



## The Transformative Operating System Called IOS

*For 25 years, Cisco IOS software has made it easier for devices and the people that use them to connect and collaborate. It powers routers, switches, and the Internet, and helped create an industry—and it's not done yet.*

It is the world's leading network system software, running on an estimated 80 platforms. It is the Internet's primary circulatory system. It is Cisco IOS software, which powers the company's routers and switches.

As Cisco celebrates its 25th anniversary, it's necessary to recognize the role of IOS in the company's success. Thanks to the Internetworking Operating System, its original name, Cisco's routers were an instant hit when they were introduced in 1986. Within a year, Cisco was selling about \$750,000 worth of routers every month. Twenty five years later, at least 70 percent of Cisco's revenue comes from products that use Cisco IOS software.

The remarkable software had a humble beginning. For several years after the company began, it was known just as "the software"—no name, just "the software"—that ran Cisco's routers.

Its eventual name captured the new company's purpose: to create routers that enabled different computers and networks to communicate. (Back when Cisco started in the mid 1980s, there was an alphabet soup of proprietary networks, including DECnet, AppleTalk, Apollo Domain, Novell IPX, Banyan VINES, IBM SNA, and TCP/IP.)





### **Crucial Early Decisions Led to Success**

Several early decisions about how to build IOS gave it staying power and made Cisco a standout, say two of Cisco's engineering leaders: Joel Bion, SVP of Research and Advanced Development, who joined Cisco 20 years ago; and Kirk Lougheed, a member of Cisco's founding team, its first engineer, the designer of IOS, and a Cisco Fellow.

First, Cisco built the IOS code base so that it was flexible and easy to make quick changes so it would work on multiple platforms, adding functions that customers desired. That let Cisco move faster than its competitors.

"As we were deploying IOS in a customer's account, we'd discover some additional thing they wanted, and turn around and give it to them days later," says Bion. "Over the years, IOS has shown itself to be remarkably extensible. High Availability, in service software upgrades, the ability to support a wide range of platforms across several market segments, componentized software—all of these capabilities were once thought to be beyond IOS' reach, but time and again the software has shown itself capable of supporting new functionality through centralized and distributed architectures."

Another key decision was to have IOS support bridging—at the time a common way to link computers and networks. While bridging and routing each have advantages, the manner in which IOS routes and forwards traffic solved many of the problems with bridging that caused corporate networks to crash, says Bion, and took customers away from companies that just built bridges.



Then, as now, Cisco had a very customer-centric view of the world. It came naturally to Cisco's founding team, who worked in IT support at Stanford University.

"We were very interested in whatever the customer wanted to pay for," says Lougheed. "If a customer needed something, we would figure out how to do it and then how to do it for others. We were very opportunistic."

### **Providing Customers with Fleet of "Trains" Creates Maintenance Challenges**

Cisco's customer-driven focus has been a reward but also a bit of a challenge for IOS over the years.

Cisco has reaped the rewards of this approach since we can quickly build and enhance versions (or trains, as they are called) of IOS for different markets. The challenge, has been in maintaining all those custom-built locomotives, says Lougheed.

But that model is shifting today.

By componentizing certain functions, "like features" will be delivered more rapidly across a broad set of platforms for an even more consistent user experience. The initiative, begun in 2008, is about shifting the architecture by standardized sets of source code that can be shared. This lets Cisco add functionality and fix bugs faster across platforms, while improving the quality and capability of IOS.

Cisco's Network Software and Systems Technology Group has been making some significant changes in software quality and the result is the evolution of an IOS that is more extensible and flexible.



Currently, Cisco IOS Release15 has a new delivery model and IOS XE is actually hosting IOS capabilities on top of a Linux kernel to provide High Availability and rapid services integration. IOS XE will continue to evolve so it can accommodate open-source and third-party applications.

"If we don't have to write everything ourselves, we can move much more quickly," comments Lougheed.

### **Transforming an Industry**

If the success of a product is measured by how much it is imitated, then IOS has clearly shown its strength. It sets the standard by which competitive products are designed and even configured.

"Anyone who goes to configure a competitor's product feels very much at home" Bion says. "IOS established the core elements of the language of router configuration"

IOS is also part of Cisco's tradition of transformational thinking.

"The idea that all communication can be supported by homogeneous, lower-level infrastructure is very common today, but it was radical thinking 20 years ago, and it broke the paradigm of how IT networking organizations operated," Bion points out.

"With IOS, Cisco was creating one from many, and that's something we still do today," he adds. "We've integrated data, voice, and video all on the same network. Our products today, from Telepresence to IP phones, help customers reap the benefits of that integration."



Cisco's strategic approach to "purpose-built" (multimarket) solutions has included best-of-breed applications, sharing information anywhere, any time, and any place. This is possible through Cisco's cross-operating systems portfolio, and includes NX-OS and IOS XR, which essentially originated from IOS-based capabilities.

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