WHEN SILICON MEETS DATA

By JT Hsu and Johnny Pi

Data access and silicon capabilities are hot assets. Chip makers want more data to build better chips, while device makers want to create customized chips to unlock business opportunities.

Disruptive technologies are creating exciting opportunities in areas as diverse as autonomous driving, cryptocurrencies, smart security, and smart homes. But many of the system and device manufacturers that aim to jump into these new markets are facing an unexpected obstacle: the mass-produced integrated circuits (ICs) they have been using can't deliver the performance necessary for today's highly specialized, real-time, data-heavy demands.

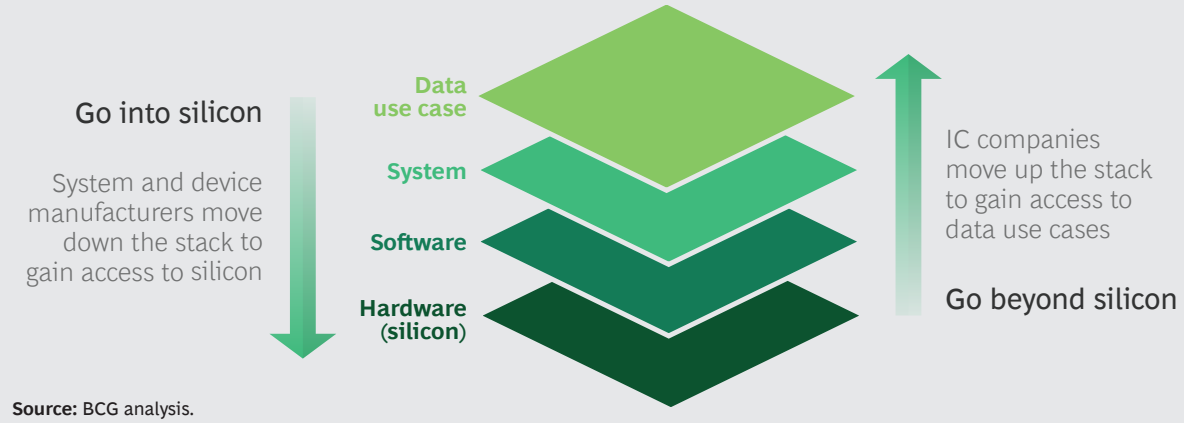
Meanwhile, the silicon-focused companies that make ICs have realized that they need to up their design game and should start producing more specialized ICs that will help customers unlock new business opportunities. Designing such chips will require a deeper knowledge of the industries these companies serve and better access to industry-specific data.

For IC makers as well as the industries that they serve, silicon and data are the two strategic control points in the new digital world. Exhibit 1 illustrates the approaches that companies are taking either to capture IC capabilities or to access data. A number of companies have taken steps to move in these new directions, but they are not necessarily aiming for full ownership of the entire value chain. Most companies can adapt to the new digital world by forming tight collaborations with ecosystem partners that own critical assets. (See Exhibit 2.)

Developing Silicon Expertise

It's common knowledge that companies need access to data if they want to leverage big data solutions and AI business opportunities. Less understood, however, is that companies can't unlock new opportunities such as autonomous driving and smart manufacturing in a cost-efficient way with generic ICs. Businesses have a growing need for application-specific ICs (ASICs) that can run what is called edge computing.

EXHIBIT 1 | Two Vertical Moves in the New Digital World



Source: BCG analysis.

Processing data close to the source, edge computing reduces the possibility of delays in sending data across long routes to data centers or clouds for analysis. It would be impractical—even dangerous—to transmit all data from an autonomous car to the cloud for analytics and then have to wait for suggested actions. The safety of passengers depends on real-time-processing capabilities that react promptly and correctly to the car's environment. As the demand for ASICs evolves, more device manufacturers are moving vertically to build in-house IC design capabilities or to acquire such capabilities through M&A.

For example, several years ago one of China's leading surveillance camera providers began offering a criminal detection solution. Every camera in the system performed facial recognition and an initial analysis to identify people who might have a match in a criminal database and then sent the processed data to the cloud for complex analysis and to notify authorities.

However, the company soon realized that general-use ICs were not up to the task. To deal efficiently with the large amounts of information collected by millions of surveillance cameras, it was necessary to process the data in an edge device before transmitting it to the cloud. The ICs that were available on the market were too costly and lacked such necessary features as low power consumption and the ability to adjust to differences in lighting. The company eventually chose to work with a strategic partner to design its own ASICs, significantly reducing the bandwidth and storage capacity needed for data transmission.

Meanwhile, large internet companies are capitalizing on their huge scale advantages. One global internet giant has more than 2 million servers worldwide and uses nearly 1 billion chips each year in its data centers. As its data center business grows exponentially, it can design and produce ever-better state-of-the-art chips to meet its business needs cost efficiently. Some consumer electronics manufacturers are also designing ASICs specifically to lower costs and improve pricing for their mass-market rollout to the smart-home market.

Accessing New Sources of Data

All this might seem threatening to the business model of established IC makers. It is. Disintermediation is a real threat for those that cannot up their design game and collaborate with customers to create ASICs that can power edge computing. But chip makers looking to develop a deeper knowledge of their customers and to access more data so that they can design and produce more specialized ICs can quickly run up against a number of thorny challenges.

One challenge is that vertical moves can jeopardize existing relationships. The long-established practice is for chip vendors to provide a stable and efficient hardware solution that device manufacturers can put to use. If chip vendors start moving

EXHIBIT 2 | Companies Are Collaborating with Ecosystem Partners that Own Critical Assets

Company description	Recent vertical-integration moves	Industry
A global leading GPU designer	• Formed partnerships—with automotive OEMs—aimed at the realization of autonomous driving • Partnered with mapping companies to develop AI for a cloud-to-car mapping system for self-driving cars	Auto
A global leading integrated-device manufacturer	• Acquired an autonomous-driving systems developer for approximately $15 billion • Had its chips installed in the vehicles of multiple Chinese manufacturers	Auto
A US-based automotive and energy solution provider	• Began in-house research on customized AI hardware chips to improve the performance and reliability of autopilot systems	Auto
A leading Chinese automobile and battery manufacturer	• Has fully owned subsidiaries focused on IC development	Auto
A leading video surveillance product and solutions provider in China	• Partnered with silicon chip makers on implementing neural networks into surveillance cameras • Is designing an in-house machine vision AI chip	Smart security
A leading video surveillance product and solutions provider in China	• Built its own chip institute to develop technologies and hardware • Developed the new industry-standard high-definition composite-video interface and is building its own AI chip	Smart security
A multinational networking, telecommunications equipment, and services company	• Employs a SoC R&D team • Announced a chip that features 60 frames-per-second high-definition TV, 1080-pixel resolution video processing, and improved performance for intelligent video	Smart security
A leading webcam and video server manufacturer in Taiwan	• Started building its own SoC in 2003, spinning off the IC design department that specializes in video compression chips	Smart security
A leading video surveillance chip manufacturer	• Worked closely with leading video surveillance companies, providing customized chips, dedicated technicians, and onsite support	Smart security

EXHIBIT 2 | Companies Are Collaborating with Ecosystem Partners that Own Critical Assets *(continued)*

Company description	Recent vertical-integration moves	Industry
A global leading electronics manufacturing service provider	• Invested in a semiconductor value chain, including design, manufacturing, packaging, and equipment • Established a semiconductor business unit and announced plans to build its in-house fabrication capability	Industry 4.0
An industrial computer, smart system, and automation company	• Collaborated with an IC design company to develop a high-definition, low-cost media cloud solution, and video-decoding SoC • Developed industrial-grade SSDs and NAND Flash	Industry 4.0
An engineering and electronics company	• Is building a $1.1 billion plant to produce self-driving and smart-city chips • Has supplied chips for cars and smartphones	Industry 4.0
A leading Chinese electrical-appliance manufacturer	• Acquired electronic and chip talent from abroad, particularly Japan • Acquired a German manufacturer of industrial robots and automation solutions	Smart home
A multinational technology giant	• Founded two IC companies, focusing on set-top box chips and microcontrollers • Launched China's first video-decoding chip that is used for superintegrated digital TV circuits	Smart home
A home appliance manufacturer in China	• Cancelled a dividend to fund a budget of RMB 50 billion to build in-house chips	Smart home

Source: BCG analysis.
Note: SoC = system on a chip; AI = artificial intelligence; GPU = graphics-processing unit; IC = integrated circuit; IoT = the Internet of Things; SSD = solid state drive.

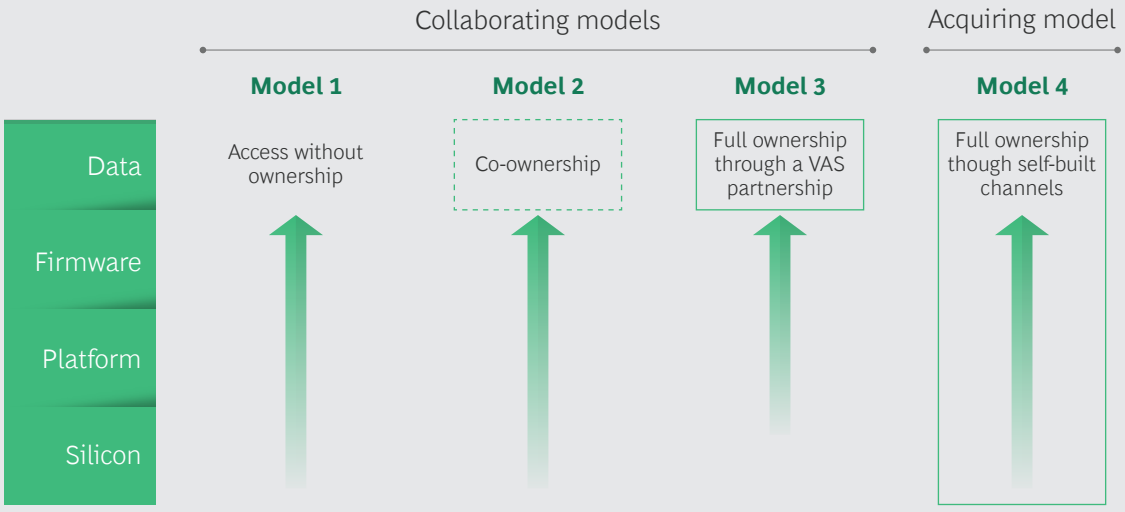
vertically, gathering data to create more specialized ICs, device manufacturers might feel threatened.

Furthermore, even silicon-focused companies that have access to more industry data may lack the domain knowledge to design truly cutting-edge ASICs that can open up new business opportunities. And companies can be constrained by corporate priorities. If a new market, such as smart security, is smaller than the company's existing business, such as smartphones, its leaders might be reluctant to devote resources to ASIC development.

Exhibit 3 illustrates the four main strategies we have observed silicon companies using to access data:

- **Access Without Ownership.** This involves collaborating with partners and not owning data. For example, an IC design company developed a graphics-processing unit and recognized that the GPU was well suited for training AI models in autonomous vehicles, as well as for the real-time processing cars need in order to react promptly to live events. But to develop autonomous-car products, the company would need

EXHIBIT 3 | Four Models Can Help Silicon Players Secure Data Access and Ownership



Sources: Expert interviews; BCG analysis.
Note: VAS = value-added service.

access to test car data. Its solution was to strike collaborative arrangements with several auto OEMs. It has since become a leader in this business.

- **Co-ownership.** In some cases, silicon-focused companies have access to and co-ownership of data with partners. For example, a provider of an autonomous-driving solution leveraged its first-mover advantage to form tight partnerships that included co-ownership of driving data with several auto OEMs.

- **Full Ownership Through a Value-Added Service Partnership.** We have seen companies collect data from other companies' devices and then assume full ownership of that data. For example, a leading AI company in China collects and owns the consumer data from its strategic partner's smart-home solution devices and provides, in return, insights about consumers gleaned from its analysis.

- **Full Ownership Through Self-Built Channels.** In this model, silicon companies provide services directly to end users, collecting their data. This represents the deepest level of data ownership—and the greatest competitive threat to existing customers. For example, an IC company became a leader in cryptocurrencies—with full data ownership—by building a vertical, fully integrated solution, including ASIC design, ASIC miner production, and cloud mining services.

Four Imperatives for Making Vertical Moves

It's important to bear in mind that not all companies need to move vertically to access IC capabilities or data. Before making a vertical move, companies need to determine whether the business opportunities that they are considering require strong edge- and real-time computing power, whether currently available chips could satisfy their needs in a cost-efficient way, and whether having data access or silicon capabilities would be strategically important for growth.

The smartphone and PC markets, for example, are still largely horizontal commercial platforms for processors, including CPUs, application processors, and memory providers. Meanwhile, foundries will likely remain competitive, as end users and solution providers continue to outsource chip production to avoid investing in high-cost fabrication.

But while there are exceptions, many companies will decide that they must move vertically to access IC capabilities or data—and the sooner the better. Fabless players—companies that outsource their silicon wafers—are already losing growth momentum as the PC and smartphone markets saturate; they also face severe threats from emerging IC design startups that are competing for new business opportunities. With this in mind, we have identified four imperatives critical to making successful vertical moves:

- **Be selective.** Companies need to rid themselves of the traditional horizontal mindset. They must start by identifying their own core competencies and thinking strategically about how to apply them vertically. This exercise should be done continually: new customer demands and possible use cases continue to arise. The companies do not need to do everything, but they do need a clear understanding of what they do well if they want to extend their scope and fend off commoditization and price erosion.

- **Act fast.** Seize first-mover or fast-follower advantage within select verticals by leveraging core competencies. As more use cases attract more investment from more industries, more windows of opportunity will open quickly—and close even faster. Speed, which is necessary in this environment, calls for lean and agile approaches.

- **Separate businesses.** Set up a separate entity (legally or informally) with its own investment logic, incentive plans, and reporting lines to stimulate new-business development. This effort requires strong and consistent support from top management. For example, a semiconductor company established a new entity when it decided to enter the health care vertical, aiming to ensure its ability to respond to customer-specific demands with speed and agility.

- **Partner and acquire.** As the borders between software and hardware and customers and competitors continue to blur, alliances and ecosystems will grow more powerful than ever. Companies should map out how far and how fast they will move vertically and seek partnerships or acquire the missing pieces necessary for pursuing their business plans.

By acting on these four imperatives, a global fabless company successfully moved into the autonomous-vehicle business. It identified a promising segment with no dominant player in which it could apply core competencies and then moved quickly to cement collaborative arrangements and access test car data. Continuing to seek out partnerships in the auto ecosystem—including, for example, OEMs, sensor providers, tier one suppliers, and mapping-service providers—the company also moved quickly to establish an independent auto solutions department to focus on developing the new business.

Two Strategic Control Points

Former Intel CEO Brian Krzanich recently stated that "today, data is the foundation of innovation. Everything you see here—smart city, auto driving, and AI—all started with data." And SoftBank CEO Masayoshi Son has said that "silicon is the core of IoT development. Data will not exist without silicon."

We believe that the future belongs to those who embrace both views. Data and silicon are the two strategic control points in the new digital world. Companies across a broad swath of industries need to move vertically either to capture IC capabilities or to access data. Disruptive moments—like the one we are experiencing now—are actually excellent times for unlocking new opportunities and partnerships.

About the Authors

JT Hsu is a partner and managing director in the Taipei office of Boston Consulting Group and the global leader of the semiconductor topic. You may contact him by email at hsu.jt@bcg.com.

Johnny Pi is a principal in the firm's Taipei office. You may contact him by email at pi.johnny@bcg.com.

Acknowledgments

The authors thank their BCG colleagues Antonio Varas, Ethan Choi, Jaison Justin, KJ Lee, Max Hong, Stefan Hoffmann, Yuichi Koshiba, Jan-Hinnerk Mohr, Jimmy Feng, Myonghyon Cho, Johnny Hsueh, Ying-Ru Chen, Noriko Hasegawa, and Yurui Guo for their contributions to this article.

Boston Consulting Group (BCG) is a global management consulting firm and the world's leading advisor on business strategy. We partner with clients from the private, public, and not-for-profit sectors in all regions to identify their highest-value opportunities, address their most critical challenges, and transform their enterprises. 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 offices in more than 90 cities in 50 countries. For more information, please visit bcg.com.

© Boston Consulting Group 2018. All rights reserved. 12/18

For information or permission to reprint, please contact BCG at permissions@bcg.com. To find the latest BCG content and register to receive e-alerts on this topic or others, please visit bcg.com. Follow Boston Consulting Group on Facebook and Twitter.