

# Toyota Motor Sales USA: Red Hat Linux Across the Enterprise

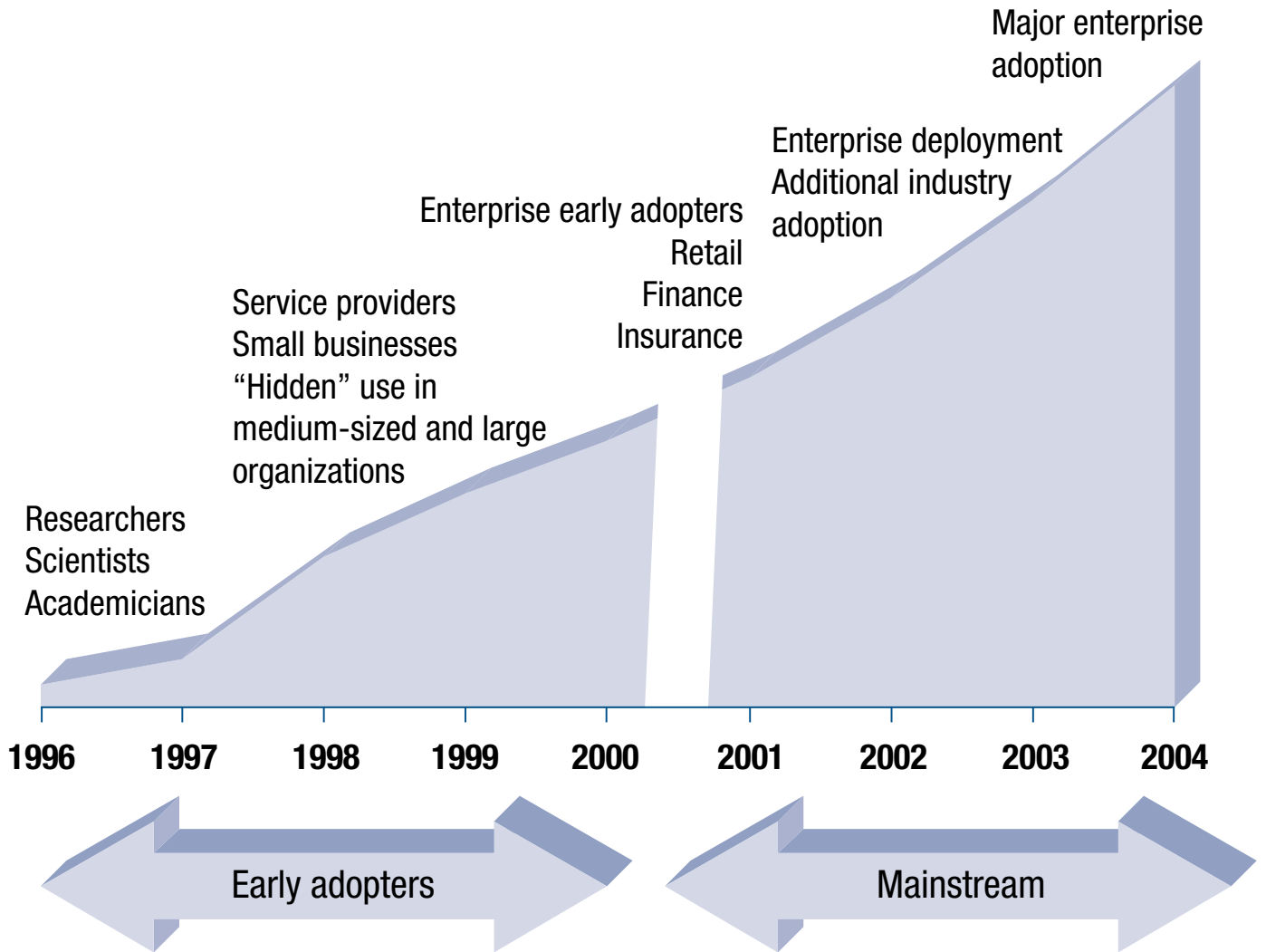
**A** well-known standard-bearer of quality in automobiles, Toyota seeks to achieve the same level of reliability in its dealer IT network as it has in its vehicles. The challenge is magnified by a flood of information to disseminate to this field force spanning 1,300 dealerships and 90,000 employees. Toyota Motor Sales USA is deploying a marquee implementation of Red Hat Linux to achieve multiple and sometimes conflicting goals of speed, flexibility, and simplicity for a system to deliver information across the nation.

Vital Statistics	
Industry	Automotive
Employees affected by this implementation	10,000
Locations under implementation	1,300 US dealerships plus headquarters
Scope	Nationwide

## Background

Toyota Motor Sales (TMS) USA, Toyota's US sales and marketing arm, oversees sales and other Toyota operations in 49 states. There are 1,199 Toyota dealers located throughout the United States, as well as 175 Lexus dealers. According to the company's mission statement, "Our vision is to be the most successful and respected car company in America. To attain that goal, our mission is to attract and retain customers with high-value products and services and the most satisfying ownership experience in America."

## Linux Enters the Mainstream



Source: IDC, 2001

Given the company's mission, it's not surprising that Toyota has, among other developments, built a network connecting its 1,300 dealerships to the U.S. headquarters. With vehicle sales exceeding 1.6 million in the United States and 5 million worldwide, the automaker has one of the world's largest deployments of Red Hat Linux. Connecting 10,000 users at dealerships, Toyota is also one of the world's most impressive Red Hat implementations.

## The IT Challenge

The challenge is how best to provide information-rich content to the dealers over a wide area network using limited bandwidth. Toyota needed a way to store and forward cached content. The car maker sought an off-the-shelf caching application that would allow specific customized modifications to optimize the cache's behavior.

Toyota uses Red Hat Linux 6.1 running on Dell PowerApp servers. Toyota approached these two large network operating systems companies to tackle this problem. Because of the number of servers involved and the name recognition of Toyota, development projects ensued to meet this requirement. Both of these vendors were able to meet Toyota's requirements with varying degrees of success; however, getting Toyota's changes into the respective production code would be virtually impossible, creating considerable support issues. The actual specs on systems deployed are surprisingly low, with Intel Pentiums running at 700MHz, 128MB RAM, and 20–30GB of drive space. The cost per site is estimated at around \$1,500. Red Hat and Dell combined to provide a relatively simple system.

## Red Hat Implementation and Deployment

Development on the Linux platform was extremely fast. Toyota developed a prototype in two weeks and completed a buildout with full testing in about two months. It overcame a number of issues plaguing vendors trying to modify shrink-wrapped product. Rather than trying to work around a monolithic application, Toyota had access to the source code (in this case Apache). Field implementation is ongoing because it requires setting up Dell PCs at 1,300 locations.

The configuration of the Red Hat Linux package was done with Apache, and with modifications by Toyota. The company altered key components of the Apache code; added SNMP management utilities, DNS, network time protocol (NTP) and Secure Shell into the server; and then finally optimized the network settings. Dell installs a configuration in the boxes based on Toyota's rollout, with units shipped directly to dealers. Dell can accept and update any changes to the configuration and make sure existing

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boxes have the latest code. Toyota also has implemented an open source solution for distributing updates in the code to those units already in the field.

Cache updates are performed depending on the level of urgency. The shortest duration is about 30 minutes and the longest is 30 days for monthly audits.

There have been scores of logistical hurdles in rolling out the dealer network, though virtually none with Red Hat Linux or Dell. Each of the 1,300 installations has some unique components, such as the dealers' names and log-in data. The most difficult piece was making sure that installation team had the proper information to configure the box to ship it to the dealers. When they plugged it in, it worked, and the team could communicate with it.

Toyota chose Red Hat Linux for the following reasons:

- Toyota had some existing Red Hat implementations.
- Red Hat is the Linux leader with 52.4% market share.
- Red Hat has a robust support mechanism in place.

Today, Toyota and Red Hat are working out the details of a long-range support project.

Before Linux, platforms were shrink-wrapped and posed a shortcoming because any changes had to be incorporated into the vendor's product development cycle to be fully supported. This yielded a precipitously long lead-time with no guarantee of completion. With open source code, Linux holds no such problem. Modifications have not been large, and Toyota has been able to accomplish them with its own staff, setting its own schedule, and costing less than outsourcing.

## With Red Hat Linux

With Linux, Toyota was able to keep a small footprint, allowing the units in the field to run as fast as possible with a minimum of resources. Toyota arguably saved money on RAM because installed PCs required less RAM than they would otherwise.

Another key benefit is that remote access and remote management are fundamental pieces of the operating system. "The only thing IT can't do remotely is hit the power switch," according to the system's architect in charge of design and development. Toyota utilizes remote diagnostics, which were not available on other platforms, to monitor and update field installations. The car maker gains in its speed and uniformity of field updates, and keeps travel expenses (of IT staff to the dealerships) to a minimum. Lastly, Red Hat included a plethora of utilities and tools that are available in the open source community, allowing capabilities such as code updating and remote network diagnostics without having to incur increases in licensing fees and applications.

Open source turns the functionality into smaller pieces, more of a jigsaw puzzle as opposed to a block. You might need to do something as simple as query information off a network interface card. In all other platforms Toyota tested, this would not be commercially viable. Looking around the Linux community, you can usually find a tool that does exactly what you need or get what you need, pare off the parts you don't want, and rebuild it. This approach keeps things elegant, simple, and clean.

Toyota's implementation team exceeded many goals because of utilities such as remote diagnostics. It has been able to help other divisions of Toyota with their configurations and troubleshooting and has opened the eyes of many people who are new to Red Hat Linux.

## Benefits of Linux

Management showed immediate savings of \$650,000 via Linux. Toyota realizes immediate savings by not requiring server operating systems in 1,300 boxes at \$500 each. Support costs are slightly, though not materially, lower than they would be with any other system. Toyota gains some advantages by being able to see into the dealers' network for some troubleshooting. "It's a wonderful thing to be able to go to upper management and tell them we downloaded everything for free; all you need to do is pay for maintenance, and it's done. When you have thousands of licenses, you can save a lot of money very quickly," according to Toyota's manager in charge of implementing Red Hat.

However, the best attributes of Red Hat have been reliability and manageability. Typically when filed systems crash, the IT department has to physically visit the dealership. Today the department has reduced travel by providing a system that can be easily administered remotely and, through an arrangement with Dell, replaced if remote diagnostics are unsuccessful.

Red Hat Linux has enabled Toyota to meet its CIO's directive to use Web-based content for communications with dealers. Those business units that have begun to leverage this architecture realize significant improvements in how information is delivered to the field. The best example to date is just-in-time training. Toyota's service organization has devised a method to improve the dissemination of information to service people in the field. Composed primarily of information-rich material, just-in-time training allows a repair technician small training videos (typically between 1 and 6 minutes in length) that demonstrate the workings of various components and processes. This is proving to be more effective than requiring that a technician search for and read several pages of text.

## Support Required

Toyota has some concerns regarding support, although it is currently negotiating a contract with Red Hat. Toyota's Production Services Group has been able to support the implementation with one person per 300 dealers and is facilitating the current roll out in conjunction with Dell.

Each dealership has from 1–40 users. IDC research shows that this is a very low ratio for support personnel to end-users.

## Lessons Learned and Future Plans

The highest levels of our IS executive staff look at Linux as an opportunity to implement cutting-edge technology. Red Hat Linux, in general, is still viewed as “out there” in terms of technology even though just about every infrastructure seems to be running some Linux. That was the case with Toyota. The success of this project has lent more credibility to Red Hat and to Linux and has allowed the Architecture Group to look at other problems that could be solved with open source software.

In the future, Toyota will install all remaining dealerships and looks forward to a stable and quiet environment. Until the Dell boxes reach the end of their life or multi-megabit networking becomes commonplace, both possibly five years, Toyota will reap benefits from its dealer IT network. Even at that point, Toyota is likely to continue with Red Hat Linux and a very similar, albeit updated, implementation. Meanwhile, The Architecture Group is looking at other areas where it might be able to leverage Linux’s reliability and low costs. It is currently in use for core applications, such as email and DNS. Every day that passes with no major problem is another day that builds the reputation of Linux as an enterprise-ready operating system.

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