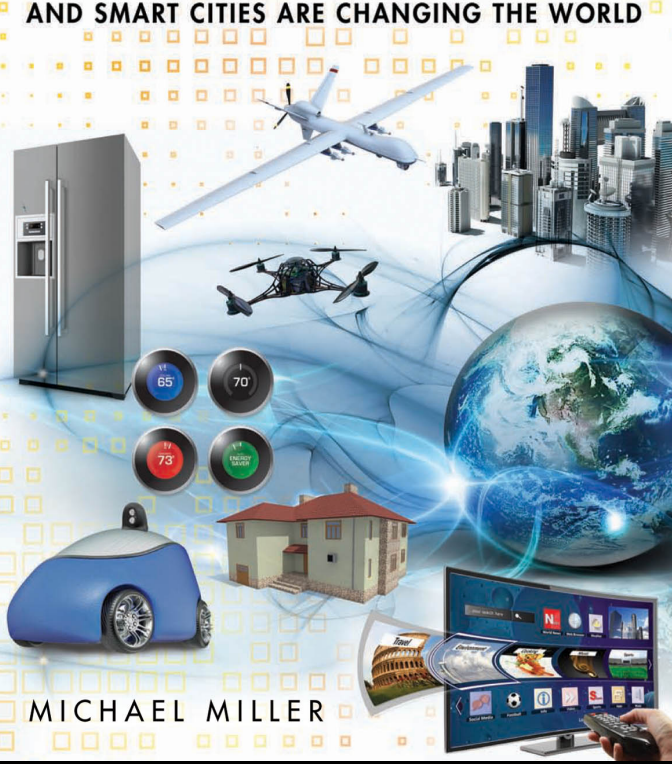
THE INTERNET OF THINGS

HOW SMART TVs, SMART CARS, SMART HOMES, AND SMART CITIES ARE CHANGING THE WORLD



MICHAEL MILLER

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The Internet of Things

How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World

MICHAEL MILLER

que®

800 East 96th Street,
Indianapolis, Indiana 46240 USA

The Internet of Things

How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World

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Michael Miller has written more than 150 nonfiction how-to books over the past two decades, as well as a variety of web articles. His best-selling books include Que's *Absolute Beginner's Guide to Computer Basics*, *The Ultimate Guide to Bitcoin,* and *Is It Safe? Protecting Your Computer, Your Business, and Yourself Online*. Collectively, his books have sold more than 1 million copies worldwide.

Miller has established a reputation for clearly explaining technical topics to non-technical readers and for offering useful real-world advice about complicated topics. More information can be found at the author's website, located at www.millerwriter.com. His Twitter handle is @molehillgroup.

Dedication

To my six wonderful grandchildren, who will inherit the future we're creating—Collin, Alethia, Hayley, Judah, Lael, and Jackson.

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Introduction

You've probably heard about the Internet of Things, sometimes called the Internet of Everything. You might not know what it is (and, frankly, the definition is a little fuzzy), but you've heard about it and you're interested in it enough to pick up this book. Good for you.

Like you, I was curious about the Internet of Things (which we'll abbreviate to IoT from here on out). I wasn't quite sure about what it was or where I could find it or even what it consisted of. All I knew is that everybody was talking about it, in the tech world at least, and thus it attracted my attention.

So, as is my wont, I went out and learned about the IoT. Then I wrote about what I learned, and the result is the book you hold in your hands, The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World. *Read along and you'll learn as I did what this IoT thing is all about.*

Spoiler alert: It isn't quite as clear cut as you'd think by the name. Yes, the Internet of Things is literally about things connected to the Internet, but it's both more and less than that.

In many ways, the IoT is marketing hype, a buzz phrase used to describe all manner of new devices and services that various manufacturers would very much like for you to purchase. There are a lot of companies adding the word "smart" to the devices they sell in the hope of tagging along on the IoT bandwagon. That's to be expected; remember all the "cyber" and "e-" things back in the early days of the Internet? Everybody wants to be on top of the latest trend. That's where the money is.

The technical definition of the IoT involves small devices, each with their own Internet Protocol (IP) address, connected to other such devices via the Internet. In other words, lots of little "things" connected to lots of other little "things" over the Internet. Instead of connecting people to other people, as does the current Internet, the new Internet of Things connects things to things. That sounds simple.

Except, a lot of the so-called smart devices ballyhooed as part of the IoT don't have their own IP addresses, don't connect to the existing Internet, and don't even connect to other devices. Which means the IoT isn't just about connecting things to things; it's also about autonomous operation—things that can operate pretty much on their own, without a lot of human interaction.

And even those devices that do connect to other devices don't connect to all other devices. A lot of what I found about the IoT involves industry-specific applications, where concepts of thing-to-thing connectivity and autonomous operation are applied to solve very specific problems. There's a distinct IoT for the healthcare industry, and another for the automotive industry, and another for the warehousing/distribution chain, and so on. The smart medical devices you'll find in your local hospital have nothing at all to do with the smart cars you might find parked in the hospital parking lot, or the smart systems employed to put food in the hospital cafeteria. Chances are they don't even use the same network to connect.

For that reason, you have to look at the IoT as multiple networks of things, each dedicated to specific industries or applications. That's how I approached it in this book, which is why you'll find separate chapters for smart homes, smart clothing, smart cars, smart medicine, and such. In a way, each of these areas will have its own Internet of Things, to which its own devices and services will be connected.

Like I said, it's not just one thing. It's lots of things.

This will all make more sense to you as you read through the book. We start with a general introduction to the IoT and its underlying technologies, then move into examinations of the many different approaches to the IoT, from the most personal (smart homes and smart clothing) to the more universal (smart medicine, smart

cities, smart warfare). We end with a chapter describing the potential problems associated with the IoT, of which there are several.

By the end of the book, you should be a lot better versed in the various things that are likely to comprise the Internet of Things. And you'll know how all of this is likely to affect you, personally. It's really quite thrilling.

What You Need to Know to Use This Book

How much prior knowledge of the Internet of Things do you need before starting this book? Absolutely none. I assume that you, like me when I first got started, don't know much of anything about the Internet of Things. This isn't a really technical book, so you don't have to come into it with a bunch of detailed technical knowledge either. In other words, this book is written for—and can be read by—anyone who's curious about the IoT. If I do my job right, this book will assuage that curiosity.

One More Thing

There's one more thing you need to know about the Internet of Things before you start reading. That is this—like all emerging technologies, the Internet of Things is in the process of defining itself. There's a lot of change happening, and it's happening every single day. What I write about the IoT today may be superseded tomorrow. It's an exciting time full of rapid development and constant discoveries, so don't expect things to stay the same for long. Read this book to get a general overview of what's happening, but then keep your ear to the ground to stay on top of ongoing developments.

Where can you learn more about the IoT, and find the latest news and developments? Alltop hosts a nice feed of IoT-related news, located at internet-of-things.alltop.com. So does TechCrunch, at www.techcrunch.com/topic/subject/internet-of-things/. And, for more business-oriented stories, check out Venture Beat's IoT feed at http://venturebeat.com/tag/internet-of-things/.

I'm guessing, however, that you'll find plenty of IoT-related stories in your day-to-day news reading. Like I said, it's a big buzzword, which means it's getting an increasing amount of coverage, even in the mainstream press. Just keep your eyes and ears open and you'll hear more about it.

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Smart TVs: Viewing in a Connected World

For many people, today's so-called "smart TVs" represent the first foray into the connected world of the Internet of Things. Just what is a smart TV, and how smart is it, really?

Whether or not today's smart TVs are truly part of the Internet of Things is an open question, but there's no question that these connected viewing devices are changing the way people watch TV and movies. Read on to learn more.

What Exactly Is Smart TV?

Let's be honest. "Smart TV," as the term is used today, is nothing more than marketing hype. The appellation refers to television sets or set-top boxes that offer connectivity to the Internet, typically via Wi-Fi wireless technology, as well as built-in Web 2.0 apps that enable viewing of various streaming video services, such as Netflix and Hulu. There's nothing inherently smart about a smart TV; it's a marketing term used to convey the ability to view Internet-based programming.

The concept of the smart TV isn't particularly new. Smart TVs have been around since 2007 or so, under many different labels, including "connected" TV, "hybrid" TV, "IPTV," and "Internet" TV. (One could even argue that the concept has actually been around since 1995's WebTV box, which served as an Internet client for traditional TVs.)

Note that a smart TV doesn't actually have to be a TV. Streaming media boxes and dongles that connect to a TV and offer the requisite streaming video connectivity also fit under the broad category of smart TV devices. So Roku and Apple TV set-top boxes are smart TV devices, as are the Google Chromecast, Roku Streaming Stick, and Amazon Fire Stick. For that matter, Blu-ray players and videogame consoles that offer streaming video connectivity are also classified as smart TV devices.

What's Inside a Smart TV?

At its most basic, a smart TV is a television set that can connect to and interact with the Internet. In practical terms, that means the television must include the following:

- Wi-Fi radio or Ethernet connection, for connecting to your home network.
- Central processing unit (CPU), the computer brain that manages all the device's operations and commands.
- Operating system (OS) that serves as the interface between the CPU and software-based applications.
- Graphical user interface (GUI) for displaying menus and other options.
- Software-based apps that enable connection to various web-based services. For example, a smart TV might have built-in apps for Netflix, Hulu, and Pandora. Most smart TVs come with several apps preinstalled; some smart TVs enable additional apps to be installed after purchase.

Some smart TVs also include apps and associated technologies that enable the device to play back media stored on your home network. In some cases, this

capability is built into the OS, as with the Apple TV; in other cases, this capability is enabled by DNLA or UPnP compatibility.

Note

DNLA stands for Digital Network Living Alliance, an industry trade group that promotes interoperability between different devices. In practical use, the DNLA specification indicates that a device is capable of playing digital media (video, music, and photos) from computers and other devices connected to the same network. UPnP stands for Universal Plug and Play and is a set of networking protocols that enabled connected devices to discover each other's presence on a network.

Some smart TVs include a built-in camera and microphone, like the one shown in Figure 3.1, for connecting with video-sharing and chat services, such as Skype. Some more advanced smart TVs use the built-in camera/microphone to navigate the onscreen menus, via a series of hand gestures or voice commands.

Figure 3.1 *The integrated camera on a Samsung smart TV.*

Naturally, a smart television set (not a set-top box) will also include a traditional television tuner for viewing broadcast, cable, or satellite programming. You typically switch from the normal viewing screen to a GUI menu for the web-based services and apps.

All smart TVs are controlled by some sort of remote control. Some remotes are basic affairs, with just enough buttons to navigate the onscreen menus. Others include keyboards (useful for typing in search terms), trackpads, even game

controllers. Most smart TVs can be controlled by universal remotes, such as those in the Logitech Harmony line. Some smart TVs can be controlled by smartphone or tablet apps.

Remember, too, that a smart TV doesn't have to be a literal TV. A smart TV device, like the aforementioned Roku box, contains the same circuitry and apps as a literal smart TV, but without the TV part. Instead, the set-top box connects to a regular TV (typically via high-definition multimedia interface [HDMI]), enabling the TV to display media played on the external device.

What You Need to Use a Smart TV

Right out of the box, a smart TV has little or no functionality. To utilize all the features of a smart TV, you need to provide the following:

- An Internet connection.
- A home network that interfaces with your Internet connection. This can be a wireless (Wi-Fi) or wired (Ethernet) network.
- Electricity. Duh.

If you have a smart TV set-top box, you'll also need an HDMI cable to connect the device to your traditional television set.

What a Smart TV Does

So a smart TV is a TV or set-top box that integrates Internet capabilities. What exactly does that mean?

Most smart TVs can perform the following functions:

- Connect to the Internet via a local network. That means connecting to your home network and sharing your Internet connection. Most smart TVs connect via Wi-Fi, although some can connect via Ethernet.
- Play video content from web-based streaming video services, such as Netflix, Hulu Plus, and Amazon Instant Video.
- Play music from web-based streaming audio services, such as Pandora and Spotify.
- Play digital media stored on other devices connected to your home network.
- Access selected websites and web-based services, such as Facebook, Twitter, and AccuWeather. Some smart TVs offer full-fledged web browsers, although it's more common to find discrete apps for specific sites and services.

Note

Not everyone who owns a current-generation smart TV is actually using the "smart" aspects of the TV. According to NPD In-Stat, about 25 million U.S. households own a smart TV of one sort or another, but only about half of these homes (12 million) have their sets connected to the Internet. In other words, they're using their smart TVs just as TVs, nothing more. Unused functionality, it is.

Considering Smart TV Operating Systems

All smart TVs and smart TV devices are like mini computers, in that they include a built-in OS and the appropriate software or middleware to run the necessary apps. Now, these devices don't run a full-blown consumer OS, such as Windows, but rather smaller, more stripped down OS's developed specifically for these purposes.

Note

Middleware is a layer of software on a device that acts as a bridge between the OS and the main apps.

There are a number of smart TV OS's in use today, many proprietary to a specific company or device. These include the following:

- Android TV, used in the Google Chromecast and selected Sony smart TVs
- Fire OS, used in Amazon's streaming devices
- Firefox OS, used on Panasonic devices
- iOS, Apple's mobile OS used in the Apple TV box (and iPhones and iPads, of course)
- Roku OS, used by Roku
- Tizen, a Linux-based OS used by Samsung
- webOS, a Linux derivative used by LG

Note

webOS has an interesting history. It's a Linux kernel-based OS initially developed by Palm back in 2009 as a successor to their once-popular Palm OS platform. Hewlett Packard (HP) acquired Palm in 2010, and webOS was considered one of the key assets in that transaction; HP intended to use the OS in a variety of new products, including smartphones, tablets,

and printers. That didn't really pan out, and by the end of 2011, HP had halted all webOS development. In 2013, HP sold webOS to LG Electronics, which uses it as the company's primary smart TV operating system.

This proliferation of OS's means that no two brands of smart TVs look or work exactly alike. While all these OS's do pretty much the same thing, they do it all differently; every company puts its own spin on onscreen menus, navigation, and operation. For this reason, you want to spend some time with a given interface when you're shopping for a smart TV or device.

Examining a Typical Smart TV

Most of today's smart TVs offer similar features and functionality. In addition to the normal TV features (screen, tuner, remote control, and so on), you get the Wi-Fi or Ethernet connectivity, onscreen GUI menus, and built-in apps that are part and parcel of the "smart" experience. Naturally, the onscreen menus and included apps differ from manufacturer to manufacturer and model to model, but all offer the same general approach.

Let us take, for our example, a typical higher-end smart TV, as of late 2014. We'll look at the Samsung UN50H6350, shown in Figure 3.2, a 50" diagonal LED-LCD model that sells for a little under $1,000. This model has all the bells and whistles that you'd expect from a TV in this price range, including smart TV functionality in the form of what Samsung calls its Smart Hub. It also includes a built-in camera and microphone, for live social networking and video chatting.

Figure 3.2 *Samsung's UN50H6350 smart TV.*

Before you can access the Smart Hub, you first have to connect the TV to your home network. This particular model includes both wireless and wired connectivity, so there is an Ethernet connection on the back if you want to use it.

Note

If you have the option (and a convenient Ethernet cable), connecting a smart TV via Ethernet is a better option than using Wi-Fi. A wired connection is not only more reliable than a wireless one (you don't have to deal with weak or flakey Wi-Fi signals), but also faster—which is a godsend when you're watching high definition (HD) streaming video.

Assuming that you'll be connected via Wi-Fi, like the vast majority of users do (it's just easier), you have to configure the TV to recognize and connect to your home network. You do this from the Network Settings setup screen, shown in Figure 3.3. Select the type of network (Wireless); then select your network from the Wireless Network list. You'll be prompted to enter your network's password, and then you're ready to rock and roll.

Figure 3.3 *Configuring the TV to connect to your Wi-Fi network.*

To access the Smart Hub, press the Smart Hub button on the TV's remote. This displays a First Screen bar of your most-used apps along the bottom of the screen. You can select an app from here or display the full Smart Hub by pointing to and then clicking the Smart Hub icon within this bar.

The Smart Hub consists of multiple screens for different types of entertainment:

- On TV, which offers suggestions for currently available programming on traditional television. You can use this page to quickly click to view specific programs or to display a more traditional onscreen programming guide.
- Samsung Apps, which is where you access all available web-based content, including streaming video services, social networks, and Skype.
- Games, which provides access to various online games (both free and paid).
- Multimedia, which enables you to access your own digital media stored elsewhere on your home network.
- Movies & TV Shows, which provides suggestions for streaming web-based content.

You'll do most of your browsing via the Samsung Apps screen, shown in Figure 3.4. Here you find apps for all the major streaming services, including Netflix, Hulu Plus, Amazon Instant Video, HBO Go, Vudu, YouTube, Vimeo, Pandora, Spotify, TuneIn Radio, and more. There are also apps for Facebook, Twitter, and Skype (using the TV's built-in camera and microphone). Click to open an app, sign into the service (if necessary), and then start watching or listening or communicating or whatever.

Figure 3.4 *Browsing web-based media from the Samsung Apps screen.*

This screen comes preloaded with some of the more popular apps. You can download additional apps via the Samsung Store, which you also access from this screen.

Operation is via the TV's included remote control, the accompanying smartphone/tablet app, voice command (the set has a built-in microphone, remember?), or hand gestures. This last one is an interesting application of the set's built-in camera; just point and "grab" to select an item onscreen.

It's all very high tech. The bottom line is that this set, like most other current-generation smart TVs, makes it relatively easy to view just about any type of programming you can think of. It takes a little time and effort to get everything set up properly, but then it's a matter of pointing and clicking to get to what you want to watch.

Exploring Smart TV Set-Top Devices

If you have an older TV (or even a lower-priced newer one without built-in connectivity), you can add similar smart TV features by purchasing a streaming media set-top device. There are lots of these devices, with the most popular being the Roku models, Apple TV, WDTV Live, and Amazon Fire TV. All of these devices are small enough to hold in your hand and sell for $100 or less.

Consider the Roku 2, shown in Figure 3.5. This one's smack dab in the middle of the Roku line (between Roku 1 and Roku 3, naturally), and sells for $69.99. It connects to your home network via Wi-Fi and to your TV via HDMI, and includes its own remote control. Configuration is as easy as navigating through a handful of setup screens.

Figure 3.5 *Roku 2 streaming media player.*

Like all Roku models, the Roku 2 comes with a number of popular apps (they call them "channels") preinstalled, including Netflix, Hulu Plus, Amazon Instant Video, HBO Go, Vudu, YouTube, Vevo, Pandora, Spotify, and TuneIn Radio. You can download a plethora of additional channels online for a variety of different

streaming services; because of its popularity, Roku has the most available third-party apps of any of the currently available smart TV devices. (Figure 3.6 shows some of the most popular Roku channels.)

Figure 3.6 *Navigating online content on the Roku 2.*

Note

If you want to access digital media stored elsewhere on your home network, install the Plex channel. Plex is a streaming media server application you install on the host PC, which then streams your media to the Plex app on your Roku box. (Learn more at www.plex.tv.)

If one of these little boxes is too big for you to deal with, consider a smart TV on a stick. These are streaming media devices in the form factor of a universal serial bus (USB) dongle, such as Google's Chromecast, the Roku Streaming Stick, and Amazon's Fire TV Stick. As you can see in Figure 3.7, these devices plug into any open HDMI connector on your TV and provide similar app functionality for web-based streaming media services. There are fewer cables to worry about, plus the cost is lower, ranging from $35 for the Chromecast to $49.99 for the Roku Streaming Stick. The Roku and Fire sticks come with their own remotes, while you operate the Chromecast with the accompanying smartphone app. It's a nifty way to add smart TV functionality to any TV set that has an HDMI connection.

Figure 3.7 *The Google Chromecast streaming media stick.*

How to Choose a Smart TV or Device

If you're considering the purchase of a new smart TV or device, there are several factors you want to consider—once you get past the basic TV-related stuff, of course.

First, determine whether you really want a new TV or whether a streaming media player connected to your old TV will do the job. You get pretty much the same functionality with a sub-$100 set-top box as you do a $1,000 top-of-the-line smart TV set, so the streaming media player route is a more affordable one. In addition, it's a lot easier to upgrade (re: throw out and buy a new one) a $50 set-top box than it is to replace a $500 or more TV when things change. And things always change.

Whether you're looking at a TV or a set-top box, you want to make sure that the device includes access to those streaming media services you use the most. While virtually all such devices include access to Netflix, Hulu, and YouTube, only a few let you connect to Amazon Instant Video. Most include access to Pandora and Spotify, but less-popular streaming music services aren't always included. Check the available apps or channels to make sure you're happy with the selection.

Next, consider whether or not you want to access media stored on your own home network. If all you do is stream movies and TV shows from the web, this functionality isn't a big deal. But if you have a large library of digital music, recorded TV shows, or DVD rips, you want to make sure your new smart device can access and play everything you own. Check to see if the device offers streaming over a local network (typically via DNLA), and that it can play back media in the file formats

you use. This is particularly important if you have a lot of DVD rips, but can also trip you up with some less-popular digital music format—especially high-resolution formats, such as Flac and Windows Media Audio (WMA) Lossless.

Almost all of these TVs and devices offer Wi-Fi connectivity, which is fine for most households. If you prefer the reliability and speed of a wired connection, however, look for a device that includes Ethernet connectivity.

You should probably look at any additional features offered by a given device. Some smart TVs (but no current set-top boxes) come with built-in cameras and microphones for live video chatting and gesture- or voice-based operation. If this sort of thing is important to you, take it into account.

Now it's time to consider how the thing works—the interface and basic operation. Make sure the device's onscreen menu system makes sense to you, and that you can easily get to where you want to get. Make sure you like how the remote works, or that there's a smartphone app available if you prefer using that. Also, if you have a universal remote for your larger home theater system, make sure it's compatible with the device you're considering.

Finally, there's the price. A streaming stick like Chromecast is the most affordable option, and set-top boxes aren't much more expensive. If you're in the market for a true smart TV, however, be prepared to spend a little more for the "smart" features than you would for a non-connectible model.

And don't forget the cost of the streaming services themselves. You'll pay around $10 a month for Netflix, Hulu Plus, Spotify, and the like. While ten bucks doesn't sound like a lot, it starts adding up when you subscribe to multiple services. Go with a half-dozen services and pretty soon you're spending as much for your online entertainment as you would on a traditional cable bill.

How Secure Are Smart TVs?

Here's a side issue worth considering. Since a smart TV or smart TV device connects to the Internet and has a CPU and an OS, it's just as capable of being hacked as is your typical desktop or notebook computer. You don't think of your smart TV as a computer, but it really is. And just like a computer can be hacked or attacked over the Internet, so can your smart TV.

Hacking Into the System

Why would anybody want to hack your smart TV? For starters, because it stores some interesting personal information, in the form of user names and passwords for all the services you subscribe to, such as Netflix and Hulu. And if you subscribe

to Amazon Instant Videos, that's the user name and password for your entire Amazon account. See where that might lead?

And hacking doesn't have to be that malicious. So-called man-in-the-middle attacks place the attacker between the Internet service or broadcaster and the smart TV, enabling the attacker to feed his own content to the victim's screen. Instead of getting the service's normal commercials, then, you may receive commercials from the attacker's company. Not necessarily world endangering, but still not desirable.

In case this seems too theoretical, consider this real-world example of smart TV hacking. In June 2014, Columbia University researchers Yossef Oren and Angelos Keromytis exposed a flaw in the Hybrid Broadcast-Broadband Television Standard (HbbTV) used on millions of European smart TVs. HbbTV has been adopted by 90% of smart TV manufacturers in Europe to add interactive HTML content to terrestrial, cable, and satellite signals. Oren and Keromytis revealed that the HbbTV standard is vulnerable to large-scale exploitations that would be "remarkably difficult to detect."

This so-called "red button" attack, named after the red button on a user's remote control, would enable a hacker to intercept the sound, picture, and accompanying data sent by a broadcast. The attacker then becomes the broadcaster, feeding whatever content he wants to the victim—and receiving data sent by the victim to various smart TV apps. A hacker could use this exploit to display bogus commercials on a victim's TV screen, or log into the victim's Facebook account and post with that person's name.

What this type of attack reveals is the paltry amount of security inherent in this new generation of connected devices. A smart TV (or any smart device) needs to be every bit as secure as your computer system, and most aren't. Where your computer is protected (somewhat) by a firewall application, most smart TVs do not have even this basic level or protection. This leaves them vulnerable to attacks that wouldn't be near as successful on a more secure personal computer.

An Eye Into Your Living Room

Then there are the security issues presented by those smart TVs that include built-in cameras. Imagine a man-in-the-middle attack where an attacker gains control of your TV's camera, and uses it to spy on whatever you're doing in your living room or bedroom. This could be simply voyeuristic or it could let the attacker know when you're out of the house, thus setting you up for potential burglary.

Again, this isn't a theoretical issue. Researchers Aaron Grattafiori and Josh Yavor, security engineers at the firm ISEC Partners, recently discovered a security hole in some Samsung smart TVs (like the one we examined earlier in this chapter) that

enabled attackers to hack into the Skype application and remotely turn on and control the TV's built-in camera. That's scary stuff.

Now, to the company's benefit, Samsung promptly sent out updates to its devices to patch this security flaw. And if you're really concerned about your TV spying on you, you can always put duct tape over the built-in camera. Not very elegant, but effective.

Official Snooping

Unsolicited snooping doesn't have to be the province of black hat hackers and the criminal element. It's equally likely that your smart TV's manufacturer is spying on you.

In November 2013, British tech blogger Doctorbeet discovered that his then-new LG smart TV was keeping track of everything he watched. Every time he changed the channel, the activity was logged and transmitted back to the LG mothership. LG then knew every program he watched and could use that data however it saw fit.

LG calls this "service" Smart Ad, because it sells the collected data to advertisers. According to LG, Smart Ad "analyses user's favorite programs, online behavior, search keywords, and other information to offer relevant ads to target audiences." Hoo boy.

Now, there's a setting on that particular LG model called Collection of Watching Info. It's toggled on by default, no surprise, and most people would never get that deep into the menu system to turn it off. Well, Doctorbeet did tiptoe into the menus and deactivated this setting. Unfortunately, it had no effect on the data collection, which continued unabated. So much for viewer choice.

You know what's even worse? This information is sent back to LG in *unencrypted* form. That means any reasonably tech-savvy monkey could intercept the data and know what programs you're watching when. That could be relatively harmless, unless you're watching something that you don't want your spouse or employer or pastor to know about. Scary, eh?

By the way, LG later responded to Doctorbeet's publicizing this issue by changing their terms of service, but not in a good way. Now, if you opt not to agree to this invasion of privacy, LG disables most of the "smart" functionality in your smart TV. That's one way of dealing with the issue, I suppose, but it's not really 21st-century privacy savvy.

Integrating Smart TVs into the Internet of Things

Okay, so it's pretty obvious that the current generation of smart TVs has very little to connect it to the Internet of Things. Just because a TV or set-top device lets you watch both broadcast and Internet-based programming doesn't make it hyper-intelligent or even moderately clever. It just adds more types of programming to what is still more or less a non-participatory device. A TV that can play old episodes of *Doctor Who* on Netflix is still just a TV.

For a smart TV to become truly smart, it needs to do more. Not surprisingly, there are people working on this.

The first thing smart TV manufacturers are likely to do is make it easier to control the smart TVs themselves. Let's face it, picking through the choices on Hulu or searching for your favorite movie on Netflix isn't easily accomplished with a traditional four-arrow remote control. Some manufacturers have experimented with including a full-fledged keyboard in a handheld remote, but that's a little too cumbersome. A better solution might be a touchscreen tablet-like controller, a remote app on a smartphone or iPad, or even Siri-like voice control. Samsung, if you recall, uses its built-in camera to enable rudimentary gesture commands, which is another way to go. Whatever the approach, the smart TV companies need to make it easier to find all the various programming they enable.

Beyond the control issue, future generations of smart TVs are likely to get smarter about what you like to watch. These new smart TVs will collect data about what you watch and when (and, if you have multiple viewers in the same household, which you probably do, what each viewer likes to watch) and make assumptions about your future viewing habits. Even better, your smart TV might connect to your Facebook or Twitter account to discover what shows your friends are watching.

All this data will be assembled and collated, and your smart TV will start making recommendations for future viewing. The set might even go the next step and create a new "just for you" screen with one-click access to the recommended programming, or just set the onboard DVR to record these programs for your viewing convenience. With your smart TV making smart choices about what you want to watch, you'll no longer have to deal with the increasingly Byzantine program guide. You won't have to think about what you want to watch at all; your smart TV will do your thinking for you.

Of course, this type of viewing information can go both ways, so expect your smart TV to feed details of what you watch back to the programming sources—and, more importantly, their advertisers. (As you've read, this is already happening with some

manufacturers, such as LG.) This will let them feed more relevant commercials to you and other viewers, so those hip twenty-somethings in the audiences will no longer be subjected to commercials for miracle socks and reverse mortgages. It's all about targeted advertising, based on the data collected by your smart TV.

Future smart TVs may also use their Internet connectivity to overlay related information on the main viewing screen. If you're watching a sporting event, for example, you may see team or player stats superimposed on the screen, or displayed in a side window. If you're viewing a classic movie, you might see bios of the director and stars, with links to other similar movies you might like.

In addition, expect smart TVs to include more interactive chat capabilities. When you're watching a movie or show, you'll be able to tweet or post to Facebook about what you're watching, and participate in group chats about the show. These might be video chats, conducted in a pop-up window and enabled by your set's built-in camera.

Future iterations of smart TV will turn the TV set into a hub for a variety of household activities. For example, you might feed video from your home's security cameras to your smart TV, so you can see who is ringing your doorbell or if your baby is asleep in her crib. (To be fair, this capability exists today in a lot of high-end, whole-house audio/video/security systems but is sure to trickle down to more affordable systems in the future.)

You can use that big TV screen to view all sorts of information. Why not click an onscreen button to view a graph of your home's water or energy usage? Or display a map that shows where all the members of your family are at the moment? Or a diagram that shows which rooms are occupied and where the lights are still on? Or a live feed from inside your refrigerator that lets you know if you have a cold beer waiting for you?

Imagine using your living room TV to control various household operations. Just point and click at the screen to turn on the lights in a given room, start the oven or dishwasher, even enable your outdoor sprinkler system. You're in front of that screen a lot of hours during the day; why not use it as an interactive household controller?

There's no reason why your smart TV can't be the main controller for all your household operations. It's right there in front of your couch, where you're no doubt sacked out. There's no reason to get up to turn up the heat or turn down the lights; you can do it all from the controller interface built into your smart TV. And your TV can alert you when things are amiss anywhere in your house or on your property.

The security angle is key. Not only can you use your smart TV to view real-time data collected from your home security system and live feeds from various security

cameras, it can also interact with other devices to provide more intelligent analyses. Imagine a system that uses face recognition to learn what each member of your family looks like; the system could then look at the faces in the security cameras and alert you when a stranger is at the door or in the house. (And, conversely, not bother you if it's a known person raiding the fridge.)

In short, there's a lot more that your smart TV can do than what it's capable of doing today. Just wait for it.

SMART TVS AND YOU

Now that you know all about the past, present, and future of smart TVs, it's time to decide whether a smart TV or smart TV device fits in your current lifestyle. Should you buy a smart TV today—or wait for some future iteration?

Let's face it, today's smart TVs are just a way to obtain more and varied programming than you get from your cable or satellite company. Whether you want to completely cut the cable cord or supplement your 400+ cable channels with a similarly large assortment of Internet-streaming sources, a smart TV lets you do it.

The primary selling point of today's smart TVs is that they integrate programming across multiple sources. No longer are you limited to just broadcast or cable programming; with a smart TV, you can easily switch from watching your daily fix of Jimmy Fallon on *The Tonight Show* on network television to binge-watching the latest season of *Orange Is the New Black* on Netflix.

If you want the additional programming that's available online, a smart TV is a better way to go than watching the same programs on your notebook or desktop computer screen. Yes, you can view Netflix and Hulu on your handy dandy PC or tablet or smartphone, but movies and TV shows are made to be watched on big screens. Computer- or tablet-based viewing, while fine for college students in their dorm rooms, doesn't cut it for a modern family accustomed to widescreen entertainment.

So if you're a Netflix or Amazon or YouTube junkie, you need some sort of smart TV device. That doesn't have to be a literal smart TV, of course; it could also be a smart TV device in the form of a set-top box or streaming media stick. These add-on devices are a lot lower-priced than even a 32" smart TV and can easily be replaced when they break or become outmoded. As long as you have an open HDMI connector on your TV, it's easy to connect one of these little devils.

That said, a full-fledged smart TV can offer more functionality than what you get in a set-top box or dongle. A built-in camera lets you use your smart TV for Skype

and other video chat, and that's kind of cool to do from your living room couch. In addition, easy as the add-on devices are to use, it's just a little simpler to do everything from the TV itself. Some people value that ease of use.

Of course, if you're happy with broadcast or cable television and don't care about Netflix and those other services, a smart TV doesn't make a lot of sense. Save your bucks and stick to a conventional TV, at least for the nonce.

Flash forward three or five years, however, and those future smart TVs will offer a lot more functionality than just an easy way to watch shows on Netflix. Truly smart viewing recommendations, interfacing with and controlling other household devices and so forth, offer the type of promise inherent with the Internet of Things. When your smart TV becomes more than just a passive viewing device, things get really interesting—and worth your active consideration.

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