WHITE PAPER

Healthcare
Solution Focus Area

# The Road to Fully-Connected Healthcare

GE Healthcare

## How to Turn Your Imaging Centers into Hubs for Enterprise-Wide Transformation

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### Executive Summary


The move toward value-based reimbursement (VBR) models is putting pressure on healthcare organizations to modernize their IT systems so they can more effectively measure and improve the quality and efficiency of their care. The long-term goal is clear. Organizations need to integrate their devices, applications, and data so that clinicians and administrators have the right information at the right time to deliver the best possible outcomes at the lowest possible cost.

Yet creating a fully-connected healthcare environment is a complex undertaking. A strategic approach is needed that provides incremental value while building the right foundation for moving forward. Focusing on data integration rather than system and application integration offers a strategy for navigating this transition more quickly. With this approach, organizations can realize many of the benefits of a fully-connected environment, while avoiding the challenges that come with integrating large numbers of devices and applications.

As organizations start down this path, enterprise imaging provides a natural hub for modernizing the flow of healthcare information. Imaging is a gateway to care for most patients, a diagnostic touchpoint for downstream clinicians, and one of the departments that is most affected by a move from volume-based to value-based reimbursement. Integrating and unifying data at this central hub can help to boost productivity at a pivotal point of the organization. It can also help to improve the overall flow of clinical information and provide greater transparency for measuring and documenting quality and efficiency.

Bottom line, it makes good sense to focus data integration efforts around enterprise imaging, an area where data integration efforts can have a substantial impact on patient care and overall profitability. This paper explores some of the challenges and opportunities involved in consolidating imaging data, integrating other data sources, and making the best use of the resulting information. It discusses how this consolidated data environment lays the foundation for advanced analytics and artificial intelligence (AI). It also offers high-level recommendations for moving forward, based on the collaborative work GE Healthcare has undertaken with Intel and with major healthcare providers around the world.

## The Transition to VBR is Underway

With the Medicare Access and CHIP Reauthorization Act of 2015 (MACRA), the transition toward value-based reimbursement (VBR) models has gained new traction. MACRA requires facilities to begin monitoring patient outcomes and efficiency metrics in 2017 if they wish to maximize reimbursement in 2019 and beyond. They must also begin showing practical improvements in information sharing, collaboration, and population health management. Although the initial impact on reimbursement amounts is small, it will increase substantially over the next few years (Figure 1).

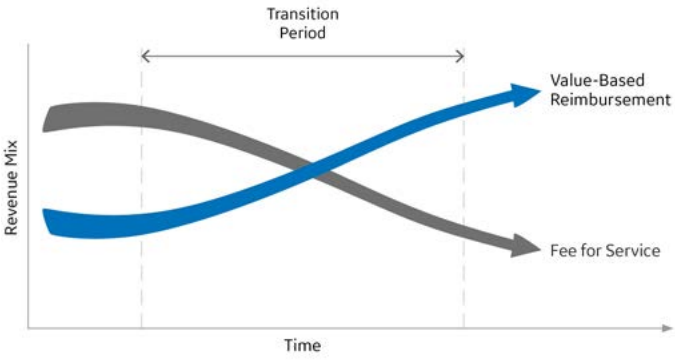


**Figure 1.** The Medicare Access and CHIP Reauthorization Act of 2015 (MACRA) is accelerating the industry shift toward value-based reimbursement (VBR) models.

Staying profitable as MACRA and other VBR models move into the mainstream will require new levels of transparency. Organizations must be able to measure clinical quality in relation to costs and efficiency. Ultimately, success will require using IT pervasively to monitor and evaluate clinical, operational, and financial processes. Of course, the IT solutions will not only have to be pervasive, but also flexible enough to accommodate ongoing change.

## The Goals are Clear, the Path is Not

It is not hard to envision the future of digitally-connected healthcare as VBR models become the norm.

- **Sensors, remote monitoring, and remote collaboration tools** will be widely deployed, from home, to office, to hospital.
- **Devices and applications will be interconnected,** and best-practices for diagnosis, care, and operations will be supported by the applications used at each point of engagement.
- **Routine procedures will be automated,** including billing, documentation, and regulatory compliance.
- **Genetic and medical data will be pooled and analytics will be used** to drive continual improvements in the quality and efficiency of both personalized healthcare and population health management.

The move to VBR is clearly shifting in this direction, yet the transition will not happen quickly. A comprehensive solution would require massive IT integration efforts to connect devices and applications, and this would need to be accomplished at a time when regulatory demands are uncertain, consumer expectations are growing, and technology standards for healthcare are still in flux.

A more strategic approach is needed to minimize disruption and maintain profitability as this transition gathers momentum. It must allow organizations to achieve incremental advantages as they move forward, while preserving the value of existing people, equipment, and processes. It must also provide a flexible foundation for addressing changing needs and accommodating future innovation.

## Integrate Data, Not Systems

Focusing on data integration rather than system and application integration offers fundamental advantages for organizations working to navigate this complex transition. Although data integration has its own challenges, it requires integration at just one level of the IT solution stack, so it can be accomplished with lower costs, less disruption, and greater long-term flexibility. It also provides the foundation for three of the most important aspects of connected healthcare: patient-centric data models, decision support systems that provide better information and care guidance at the point of care, and the use of analytics to drive continual improvements in quality and value.

As organizations focus on data integration, they can also begin to lay the groundwork for more complete connectivity at all layers of the IT solution stack by gradually modernizing their applications and infrastructure. Newer software suites that support a broad set of healthcare standards and run on industry-standard servers help to maximize flexibility in complex environments. With this approach, connectivity and data sharing are simplified with each new deployment, and a more flexible foundation is established for integrating future technologies.

Imaging is a natural hub for data consolidation as it tends to be a major profit center in traditional pay-for-service models, but becomes a major cost center in newer, value-based models. Thus it is an area where these efforts can have such a substantial impact on data management, patient care, and overall profitability.

## Imaging: The Natural Hub for Data Integration

Imaging is the gateway to care for many patients, and typically has a major impact on treatment planning. Because of this, it lies at the heart of healthcare data integration and is a natural hub for data consolidation. Diagnostic accuracy depends, in part, on radiologists having access to all relevant patient data in a readily consumable form. Once a diagnosis is made, the quality of downstream care has a similar dependence on the ability of clinicians to access diagnostic information that has been well integrated with other relevant patient data.

Imaging is not only a natural data hub from an information perspective, but also from an IT perspective. Most imaging departments already have massive data repositories. Large hospitals store hundreds of millions of digital images and must expand their storage systems almost continuously to handle growing volumes. Over 400 million procedures a year in the U.S. involved at least one medical image.[1] For a single patient, a lumbar spine magnetic resonance imaging (MRI) exam may generate up to 300 images. In addition, a doctor may need to review prior scans and notes in a patient's electronic medical record before making a diagnosis.[2] Imaging departments are expanding their storage systems almost continuously to keep pace with demands, so existing infrastructure typically provides a scalable foundation that can be leveraged to support more complete data integration.

Consolidating and unifying imaging data is therefore an important step toward improving clinical information flows. Consolidation can help to simplify:

- **Clinical access to imaging information,** both within and beyond the organization.
- **Integration with other data sources,** such as clinical notes, lab reports, and EMRs. Of course, there is nothing simple about integrating these additional data sources. Different data sets tend to exist in silos, and connecting them is difficult, expensive, and prone to synchronization and data quality issues. As will be discussed later in this paper, these issues can often be ameliorated by consolidating access to data, rather than physically consolidating data storage systems (Figure 2).
- **The use of analytics** to aid radiologists and other clinicians, as well as operational and financial teams. Although different data sets can always be analyzed separately, bringing them together enables deeper insights to be gleaned with less effort.

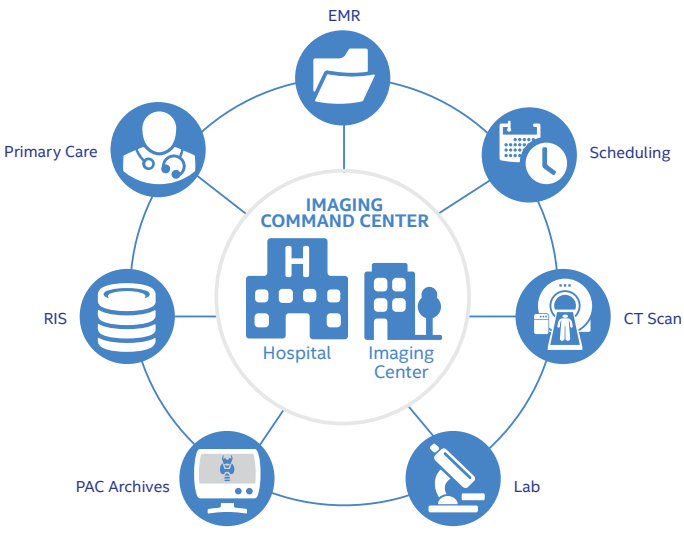


**Figure 2.** Consolidating access to information through data streaming delivers many of the benefits of physical data consolidation, with far less cost, effort, and disruption.

There is another reason to make enterprise imaging the hub of data integration efforts. Imaging tends to be a major profit center in traditional pay-for-service models, but a major cost center in newer, value-based models. Because of this, the shift to alternative models for imaging has a fundamental impact on overall profitability for most healthcare organizations.

Given these issues, it makes good sense to focus data integration efforts on enterprise imaging, an area where these efforts can have such a substantial impact on data management, patient care, and overall profitability.

## Moving Enterprise Imaging into the New Era

### Consolidating Image Storage

Many healthcare organizations have already begun to consolidate their imaging data into Vendor Neutral Archives (VNAs) to simplify sharing and to reduce IT infrastructure and management costs. Two technologies can be used to extend the value of a VNA in situations where physical data consolidation is too complex or costly: Cross Enterprise Reading (XER) and Cross Enterprise Document Sharing (XDS).

XER and XDS provide connections between local and remote storage systems. They also enable queries, so that clinicians can access patient information almost instantly from any connected system. This approach helps to reduce costs and management overhead compared to a storage consolidation project. It also helps organizations avoid the kinds of data quality issues that typically arise during data synchronization projects. For most organizations, a judicious combination of storage consolidation and access consolidation will be the most cost-effective way to achieve their goals.

As organizations begin to consolidate their data, they can also begin to expand their use of analytics. Most imaging departments today focus on metrics such as diagnostic accuracy, radiation exposure, productivity, and reliability. As they move to new payment models, they will need to include additional metrics to simultaneously optimize productivity and outcomes.

Focusing on data integration rather than system and application integration offers a strategy for navigating this transition from fee-for-service to value-based care to more quickly realize many of the benefits of a fully-connected environment, while avoiding the challenges that come with integrating large numbers of devices and applications.

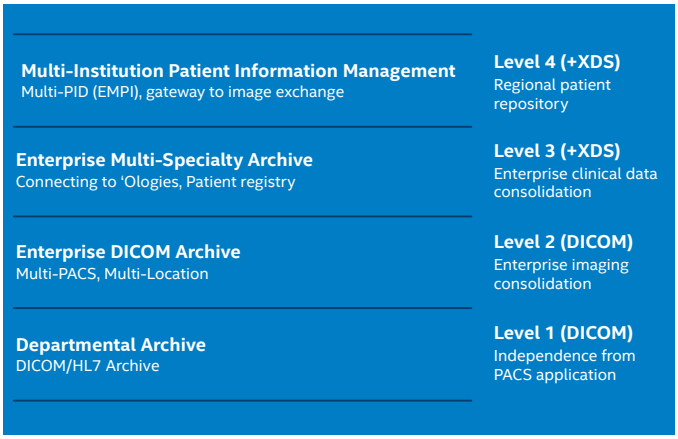


**Figure 3.** A Vendor Neutral Archive (VNA) with Cross Enterprise Reading (XER) and Cross Enterprise Document Sharing (XDS) lays the foundation for efficient, information-wide sharing of patient information.

For example, according to the Canadian Association of Radiologists, as much as 30% of imaging tests can be considered inappropriate or lacking in clinical value.[3] Identifying such tests and reducing their numbers can provide significant cost savings. Linking imaging decisions to other variables, such as patient outcomes, the length of hospital stays, and overall spending per patient can provide similar benefits. With a consolidated environment for patient data, the use of analytics to illuminate these and other issues can be gradually expanded.

## Universal Viewing

(The following descriptions are based on GE Healthcare's Centricity Universal Viewer. Not all features and functionality will be supported in other universal viewing solutions.)

The value of consolidated data can be enhanced by implementing a universal viewing solution with data integration capabilities (Figure 4). Most radiologists currently deal with multiple IT systems (PACS, RIS, EMR, etc.), all of which must be accessed using different workstations and different interfaces. This diversity is inherently inefficient, typically resulting in high infrastructure costs, complex workflows, incomplete information, and redundant imaging. Studies show that radiologists typically spend as much as 19% of their time navigating among multiple workstations,[4] so it also has a direct impact on productivity.

Universal viewing can help organizations improve quality and efficiency in their imaging departments, while also making it easier to share information with other departments and facilities (see the sidebar on page 5, "St. Luke's University Health Network"). Depending on the solution and implementation, a universal viewing solution can provide:

- **A single resource for image analysis and reporting** across all imaging modalities, so radiologists and other imaging specialists can work from a single desktop using consistent tools and interfaces. This uniformity helps to improve productivity and collaboration. It can also help organizations move toward the use of structured reports that help to promote higher quality and greater consistency (studies have shown that roughly 20% of radiology reports contain errors or are confusing[5]).
- **Complete patient information** including remote studies, surgical notes, pathology reports, lab data, clinical notes, light images, and EMRs. Advanced patient matching algorithms can be used to streamline access to information in remote storage systems that use alternative patient identifiers. This quick access to current and historical patient information can help to improve diagnostic accuracy, while reducing the volume of duplicate and inappropriate studies. Support for image-enabled EMRs can help extend these benefits to downstream clinicians.

**Figure 4.** A universal viewing solution allows radiologists and other clinicians to access all critical patient information from a single desktop, using unified tools and interfaces.

IMAGING TRANSFORMATION IN ACTION:

### St. Luke's University Health Network

With seven hospitals, multiple outpatient centers, and more than 200 affiliated cites, image and information sharing has been a historically cumbersome process at St. Luke's.

To address this challenge, the organization recently deployed Centricity Clinical Archive and Universal Viewer deployed on Intel® Xeon® processor-based servers to streamline access to priors and to unify imaging across the radiology and cardiology departments. St. Luke's roadmap now includes image-enabling their EHR and health information exchange (HIE) to provide universal access to images across their entire network.

**TO LEARN MORE**, read the Frost & Sullivan Enterprise Imaging White Paper at http://www.bitpipe.com/detail/RES/1489005127_208.html

- **Advanced visualization tools for CT, MR, cardiology, oncology, mammography, and other specialties.** A common platform eliminates the need for multiple imaging systems that must be managed, maintained, and upgraded. It also simplifies training and cross-modality collaboration and shortens diagnostic times.
- **Web-based access.** Images, reports, and tools can be securely accessed using any Internet-connected device. This is good for radiologist productivity. It also makes it easier for referring physicians and care teams to access images and reports. This will become increasingly important as VBR models create greater competition among healthcare providers. As imaging organizations compete for customers, it will be essential to provide a good experience for every authorized user, including radiologists, specialists, referring physicians, and other members of the patient centric care team.

As a primary point of engagement for radiologists, a universal viewing solution also provides an opportunity for improving the viewing experience. Valuable capabilities include the following.

- **Workflow management** solutions simplify the coordination of workloads across multiple radiologists and locations. A well-designed solution can improve organizational efficiency by balancing and prioritizing caseloads, and by helping to ensure that time-critical cases get to the right physician in a timely manner.

Focusing on data integration rather than system and application integration can be accomplished with lower costs, less disruption, and greater long-term flexibility.

- **Image preprocessing and setup** helps radiologists focus more quickly on the most relevant information. As an example, Centricity Universal Viewer includes a feature called Smart Reading Protocols, which uses advanced machine learning to automate the creation of customized hanging protocols based on study types and individual preferences. There is no need to establish complex set-up rules. This embedded intelligence helps the organization move toward best-practices, while still accommodating the preferences of individual radiologists.
- **Adaptive Streaming Engine** enables the viewing application to adjust automatically to the speed and quality of network communications. Since this technology works by streaming data for viewing rather than by replicating images, it eliminates the wait times associated with full image transfers. It also helps to preserve security, privacy, and data integrity, since images are never moved or replicated.

All of the above capabilities are valuable for improving productivity and reducing the time from image to report. The viewing platform should also be designed so that the latest advances in visualization technology from the manufacturer—as well as from third parties and the academic care community at large—can be integrated quickly and without disruption to existing operations. The overall performance and reliability of the underlying hardware and software platform is also critical to ensure the best radiology experience. (See the sidebar on page 6, "When Every Second Matters.")

## Artificial Intelligence

Consolidated data and universal viewing offer substantial benefits today, but the best is yet to come. Artificial intelligence (AI) is emerging as a valuable support tool in healthcare environments, and algorithms are in development across many disciplines (see the sidebar on page 7, "Artificial Intelligence and the Future of Healthcare").

Data, and lots of it, is the fuel that drives effective AI. By consolidating connectivity and access to images, documents, and other data types, organizations can provide a better foundation for effective AI. Universal viewing can help by providing a more unified environment for accessing AI-driven decision-support tools across care teams and specialties.

Although predicting technology evolution is never certain, one thing already seems clear about AI: ignoring emerging solutions would be a serious mistake, especially given their early success in image analysis. Integrating AI into existing workflows has the potential to help radiologists manage and prioritize their workloads more effectively to achieve desired outcomes. It will also help them handle the growing torrent of patient data, whether it comes from 3D imaging studies or real-time sensor data.

Over time, AI algorithms will evolve alongside other data analytics solutions to assist clinicians across all disciplines deliver better care faster and at lower cost.

- **Current and historical information** will be filtered, aggregated, and presented in easily consumable formats targeting the specific requirements at each point of engagement.
- **Alerts** will identify issues and information that might otherwise be overlooked.
- **Decision support systems** will help clinicians make better choices based on the latest medical research and best practices within the context of each individual case.
- **Many common procedures will be automated,** relieving some of the load on overworked clinicians and freeing them to focus on the critical issues that require their specialized expertise.

With consolidated healthcare data, unified tools, and increasingly sophisticated analytics, healthcare will be on a track toward levels of quality and efficiency we cannot imagine today. Ultimately, this will be positive for all involved, leading to healthier patients, healthier organizations, and a healthier industry.



The long-term goal is clear—Organizations need to integrate their devices, applications, and data so that clinicians and administrators have the right information at the right time to deliver the best possible outcomes at the lowest possible cost.

## Getting Started

The Center for Medicare & Medicaid Services has been clear in its intent to move payment models away from fee for service, and many healthcare organizations are already beginning to prepare for the inevitable transition to VBR. As you organize to address these reforms, careful planning can help you establish a flexible foundation that supports a simultaneous transition toward more efficient, standardized care strategies that help to improve quality, outcomes, and patient satisfaction.

During the transition, your systems will have to handle a variety of payment models while also managing risk and improving efficiency. A good way to begin your move is to evaluate the readiness of your organization from both a systems and cultural perspective, including the following.

- **Assess how your organization uses data to drive action.** Questions to explore include: Are you providing access to key information? Are you making investments in data and technology to support upcoming regulatory and reimbursement models? How can you help different areas of your organization progress from being "data blind" and reacting on instincts to leveraging retrospective data through dashboards, and, ultimately, using analytics to anticipate and react to potential problems?
- **Assess the cost of delivering care.** What barriers prevent your organization from establishing sufficient transparency and financial incentives to lower the cost of care? Do you have systems in place to evaluate the post-discharge period and reduce readmission rates? Are parts of your organization taking a wait-and-see approach to payment transformation? Or, are they looking to actively drive down costs and improve integration?
- **Begin the move toward predictive analytics.** Once you have begun the transition toward new reimbursement models, the cost savings from your initial efficiency improvements can be used to invest in tools, such as predictive analytics, which enable more informed decision making. Analytics solutions are evolving quickly, and it will be important to monitor technology progress and vendor roadmaps so that new solutions can be integrated with as little cost and disruption as possible.

## Artificial Intelligence (AI) and the Future of Healthcare

Increased computational power and advanced data science techniques are creating new opportunities to introduce artificial intelligence (AI) into healthcare. Diagnostic imaging—including radiology, cardiology, pathology, and dermatology—are at the front of the queue.

AI algorithms can comb through massive amounts of imaging, textual, and genomic data to quickly deliver cutting-edge decision support and, in some cases, care recommendations. But will they ever replace radiologists and other imaging-based clinical specialists?

A more likely scenario is that AI algorithms will become powerful assistants that enable unprecedented leaps in clinical productivity and diagnostic confidence for human specialists. Globally, the opportunities are incredible, especially in areas where resources are limited.

GE Healthcare and Intel are working to turn this vision into reality. For example, both companies are working with University of California San Francisco's Center for Digital Health Innovation to develop a library of deep learning algorithms. The initial goal is to improve clinical outcomes by accelerating differential diagnosis in acute situations.

GE Healthcare and Intel also provide an ideal foundation for AI-enabled healthcare applications. GE Healthcare Centricity software is highly optimized for Intel® Xeon® processors, which currently support roughly 97% of AI workloads around the world.[6] This can help to simplify the integration of deep learning algorithms as they emerge, without requiring hospital IT staff to perform complex integration efforts.

This is just the beginning. AI will ultimately help transform outcomes, and Intel expects to deliver a 100X improvement in deep learning performance by 2020 with the Intel® Nervana™ Platform. By working closely together, GE Healthcare and Intel will provide a simpler road toward non-disruptive adoption of these powerful new capabilities.

By consolidating connectivity and access to images, documents, and other data types, organizations can provide a better foundation for effective AI by providing a more unified environment for accessing AI-driven decision-support tools across care teams and specialties.

As imaging service grow beyond departmental silos in a competitive VBR-driven marketplace, it will be important to make it more accountable to other departments and organizations, and to referring affiliates and payers.

There are additional challenges you may want to explore with respect to medical imaging. As imaging grows beyond departmental silos into a multi-departmental, enterprise-wide resource, you will need to adopt a more information-driven and consultative approach. It will be important to make imaging more accountable to other departments and organizations, and to referring affiliates and payers, so your imaging services are competitive in a VBR-driven marketplace.

Technology will be important during the transition to value based reimbursement. Many organizations have already moved to upgrade or replace their last generation imaging viewers and supporting archive systems. Today's systems provide many new capabilities, such as digital workflows, enterprise search, EMR records integration, cloud-based collaboration, and AI-based productivity and decision support tools. These capabilities enable significant productivity gains within the imaging function, while also supporting improved collaboration across departments, disciplines, and facilities.

Perhaps even more importantly, the latest generation systems are designed to connect easily with the many other 'pools of information' that exist both within and beyond the organization. This integration will be increasingly important to provide an accurate 360-degree view of each patient in a timely and efficient manner. With better tools and information, radiologists can become more effective and imaging organizations can adapt and thrive as payment models evolve.

## Conclusion

With all the uncertainty surrounding the healthcare industry today, certain things remain clear. Strategic improvements in quality, efficiency, and transparency will help organizations deliver better care and compete more effectively both now and in the future. Modernizing enterprise imaging can help to improve the overall flow of information in today's complex healthcare networks. It can also help to establish the consolidated data foundation needed for the efficient use of emerging AI solutions and other data analytics tools.

GE Healthcare has partnered and worked with dozens of healthcare networks around the world to assist with consolidating imaging data, integrating other data sources, and streamlining local and remote access using Centricity Solutions for Enterprise Imaging. GE Healthcare also works closely with Intel to make sure the next generation solutions are designed from the ground up to provide the performance and reliability needed for life-critical applications, and the scalability and flexibility needed to support constantly increasing requirements. By partnering with GE Healthcare, you gain the backing of two industry leaders who have built an open platform that can help you move forward with greater confidence.

## Learn More

**GE Digital Healthcare:**
http://www3.gehealthcare.com/en/products/categories/healthcare_it/medical_imaging_informatics_-_ris-pacs-cvis

**Intel in Healthcare:**
https://www-ssl.intel.com/content/www/us/en/healthcare-it/healthcare-overview.html

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[2] Source: "Partners HealthCare and GE Healthcare Launch 10-year Collaboration on Artificial Intelligence," Imaging Technology News (itn), May 17, 2017. https://www.itnonline.com/content/partners-healthcare-and-ge-healthcare-launch-10-year-collaboration-artificial-intelligence.

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[5] Source: "Medicare Claims Show Overuse for CT Scanning," by Walt Bogdanich and Jo Craven McGinty, The New York Times, June 17, 2011.

[6] Source: Intel.



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