bcg.perspectives
by THE BOSTON CONSULTING GROUP

THE COLLISION OF POWER AND PORTABILITY

By Philip Evans

The changes taking place in the technology, media, and telecommunications sector are accelerating as industry leaders such as Google and Hewlett-Packard take far-reaching strategic steps to reposition themselves. This second article in our series on the post-PC era examines the collision between the paradigms of power and portability, which promises to have a defining impact on the shape of the industry.

Companies from opposite poles of technology's power–portability spectrum are colliding. This is not normal, day-to-day competition but a confrontation between business paradigms, with tablets at the fault line. The changes under way will affect everything from smartphones to notebooks—as well as the companies that make and sell these devices and their component parts and software. Google's proposed acquisition of Motorola Mobility and HP's possible divestiture of its PC business—as well as other industry-changing moves that will surely follow—are early consequences as companies start to adapt.

The Power–Portability Spectrum

Intelligent devices at either end of the power–portability spectrum are characterized by very different business paradigms. At one extreme reside the largest, most powerful—and least mobile—machines: supercomputers, mainframes, and server-filled data centers. At the other are the smallest, least muscular, but most mobile devices—of which the wearable iPod Nano is perhaps the exemplar.

System architecture at the power end of the spectrum is mature and modular. The dominant device is now the PC, and by far the largest share of PC industry value (67 percent, currently) has been extracted by the two companies that control the layers where monopoly position is easiest to maintain—because of either network effects, in the case of Microsoft, or scale economies, in the case of Intel.

Driving technological and industry development at the power end are what might be termed the "big exponentials"—the laws of progressive improvement. Best known is Moore's law: the number of transistors on an integrated chip doubles every 18 months (or did until recently). Equally important are Kryder's law (data density on a storage medium doubles every year) and Butters' law (the bit rate on a fiber-optic cable doubles every nine months).

The big exponentials have three major consequences for how we use technology. The first (yet another law: Myhrvold's) is that the complexity of applications expands faster than the uses to which those applications are put. Microsoft Excel was a 1.2 MB program when it came out in 1987; today, version 12.0 is 58 MB. It's not clear that it's 50 times better than version 1, but the program has expanded to fill the technology available—because it can.

The second major consequence is the evolution from integral to modular design. As each device or service matures, the locus of innovation shifts from architecture to components. Assemblers combine largely interchangeable components to meet the requirements of different user segments. Component suppliers compete on dimensions of merit: cost, speed, reliability, capacity, and so forth. The architecture remains fixed.

The evolution from integral architecture to modular design has been occurring for some six decades. Remember when a supercomputer required a colossally integrated design, mainly to stop it from melting? Today the same functionality is provided by racks of modular PCs running Linux, itself the most modular of operating systems. The computer industry made a big jump toward modularity with the launch of the IBM System/360 in 1964, and another with the introduction of the PC in the early 1980s. Likewise, the "information superhighway" evolved from a variant on cable television (Prodigy and AOL) to open interoperability between browsers and web pages, mediated by the common standards of TCP/IP and HTML. The results have been layered, modular architectures, not just of products but of the industries that make the products.

The third major implication of the big exponentials is that the binding design constraint shifts. In the earliest days of computing, the principal restriction was the central processor's computing power. Systems were designed to use that asset as efficiently as possible. The CPU was secreted in a refrigerated sanctum accessed by "dumb" terminals and guarded by a polyester-robed priesthood. Code was written in a language designed for run time efficiency; "great" code was code written in the fewest lines.

By the 1980s, CPUs had became so powerful that utilization efficiency no longer mattered. Far more constraining was the problem of moving data around. This drove the industry toward minicomputers and, eventually, microcomputers—PCs—which were grossly inefficient in their use of CPU cycles but put computing power where the user sits.

Thanks to the Internet and broadband networks, the binding constraint has moved again. Transporting information is hardly a problem today, and two very different constraints now shape IT architectures. One is the cost of system maintenance: data integrity, error correction, backup, updating, debugging, and crash recovery. The pendulum has swung back: by centralizing services in data centers and providing software and data through the cloud, uptime can be managed more efficiently.

The other new constraint is input/output, or I/O: the ease with which we can access media and information in a convenient, portable, and personalized fashion. The big exponentials make new I/O possible; pent-up consumer demand makes it attractive. Single-purpose, analog devices (phones, music players, cameras) can be replaced by multipurpose digital ones. This immense opportunity has lured computer makers from the power to the portability end of the spectrum, where, until very recently, they found the greatest growth and profits in laptops and netbooks.

But computer companies were prisoners of their paradigm: they brought with them their layered, modular business model and the biases of their home turf. They tended to overprovision processing power and waste CPU cycles, thereby using batteries inefficiently. They underinvested in seamless interfaces because they were not used to dealing with I/O as the constraint. They mixed and matched features and functions in the expectation that the market would sort out which ones mattered to whom.

Then they ran into Apple.

The Portability Paradigm

From its beginnings, Apple has pursued a different model, one based on a more integrated design and architecture. Since network effects are so powerful, this model confined the Mac to a small, premium niche in the computer business and almost bankrupted the company 15 years ago. However, the paradigm it represents, anomalous in the power segment, is perfect for portability.

In 2001, Apple took the plunge into mobility with the introduction of the iPod, a device apparently unrelated to its core computer business. Like the Mac, the iPod's integrated hardware and operating system had its own data format (AAC), its own particular method of uploading (iTunes), and even, in the early days, a near-proprietary connector (Firewire). Apple's one critical concession to openness was iTunes for the PC. The full significance of the iPod was not immediately apparent, since it was not a paradigm shift *among* portable devices; it was simply the best digital music player on the market. From the computer industry's point of view, it looked as if Apple, having lost the battle against Microsoft, had decided to take on Sony in an entirely different business.

The real significance became clear, though, as Apple undertook its own migration back across the spectrum toward the power-focused domain of the PC.

The first step was the extension of the iPod franchise with the creation of the iTunes music store in 2003, which quickly disintermediated traditional retailers and forever changed how music is marketed. This was another huge success. Apple has sold some 15 billion songs through the store, which (uniquely) it can run as a breakeven operation, monetizing the investment through hardware sales.

Apple repeated the cycle further along the spectrum with the iPhone, which combines a range of functions in another extraordinarily successful device, again characterized by tight integration of hardware and software. In stark contrast with device makers at the power end, Apple optimized the iPhone around I/O rather than a proliferation of feature combinations, resisting the temptation to add complexity simply because it could. Experts initially failed to grasp why it was such a significant innovation and competitive threat. Consumers, innocent of tech theology, grasped the point immediately. To date, Apple has sold about 200 million iOS devices and achieved a major shift in bargaining position vis-à-vis the telecommunications carriers that have dominated that industry.

Apple leveraged its portable hardware advantage by developing an ecosystem. The key steps were publishing APIs so that developers could write for the iOS platform, and expanding the iTunes Store from songs to apps. Apple offers some 425,000 apps, and the number downloaded now exceeds 14 billion. In the I/O-constrained context of a phone, apps (so far) provide a better experience than HTML and JavaScript through a browser.

The third step in Apple's migration along the spectrum, following exactly the same principles, came just 18 months ago with the iPad. This breached territory traditionally dominated by the netbook—and, to an extent yet to be determined, by the laptop. Again consumers got it right away. At the launch, Wall Street projected first-year sales of 1 million to 5 million units. Actual sales were about 25 million in the first 14 months. IDC is now forecasting sales of

53 million units for 2011. Some 90,000 applications have been developed just for the iPad. Netbook sales, previously the fastest-growing segment of the PC industry, are plummeting.

Apple reinforced its success with its own version of "embrace and extend." Vertically, on the dimension of the technology stack, the company codesigned and bundled the hardware and operating system. It extended the latter into key applications such as Mobile Safari, iPhoto, and the iPod music-playing program, as well as into various retailing platforms: the iTunes Store, App Store, and iBookstore. At the same time, Apple moved down into components by developing deep and preemptive relationships with its suppliers. It also invested heavily in capabilities for designing custom hardware components, such as the A4 and A5 chips.

Meanwhile, Apple has successfully exploited synergies laterally across the power–portability spectrum. The Apple brand delivers a powerful halo effect for each new device that comes to market. The look and feel of iOS is converging, not only among iOS devices but also, in part, with Mac OS 10.7 (OS X Lion). The company has created cloud services—MobileMe and now iCloud—which provide integrated data access across multiple devices. It has built these devices, from the smallest iPod to the most powerful Mac, on a common software foundation. Perhaps above all, Apple has established direct retailing relationships with its customers: some 225 million credit-card accounts able to purchase with a single click.

The Power–Portability Collision

Technology has driven the fusion of devices and capabilities across the power–portability spectrum. Companies following the PC paradigm exploited this trend. But true to their heritage, they overemphasized capabilities facilitated by modularity and underestimated the value of architectural integration. Apple, with its distinctive legacy, played the game differently and established a position at the portability end of the spectrum that will be difficult to dislodge. Tablets and netbooks are the intermediate case where things still hang in the balance.

It's easy to look at tablets versus netbooks as the manifestation of tradeoffs between screen versus keyboard, Apple versus Microsoft, apps versus browser, Flash versus HTML5. To do so minimizes the conflict between two paradigms. Tablets are the tectonic fissure in the structure of the information devices industry. They are the point where two fundamentally different paradigms compete to provide similar services. The netbook is the least powerful edge of a modular paradigm rooted in the abundance of power. The iPad is the least portable edge of an integrated paradigm developed to enable portability.

There is a school of thought that holds that if the big exponentials keep working, this domain, too, should ultimately become commoditized. The value of codesign should decline and that of feature and component recombination should rise. Modular should supplant integrated. Open should replace closed. Honeycomb should supplant iOS. Google will inherit the Wintel paradigm, and the modular Android stack will eventually prevail. But collisions are messy and unpredictable. The evolution of technology industries is path-dependent, not deterministic. When and how, and even whether, depend on individual genius as well as impersonal forces. For now, individual genius is winning.

About the Author

Philip Evans is a senior partner and managing director in the Boston office of The Boston Consulting Group. You may contact him by e-mail at evans.philip@bcg.com.

For Further Contact

If you would like to discuss this report, please contact one of the authors.

The Boston Consulting Group (BCG) is a global management consulting firm and the world's leading advisor on business strategy. We partner with clients in all sectors and regions to identify their highest-value opportunities, address their most critical challenges, and transform their businesses. Our customized approach combines deep insight into the dynamics of companies and markets with close collaboration at all levels of the client organization. This ensures that our clients achieve sustainable competitive advantage, build more capable organizations, and secure lasting results. Founded in 1963, BCG is a private company with 74 offices in 42 countries. For more information, please visit www.bcg.com.