed demands of its subscribers, performs each of the steps of the claimed method as described below using virtually separated private data streams provided to Company by service providers or generated by Company itself before being sent to a Company PON interface router. It makes no difference for infringement, either way, because generating private streams is not claimed.</p>
<p>receiving from at least one passive optical network (PON) interface router out of a plurality of PON interface routers at a PON optical line terminal (OLT), at least one private data stream out of a plurality of data streams,</p>	<p>Company provides IP based services to its subscribers using Passive Optical Networks (PONs).</p> <p>In the past, the only IP based service provided by ISPs (which was not provided using PONs before the invention of the ‘898 patent) was computer related information. Today, IP based services provided by Company to its subscribers can include digitized voice, video and data information.</p> <p>Public information available and the PON based services advertised by Company show Company’s use of PONs. The advertised speeds available via Company’s PON networks require the use of the RFC 4364 Standard – BGP/MPLS IP Virtual Private Networks (VPNs) and related standards applicable to the ‘898 patent.</p> <p>PONs, such as those used by Company, provide present and future data speeds to subscribers efficiently and cost effectively. PONs, are also much easier and cost effective</p>

to deploy, operate and maintain than conventional copper based infrastructure. In addition, PONs are highly sustainable, saving considerable power by eliminating the need for riser closets and associated air conditioning costs.

Each PON includes an optical aggregation switch called an OLT, and one or more passive optical splitters that connect the OLT to several Optical Network Units (ONUs).

The RFC 4364 Standard requires that any aggregation switch and additional non-routing components used within the network perform their intended functions while remaining “invisible” with respect to the RFC 4364 requirements. At the time of the invention claimed in the ‘898 patent, PON was a new technology that had strong opposition from the US Information Technology sector. The PON OLT and other PON network components are invisible to the RFC 4364 Standard by not interfering or changing the required virtual routing characteristics or the MPLS labeling of IP packets.

An OLT can receive private data streams directly from a PON interface router, or indirectly via a network aggregation switch connected between one or more PON interface routers and the OLT.

As an example, Figure 2 of the ‘898 patent shows:

A PON interface router 140.

An OLT 146.

Data streams that include private data streams are carried via uplinks (142 and 144) to an OLT (146), which creates initial feeds (166, 168 and 170), that become distribution feeds (176, 178 and 180). The private data streams are intended for specific subscribers.

Company’s OLT receives from a PON interface router virtually separated private IP data streams that deliver various services

intended for specific subscribers in accordance with the RFC 4364 Standard, Page 3, Section 1.1. Virtual Private Networks:

“Consider a set of “sites” that are attached to a common network we call “the backbone”. Now apply some policy to create a number of a subsets of a set, and impose the following rule: Two sites may have IP connectivity over that backbone only if at least one of these subsets contains them both.

“These subsets are Virtual Private Networks (VPNs). Two sites have IP connectivity over the common backbone only if there is some VPN that contains them both. Two sites that have no VPN in common have no connectivity over that backbone.”

A Service Provider delivers services to Company via its backbone. Each of those services delivered must come across a VPN. Each VPN must be created via a VRF in accordance with the RFC 4364 Standard.

If, as an ISP, Company is delivering services from HBO MAX to Subscriber A, and those services are coming from HBO MAX via the backbone of the Service Provider Company contracts with, such HBO MAX services must be delivered from HBO MAX to Subscriber A via a VPN.

This does not exclude the possibility that Company may have its own SP backbone and play the roles both of SP and ISP, as is the case with many major players in the ISP space.

The use of the RFC 4364 Standard by Service Providers (SPs) to create Layer 3 VPNs is the preferred method because it supports the current and future multi-Gigabit speeds achievable by the ISPs PONs and because it scales up in a cost effective manner. See, e.g., Oracle Communications IP Service Activator Concepts, Release 7.4 (December 2017) and MPLSL3 VPN White Paper by Armante Bustamante (January 2012).

<p>wherein said at least one private data stream is virtually separated using Virtual Routing and Forwarding (VRF) to form at least one virtually separated private data stream comprised of Multi-Protocol Label Switching (MPLS) data packages that have been uniquely labelled using MPLS for further identification as MPLS labelled data packages,</p>	<p>Each private data stream received by Company’s OLTs has been virtually separated using VRF. The virtually separated data streams is comprised of pre-appended anti-spoofing MPLS labels per the RFC 4381 Standard – Security of BGP/MPLS IP VPNs, Section 3.4 - Label Spoofing:</p> <p>“The interface between the CE router and its peering PE router is an IP interface, i.e., without labels. The CE router is unaware of the MPLS core, and thinks it is sending IP packets to another router. The ‘intelligence’ is done by the PE device, where, based on the configuration, the label is chosen and pre-appended to the packet. This is the case for all PE routers, towards CE routers as well as the upstream service provider. All interfaces into the MPLS cloud only require packets, without label.”</p> <p>The CE router and all other devices, including the PON, receive and pass IP packets, without recognizing in them the pre-appended MPLS label or interfering with the MPLS label.</p> <p>In addition, as an example, specification language of the ‘898 patent states that:</p> <p>“The premise router 140 can be configured with Virtual Routing and Forwarding (VRF) as described in RFC 4381 and RFC 4382”</p> <p>VRF is used to generate virtually separate private data streams in accordance with the RFC 4364 Standard and its supporting RFC 4381 Standard and RFC 4382 Standard – MPLS/BGP Layer 3 Virtual Private Network (VPN) Management Information Base.</p> <p>In further support of VRF and the private data streams VRF creates, the RFC 4381 Standard, Section 3.1 – Address Space, Routing, and Traffic Separation, Pages 6 states:</p> <p>“BGP/MPLS allows distinct <u>IP</u> VPNs to use the same address space, which can also be <u>private address space</u> (RFC 1918 [2]). This is achieved by adding a 64-bit Route</p>
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	<p>Distinguisher (RD) to each IPv4 route, making VPN-unique addresses also unique to the MPLS core. This extended address is also called a “VPN-Ipv4 address”. Thus, customers of a BGP/MPLS IP VPN service do not need to change their current addressing plan.</p> <p>“Each PE router maintains a separate Virtual, Routing and Forwarding instance (VRF) for each connected VPN. A VRF includes the addresses of that VPN as well as the addresses of the PE routers with which the CE routers are peering. All addresses of a VRF, including these PE addresses, belong logically to the VPN and are accessible from the VPN.”</p>
<p>and wherein said at least one virtually separated private data stream including said MPLS labelled data packages is intended for at least one of a plurality of ONUs, and wherein said at least one of a plurality of ONUs serves at least one of a plurality of private user devices;</p>	<p>As an example shown in Figure 4 of the ‘898 patent, the data streams intended for specific subscribers, which include virtually separated private data streams, are sent to each of ONUs (330, 332, 334) after passing through splitter 308. Each ONU strips out the frames of the virtually separated data streams that are intended for the specific subscriber associated with that ONU, which makes those frames available to that subscriber on a dedicated private line (340, 342, 344).</p> <p>This step is performed by Company’s PONs because those PONs send data streams including virtually separated private data streams intended for specific subscribers to all subscribers with ONUs attached to splitters that provide the data streams.</p> <p>The term ONU is the term used in PON ITU Standards. The term ONT (Optical Network Terminal) is the commercial name used by PON vendors to refer to an ONU. This claim uses the term ONU in accordance with PON ITU Standards, which apply to any type ONU of different variants of PON. Company uses variants in concert with the PON ITU Standards.</p>

<p>aggregating within said OLT said plurality of data streams and said at least one virtually separated private data stream into a common data feed;</p>	<p>As an example shown in Figure 2 of the ‘898 patent, OLT 146 aggregates data streams, including virtually separated private data streams carried by links 142 and 144, and provides aggregated streams in initial feeds 168, 169 and 170, which carry common data feeds.</p> <p>This step is performed by Company’s PON OLTs, which produce data streams that can include at least one virtually separated private data stream intended for specific subscribers. A PON OLT is the main headend equipment of each different variant of PON. The OLT receives data streams from various services and converges those signals for distribution as a single beam of light delivered via its PON ports. Each OLT can support multiple PON ports depending on the capacity of its chassis. All PON variants, including those used by Company, use PON OLTs.</p>
<p>distributing said common data feed to said plurality of ONUs:</p>	<p>As an example shown in Figure 2 of the ‘898 patent, initial common data feeds depicted as 166, 168 and 170 can be cross connected via optical distribution patch panel 172 to distribution common data feeds 174, 176, 178 and 180, which send a common data feed to ONUs of Tenants 102, 104 and 106.</p> <p>This step is performed by Company’s PONs because a common data feed including data streams that can contain virtually separated private data streams intended for specific subscribers is sent to multiple PON ONUs. Each active PON Port within the OLT sends its single beam of light with the converged IP signal to several ONUs.</p>
<p>wherein said distributing comprises:</p>	
<p>replicating said common data feed using at least one optical splitter connected to said plurality of ONUs;</p>	<p>As an example shown in Figure 4 of the ‘898 patent, the distribution common data feed 174 is replicated by splitter 308 on fiber drop lines 320, 322 and 324.</p> <p>This step is performed by Company’s PONs. Within all PON variants, the converged signal</p>

	<p>from the PON port is replicated by an optical splitter connected to a group of ONUs. For example, a 1-to-32 optical splitter can be connected to 32 ONUs. Such ONUs receive the same converged beam of light, with the converged IP signal replicated for each ONU.</p>
<p>delivering said common data feed to said plurality of ONUs;</p>	<p>As an example shown in Figure 4 of the '898 patent, fiber drop lines 320, 322 and 324 deliver common data feed 174 to ONUs 330, 332 and 334.</p> <p>This step is performed by Company's PONs. Each ONU connected to an optical splitter receives the common signal carried by the converged beam of light provided by a PON port within the OLT.</p>
<p>extracting within said at least one of said plurality of ONUs, said at least one virtually separated private data stream including said MPLS labelled data packages from said common data feed;</p>	<p>As an example shown in Figure 4 of the '898 patent, ONU 330 extracts frames 301, ONU 332 extracts frames 303 and ONU 334 extracts frames 305 from common drop line 320.</p> <p>This step is performed by Company's PONs. Each ONU extracts private data stream information to be received by the subscriber associated with that ONU.</p>
<p>sending said at least one virtually separated private data steam including said MPLS labelled data packages from said at least one of said plurality of ONUs to said at least one of a plurality of private user devices.</p>	<p>As an example shown in Figure 4 of the '898 patent, ONU 330 sends frames 301 via private line 340 to Tenant A, ONU 332 sends frame 303 via private line 342 to Tenant B and ONU 334 sends frame 305 via private line 344 to Tenant C.</p> <p>This step is performed by Company's PONs. Each ONU sends the IP data packages of the virtually separated private data stream intended for one or more specific subscribers to those subscribers.</p>