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Intelligent Broadband Networks

2016 Global Internet Phenomena

SPOTLIGHT: INSIDE THE CONNECTED HOME

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Intelligent Broadband Networks

Introduction

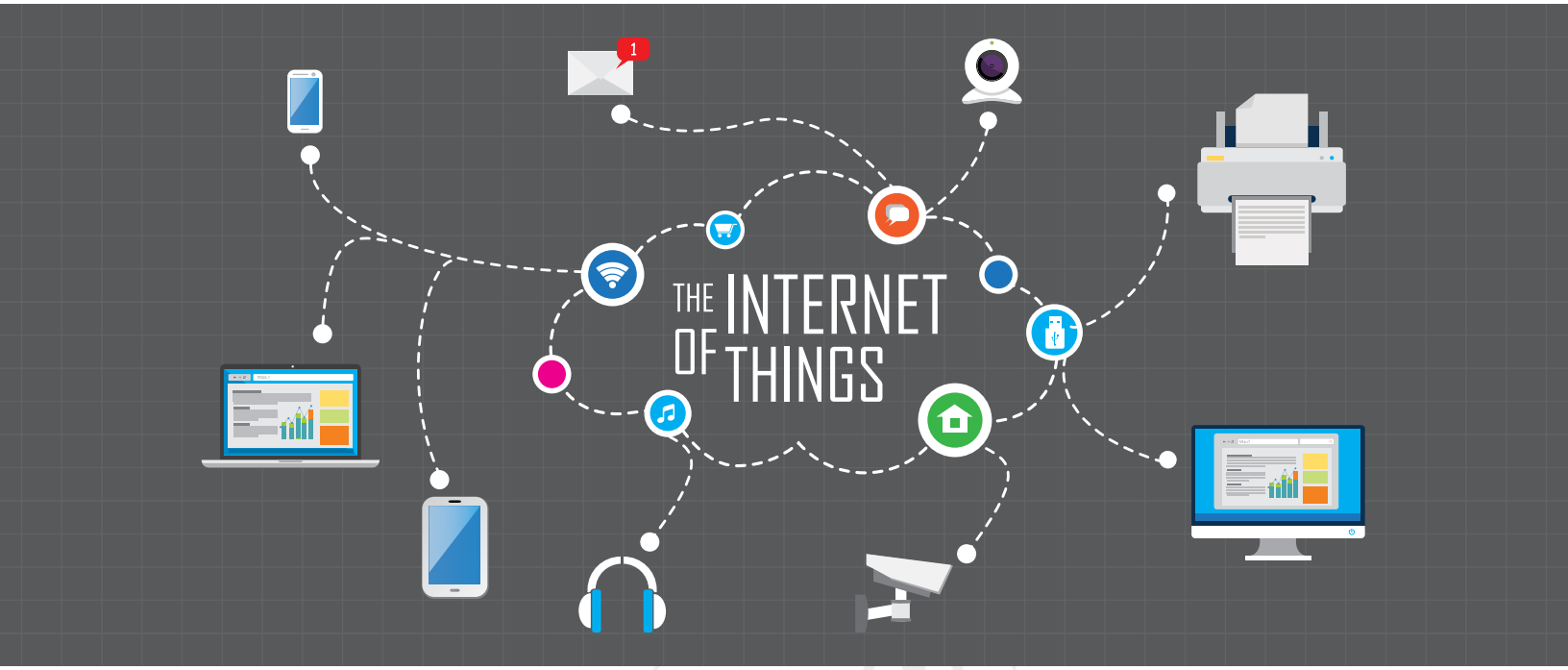
In this era of the Internet of Things (IoT), there is no practical limit to the number of devices that can have an IP address. In addition to 'traditional' devices like laptops, tablets, mobile phones, gaming consoles, smart televisions, etc., the Internet will soon see the addition of billions of new devices (e.g., thermostats, entertainment devices, security cameras, small appliances, etc.) connected through our homes.

The increasing number and diversity of connected devices brings opportunity to communications service providers (CSPs) who can identify trends and create services that anticipate new needs.

To take full advantage of these opportunities, and to enable the Internet of Things, CSPs must deploy solutions that meet a range of technical requirements, including:[1]

- The ability to identify individual client devices in real-time
- The ability to differentiate between a client device (devices such as a smartphone or PC that originates packets on the network) and an access device (devices such as a router or modem that connects to the access network and owns the IP connectivity session)
- The ability to identify devices that are behind equipment performing network address translation (e.g., a home router or public WiFi access point)

This Global Internet Phenomena Spotlight endeavors to provide insight on devices that are being actively used within North American households in the hopes to better understand how the increasing number of devices impacts Internet usage.



1. These requirements are discussed in greater detail in the whitepaper Internet Traffic Classification, available at www.sandvine.com

Number of Devices in the Home

After examining data from selected cable and DSL networks in North America, Sandvine has concluded that on a typical day there are 7.1 devices connected to the Internet for every household with an active fixed access connection.

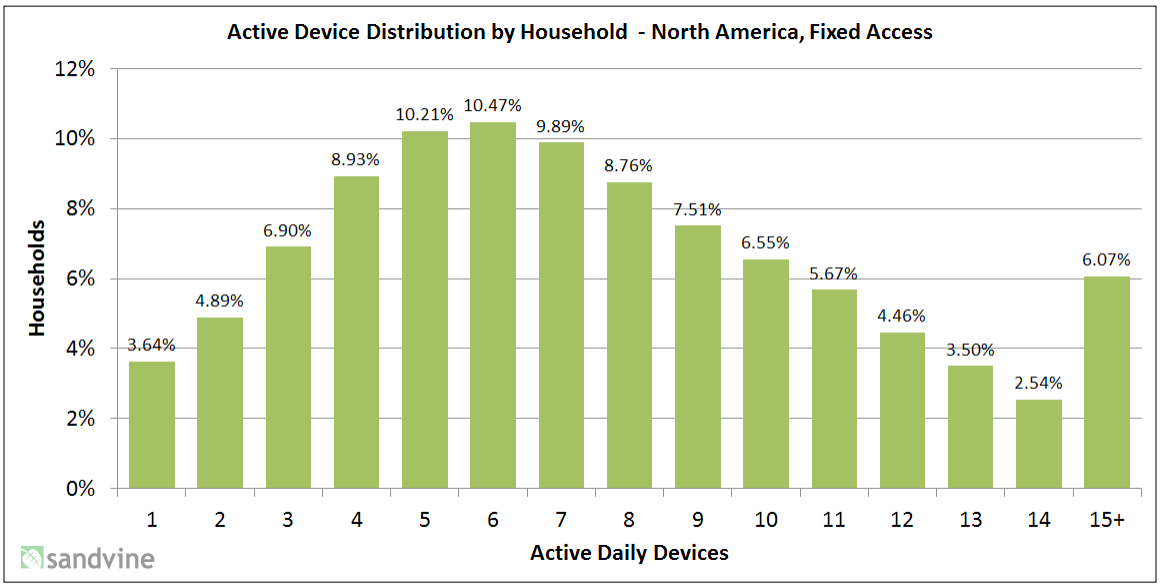


Figure 1 - Active Device Distribution by Household - North America, Fixed Access

Figure 1 shows the relatively normal distribution pattern associated with the devices in the home data collected from almost 500,000 North American households. A keen observer will notice that while the average number of active devices is 7.1, the most common number (or mode) of devices found in the home is actually six. This is because there are a small percentage of subscribers who operate a significant number of devices greater than the mode within their home, which helps to raise the overall average. In this study it was observed that 6.8% of subscribers have more than fifteen active devices in their home each day.

Top Traffic Generating Devices

Once it is understood how many devices are in the home, one can then move on to understand the devices that consume the network traffic within these households

Figure 2 below demonstrates the devices that consume the most downstream traffic on networks. The leading device, perhaps unsurprisingly given their prevalence, is Windows PCs which account for 18.5% of downstream traffic. After that though, post-PC devices begin to take over. In May 2012, Sandvine reported that mobile devices (smartphones and tablets) accounted for 9% of traffic and dubbed the phenomena of their use on fixed networks as “home roaming”. Today, those same devices (Android, iPhone, and iPad) now account for almost 30% (29.3% to be exact) of all downstream traffic on fixed access networks in North America.

After small screen mobile devices, devices such as game consoles and set-top boxes designed to be connected to the largest screen in your home, the television, round out the top 10.

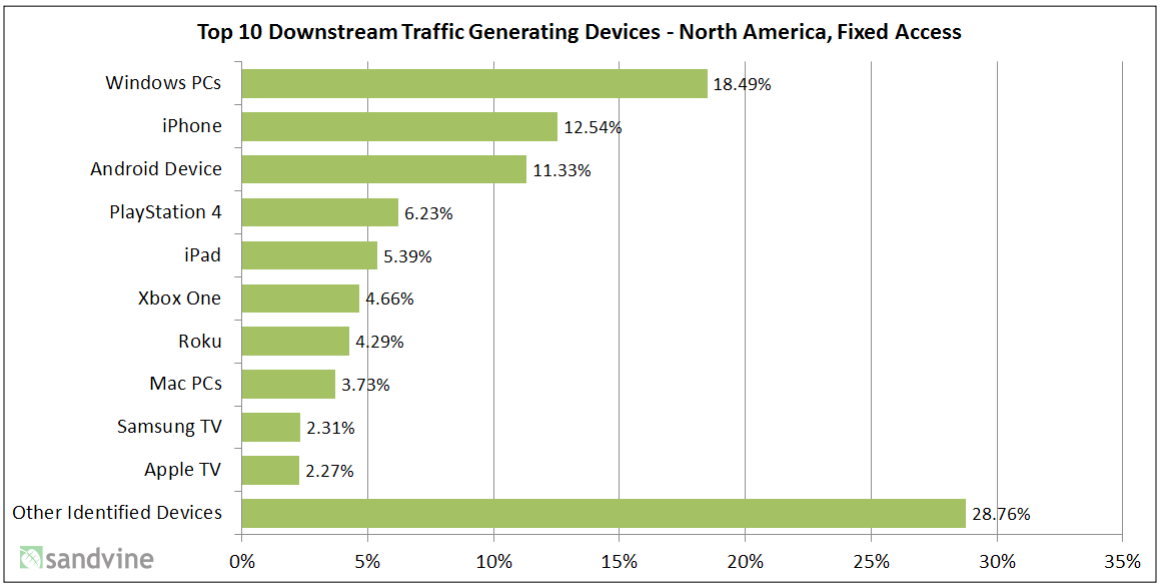


Figure 2 - Top 10 Downstream Generating Devices - North America, Fixed Access

While the majority of Internet traffic on fixed networks is generated in the downstream towards the subscriber, it still proves revealing to examine what devices generate the most upstream traffic, and Figure 3 below examines just that.

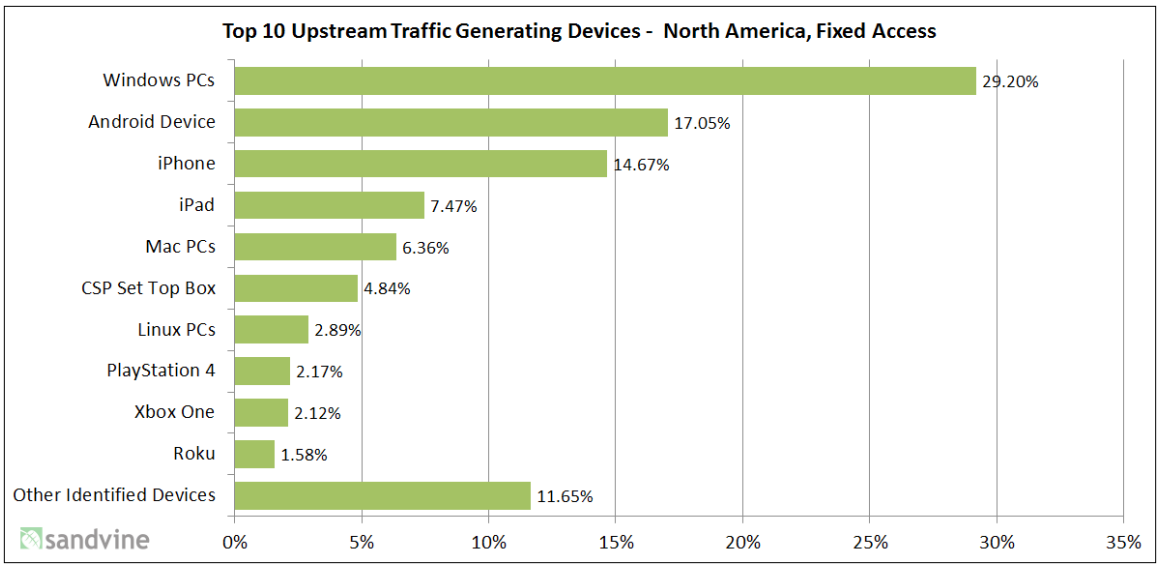


Figure 3 - Top 10 Upstream Generating Devices - North America, Fixed Access

Like on the downstream, Windows PCs continue to generate the most traffic, but in the upstream they are responsible for a much larger share. This is due to the fact that the largest upstream traffic category according to our most recent Global Internet Phenomena traffic is Filesharing, and that type of traffic is difficult to generate using modern mobile devices, game consoles, and set top boxes.

Figure 4 below shows the top generating devices by total (or aggregate) traffic. While this data is simply an amalgamation of what was presented in the upstream and downstream charts posted above, we are including it to provide a clear picture of total network traffic. The most revealing data presented by this chart is that PCs (Windows, Mac, and Linux) now account for less than 25% of total fixed network traffic.

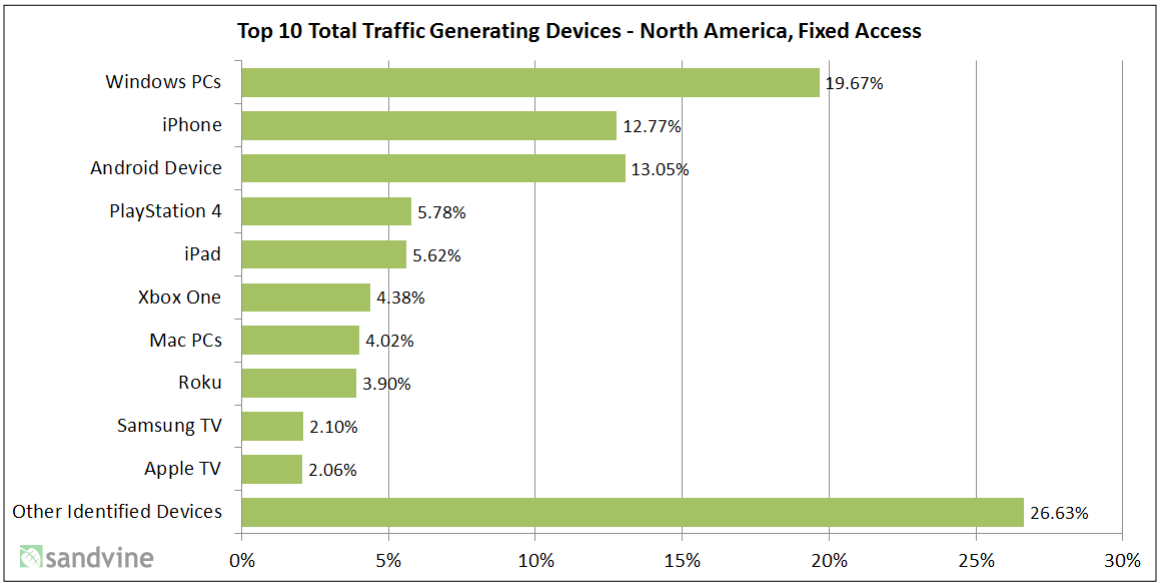


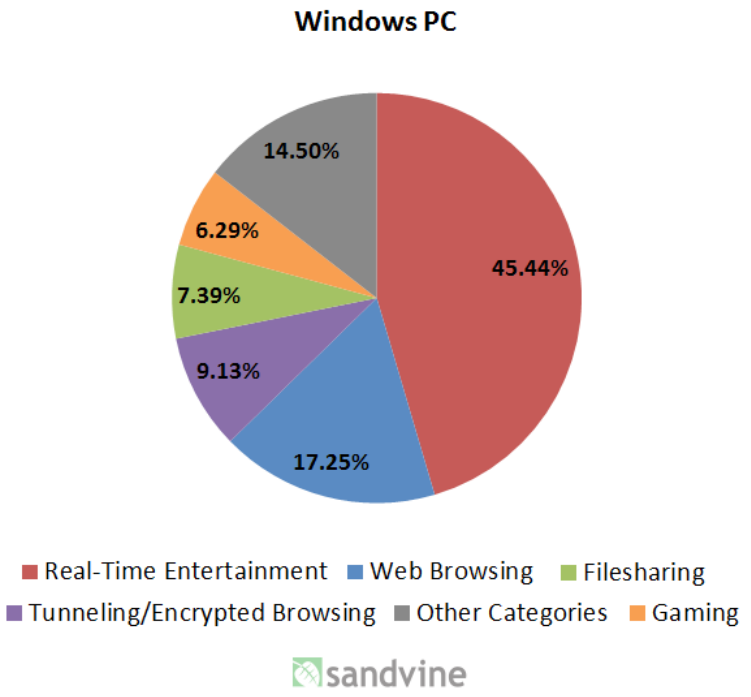
Figure 4 - Top 10 Total Traffic Generating Devices - North America, Fixed Access

Traffic Composition by Device Type

After an examination of top devices at the network level, Sandvine began to examine the composition of individual devices. Rather than examining simply the top devices on the network however, Sandvine chose leading devices from broad device categories in an attempt to demonstrate how different device types can generate different types of traffic. For this research we chose to examine computers (Windows), smartphones (Android Device), game consoles (PlayStation 4), tablets (iPad), and set-top boxes/smart TVs (Roku).

Computers

In our most recent Global Internet Phenomena Report, we revealed that traffic on North American fixed access networks was dominated by Real-Time Entertainment. Figure 5 below shows that domination existis on computers with 45% of Windows PC traffic is streaming audio and video. The remaining traffic on this device type is Web Browsing, Tunneling/Encrypted Browsing (primarily SSL browsing traffic, not VPNs), Filesharing, and Gaming. Since Windows PCs dominate the upstream traffic, as mentioned in the previous section of this report, they are the only device type where FIlesharing makes up a significant component of that device's traffic composition.



Smartphones

While in our study, iPhones slightly edge out Android devices for bandwidth share, we chose to examine Android device traffic for smartphones, because of how iOS (Apple's mobile operating system) also powers the iPad which is also examined in this study.

As expected, Real-Time Entertainment also dominates on smartphones, accounting for 62% of traffic. Like on the PC, Web Browsing and Tunneling/Encrypted Browsing round out the top three categories. The fourth and fifth most popular categories (Social Networking and Marketplaces) are linked in the sense that social networking applications are consistently at the top of App Store lists. This speaks to the fact that subscribers download these apps in large quantities, which means they are popular to use, and that their updates will help drive additional marketplace traffic. It should be noted though, that social networking applications are relatively small in size (50-100MB), compared to mobile games (often 500MB-2+GB) and that many larger apps as well as OS updates can only be downloaded on WiFi in order to ensure that a subscriber doesn't accidently burn through their mobile quota.

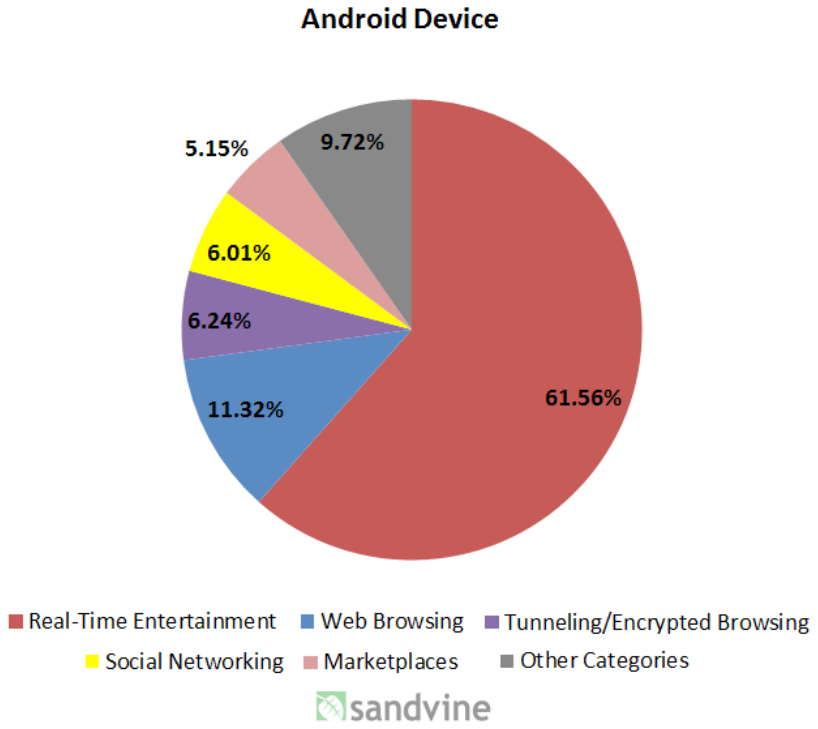
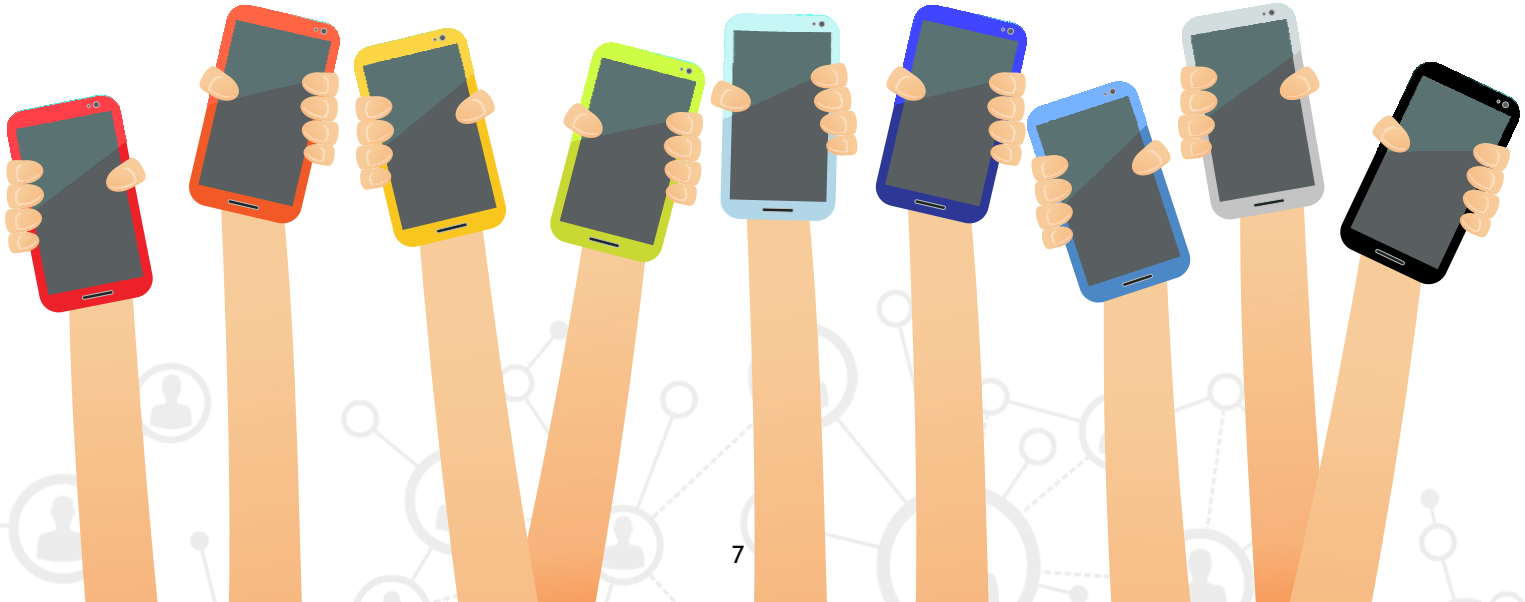


Figure 6 - Android Devices Total Traffic Composition



Tablets

While Android and iOS smartphone and tablets run a common operating system between their smartphones and tablets, looking at an iPad usage reveals that a larger tablet screen drastically increases streaming consumption. On the iPad, over 80% of the traffic is from streaming audio and video, which is over 10% higher than the average for all traffic across the network. Aside from Real-Time Entertainment, usage appears to be similar to smartphones, with Web Browsing, Marketplaces, and Social Networking being the only traffic categories of any significant share, although at a lower share than on smartphones.

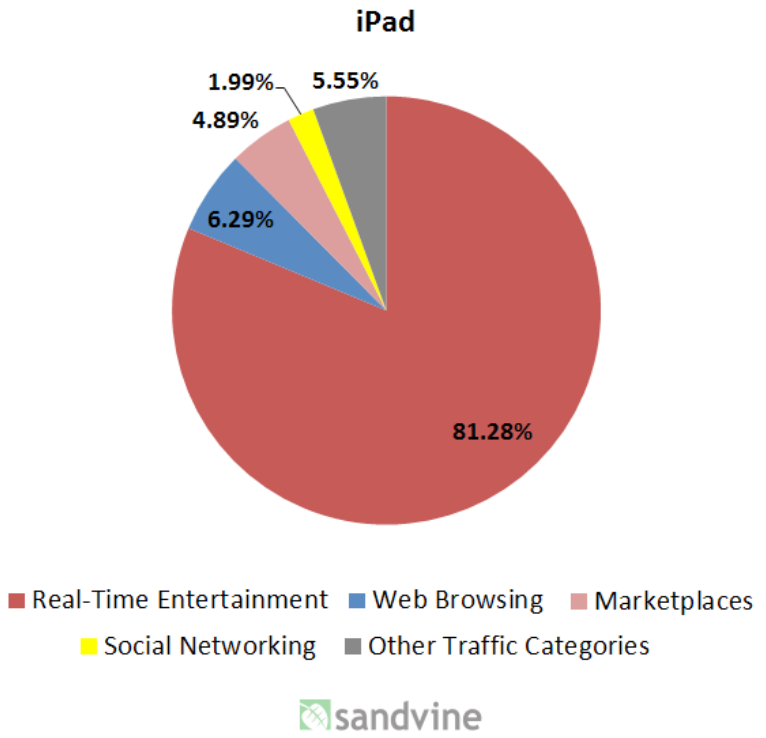


Figure 7 - iPad Total Traffic Composition

Game Consoles

Modern game consoles aren't just for playing games; they are designed to be the centerpiece of a living room. An examination of PlayStation 4 (PS4) traffic reveals just how diverse the usage of these devices can be. Like all devices examined, the majority of traffic (65%) is generated by Real-Time Entertainment. After that, Marketplaces (25%) are the second largest source of traffic because unlike smartphones and tablets where updates could often be measured in megabytes, on game consoles downloads in the form of game purchases, free demos, and software updates are often multiple gigabytes in size. The most revealing part of an examination of a PS4's traffic usage may however come from the fact that just 2.5% of the devices traffic is gameplay itself. The reason it is so low is because gameplay traffic generated by multi-player games is typically only telemetry data shared with a server, and that large graphics files are typically hosted locally on the device after being downloaded.

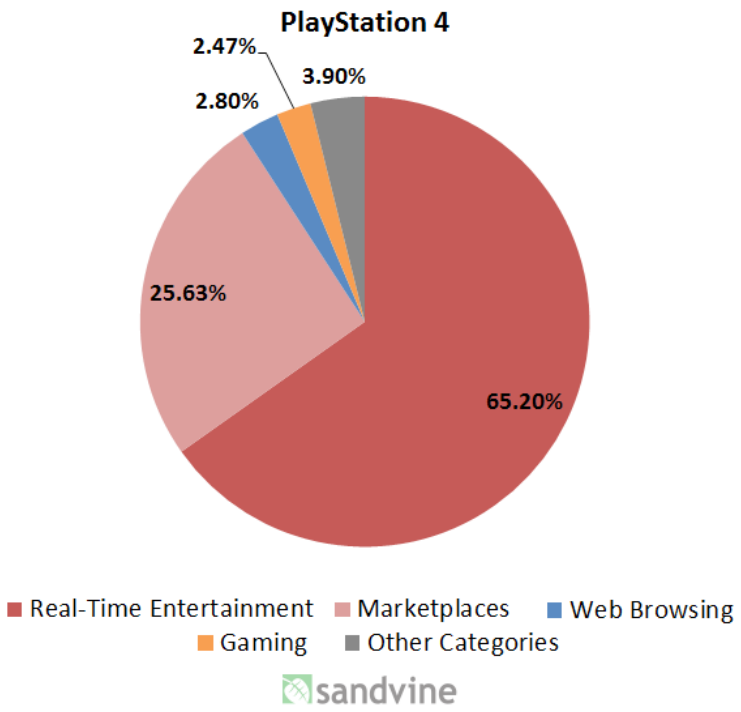


Figure 8 - PlayStation 4 - Total Traffic Composition

Set-top Boxes/Smart TVs

Set-top Boxes and Smart TVs are connected to really large screens (televisions), and their sole purpose is to typically stream video. Given this fact, it should then come as no surprise that 95% of Roku traffic is generated by Real-Time Entertainment application traffic. The remaining 5% of traffic is generated by Marketplaces used to download and update apps, as well as traffic required to navigate the video catalogs on streaming sites like Netflix.

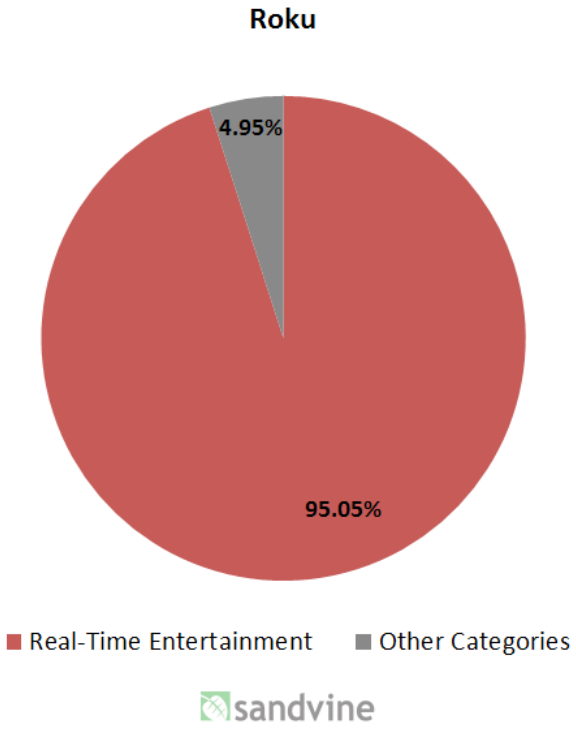


Figure 9 - Roku Total Traffic Composition

Spotlight on Rio 2016

Moving beyond broad traffic categories it is also possible to examine how different devices are used by individual applications.

Below you will find a chart showing one night of device usage for NBC Olympic streaming from August 10th of this year on a US fixed access network.

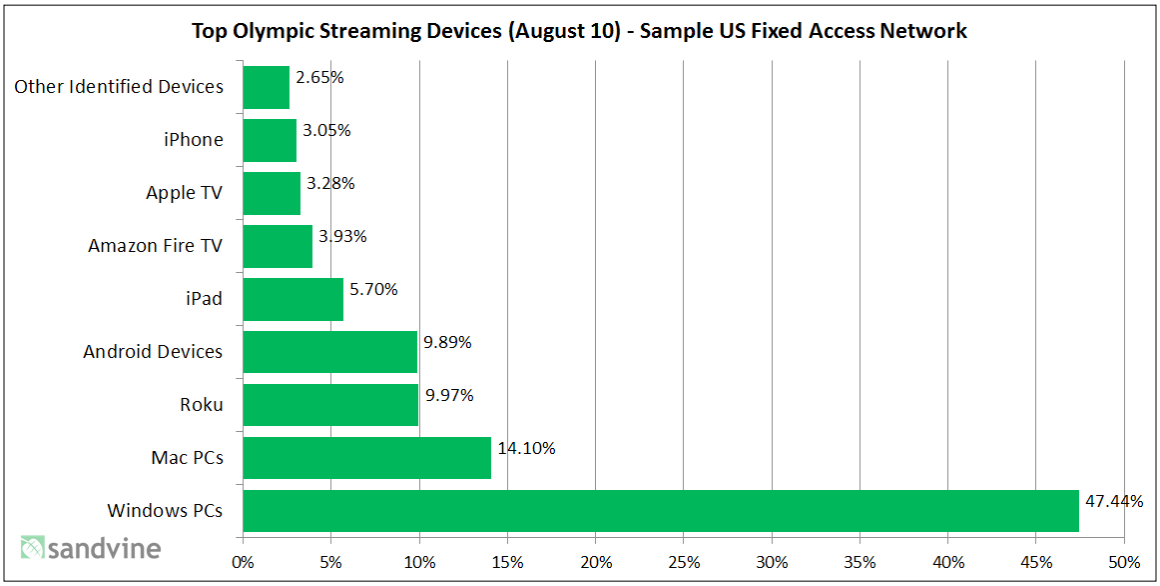


Figure 10 - Top Olympic Streaming Devices - Typical Day - US, Fixed Access

The data shows that PCs dominated Olympic streaming with Windows and Mac PCs accounting for over 60% of total traffic.

After PCs, mobile devices, and set-top boxes handle the remaining share. Looking at mobile devices, which for the purposes of this report we'll count as Android devices, iPads, and iPhones, theyaccounted for 18.6% of Olympic traffic, with Android and iOS (iPad and iPhone) operating systems being roughly equal.

Finally, when it comes to set-top boxes, Roku (10%) won the gold, with Amazon's Fire TV (3.9%) edging out the Apple TV (3.3%) for silver.

The remaining 2.7% listed as "other identified devices" includes a number of devices such as iPod Touches, Chromecasts, and XBox Ones which all support NBC's Olympic streaming application, but accounted for a small amount of traffic on their own.

The above data is from one singular network, but an examination of other applications revealed that there is often variance between top devices when looking at individual applications. One such example would be with Netflix, where on one network examined, the top streaming device (accounting for 12% of all Netflix usage) was that CSPs television set-top box. When examining networks that did not have Netflix available on the television set-top box, the top device was instead often one of the leading game consoles.

Using Device Identification for Creating Subscriber Services

This level of granular device visibility that Sandvine can provide opens up many possibilities for innovative CSPs to offer new service plans to their suscribers.

One such example would be through sponsored promotions with partners or a third party. In South Africa, Sandvine helped power such a promotion for Vox Telecom, where subscribers who purchased a new Samsung Smart TV, entered the MAC address of their new television through an online captive portal and received a terabyte of premium Fat Pipe ADSL service was theirs.

The bonus terabyte of data was good for a full year and could be consumed on the Samsung Smart TV or any other device in the home to stream YouTube videos, watch movies, connect with social media, email, chat, or surf. While in this particular instance usage was available to any device, it's very easy to see the potential for limiting usage to a single device.

Technical Details

So how is Sandvine[2] able to accurately count the number of active devices?

Within the home network depicted in Figure 11, there are many client devices (e.g., laptop, tablet, mobile phone), and the diagram could have included many others (e.g., game console, smart thermostat, etc.), but there is only a single access device (i.e., home router). The home router connects to the CSP's network, but the client devices actually originate packets.

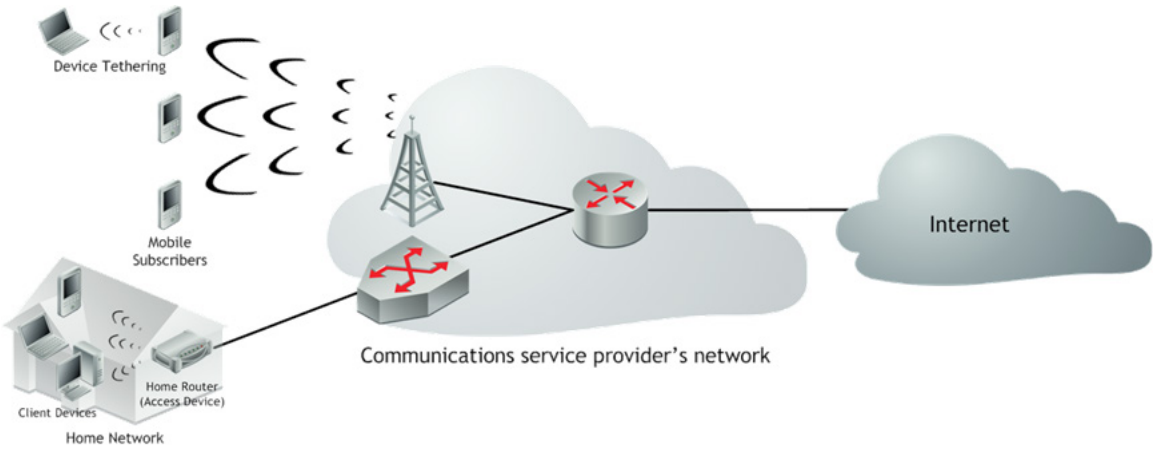


Figure 11 - 'Traditional' connected devices; notice the home-roaming

At the highest level, client device awareness in fixed access networks is achieved by tracking known patterns within TCP traffic across multiple flows within a subscriber session. Device statistics are counted per-device and per-subscriber.

To recognize client devices, Sandvine relies on layer 4 (i.e., transport) attributes to classify the device instance, then examines the User Agent (metadata in the applciation on the browser, OS or device) to identify additional features of the device. The process of client device recognition is made up of two main traffic characteristics:

- The TCP Timestamp Option (RFC 1323[3]): Many operating systems use this TCP option. It can be used to classify each new TCP flow to a known group of TCP flows that represent a single device.
- The TCP Source Port: Some operating systems (e.g., Windows) increment the source port for each new TCP port. This behavior can be used to classify each new TCP flow to a known group of TCP flows that represent a single device.

Additional SandScript[4] policy is applied at the application layer to correlate usage metrics to a device instance. Once these initial groupings are defined, a device instance is created and tracked by our Policy Engine. This device instance is identified as a specific type of device by analyzing HTTP User-Agent headers.

2. If you want to geek out on this stuff, check out this Technology Showcase: Policy Control for Connected and Tethered Devices Technology Showcase
3. "TCP Extensions for High Performance", available at https://www.ietf.org/rfc/rfc1323.txt
4. SandScript is Sandvine's event-driven policy definition language, used to turn business rules into network policy control instructions; more information is available at https://www.sandvine.com/technology/sandscript.html

Study Details

Sandvine's Global Internet Phenomena Reports examine a cross-section of the world's leading fixed and mobile communications service providers and are made possible by the voluntary participation of our customers. Collectively, Sandvine's customers provide Internet and data service to hundreds of millions of subscribers worldwide.

The data gathered for this report was collected in July 2016 from selected North American fixed access operators and is completely subscriber-anonymous. No information regarding specific content or personally-identifiable information (including, but not limited to, IP or MAC addresses and subscriber IDs) was collected during this study.

This study reflects the traffic profiles of real service providers, including the impact of any network management (for instance, congestion management and traffic optimization) policies that may be in place.

In parts of the report we may reference industry publications, analyst studies, media articles and other sources. As such, we are indebted to the collective work and wisdom of a large number of individuals and organizations and have endeavoured to correctly cite all sources and to identify the original creator of referenced material.

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