

Digital Cohesion

The Era Beyond Disruption

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Executive Summary

Imagine a 50-year old diabetic man watching TV at home when he hears a knock on his door. It's a home healthcare professional, alerting him that he will soon experience a diabetic coma if action is not taken immediately.

The man has a wearable device on his wrist that regularly and automatically measures his heartbeat, sugar level, and blood pressure. It's connected with home sensors and with a medical service that tracks analytics, monitors the IoT sensors, fitness levels, food eaten and uses machine learning, automation and more to continually assess the health of its patients—and to take action when needed.

This scenario is closer than you may think. It will be enabled by a term called *Digital Cohesion*, an era in which multiple applications self-assemble to provide autonomous and predictive services that continually adapt to personal behaviors. These services will automate the mundane, anticipate needs, enable better decisions, and enhance our personal and business lives.

To be useful these services will need to be fast (instantaneous) with access to large amounts of knowledge including incorporating all of the sensor data around them. Moving large amounts of information quickly and securely to and within the cloud will be critical and the key competitive differentiator in this new era. It will put tremendous pressure on networking technologies with new approaches needed for automation, security, interoperability and performance. The good news is that adopting these new technologies not only paves the way to the future but many progressive service providers and enterprises that are now deploying one or more of these approaches are seeing substantial benefits today.

Trends show Digital Cohesion is coming fast and that users will adopt quickly and ask for more. Although there are still some hurdles to overcome, most of the technologies to make it happen exist today with the rest being planned. Those service providers and enterprises who embrace this vision will quickly be in a unique and enviable position in their industries.

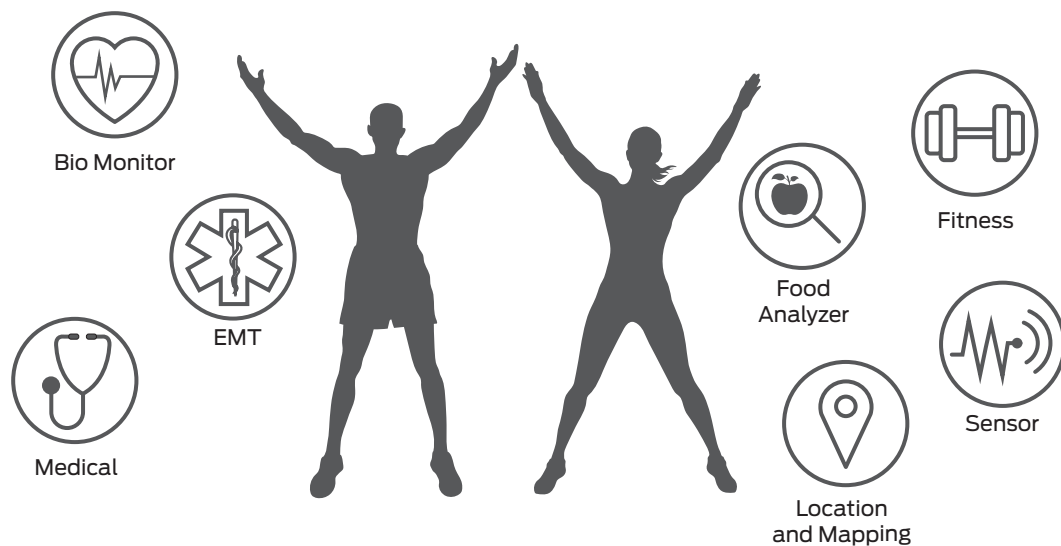


Figure 1: A Healthier You

Digital Disruption

The pace of disruption has never been greater. New entrants are removing customer pain points and gaining market share faster than ever before. Names such as Airbnb, Uber, Bitcoin, and Netflix have upset business models seemingly overnight. They asked questions unimaginable just a few years ago:

- Why does a hotel company need to own properties?
- Why do ride-hailing companies need to own cars or employ drivers?
- Do we really need physical money anymore?

Without capital constraints, these companies have expanded rapidly and concentrated their work on continuously improving the customer experience by turning the business model on its head, adapting it more and more to how customers behave and enabling it with technology. The effect on incumbent companies has been earth shattering.

Uber hit their two billionth trip in June 2016, and a recent report revealed that taxi ridership for business users has plummeted 51 percent in the U.S. since 2014. Even car rentals have decreased (Source: Certify). Uber now has a valuation greater than that of companies that make the cars its drivers use (GM, Honda and Ford).

Today: Digital Disruption in All Industries

Business Models Adapt to People

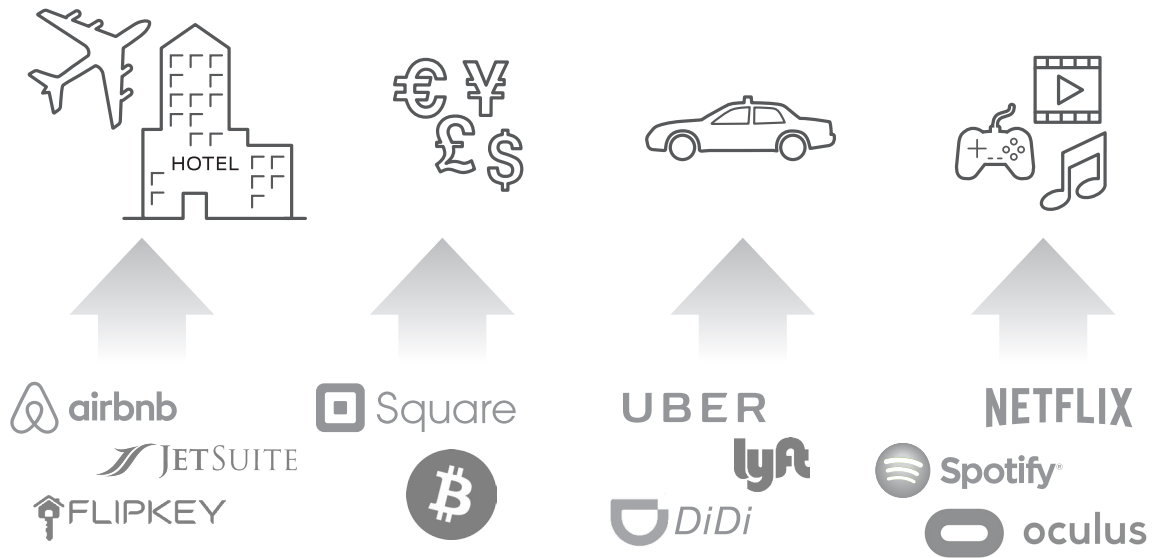


Figure 2 - Digital Cohesion

Airbnb has a valuation of over \$20B which now exceeds global hotel chains like Hyatt and Hotels are losing \$450M in direct revenues per year to them. And here is the frightening fact for the incumbents—the Airbnb platform has near-zero marginal cost. A new room can be incrementally added to (or removed from) the platform with negligible overhead. Because of this, Airbnb can scale supply in a near-frictionless manner to meet demand, even on short timelines. By contrast, increasing hotel room supply involves buildout, causing significant marginal costs for hotel chains.

It is an old lesson that is being replayed in the modern world: provide a product or service that offers much higher benefits at a lower cost and you will gain market share quickly. This is especially true in a world where news spreads within minutes and people are adapting to new ways of doing things faster than ever.

Moving Forward – Forces will Accelerate

While disruptive companies have excelled by changing age-old business models to upend industries, we see four new forces that will create a new era of possibilities:

1. User Expectation

Our time-to-adoption of new business models and ways of doing things is shortening. And our expectations of value are quickly rising. Even a few years ago, who would have thought that people would so easily accept rides in unmarked cars with strangers. Yet to date, over a billion people have done it. Why? Because the value is so much greater than what had previously been available. Also, beyond cost and time, the experience itself—especially the ease with which the transaction is done—is superior. The bar is now set higher. There is no going back.

2. Competitive Pressure

As all companies adopt user-centered business models and services, competition will shift to the “experience” and how tightly integrated it is with consumer and business behaviors. And we live in a time where five people and a great idea can create a revolutionary product or service that creates a better experience—disrupting multi-billion dollar companies and industries.

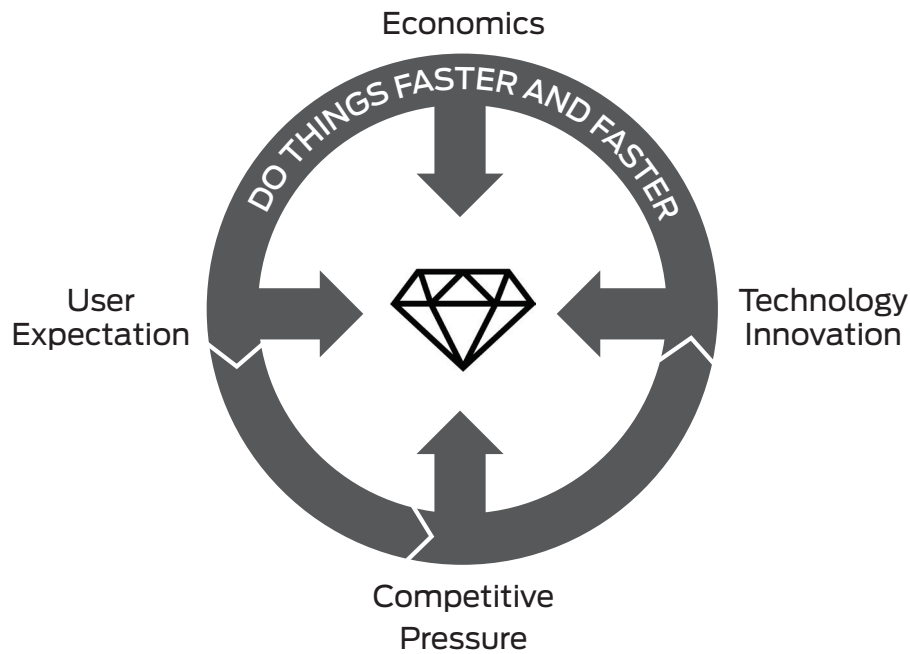


Figure 3 - Forces Leading to Next Era

3. Technology Innovation

Technology is the key reason these small teams have the ability to disrupt established businesses. It has leveled the playing field. The cloud has given everybody access to unlimited compute and storage power—cost effectively and on demand. And everybody has a common and effective path to get to their desired market through the ultimate portable human companion—the smartphone. Many startups that failed in the 2001 dot.com bust, failed not because the idea was flawed but because they didn't have the enormous market access that the smartphone provides today. In addition, the Internet of Things is rapidly expanding and fueling faster, smaller, cheaper and continually connected devices. With the ability to manipulate huge amounts of data in near real-time, companies can now quickly derive knowledge and insights to accelerate decision-making, and outflank competitors.

4. Economics

The economics of industries will continue to be challenged. Not only where profits (if any) will be found but what the core competitive factors are. Same-day delivery of goods ordered online (Amazon), global communication for free (whatsapp), real-time translation (Google)—these are just a handful of dramatic new capabilities that are transforming markets. Think what will happen to the auto, insurance, and repair companies when driverless/ownerless cars arrive in the next few years. Simply stated, the ability to provide the same value at a better price, or more value at the same price, has always been and will continue to be one of the greatest motivators for continued progress and innovation.

The New Era of Digital Cohesion

As users grow accustomed to this simplicity of use, they will demand that technology adapt even more to their behavior. In the past we have been very good at adapting our minds and bodies to the tools and technologies presented to us. Numerous studies show that we are adopting newer technologies faster than ever before. In the future when technologies progress to automatically and continually adapt themselves to us (at a faster and faster rate)—then, the technology will “disappear” into the background of all we do.

Digital Cohesion

“A future in which applications connect and self-assemble to deliver compelling mega-services that enhance our lives.”

How is Digital Cohesion Different?

Digital Cohesion will usher in an era of substantial change in the way we interact with technology:

1. From learning curve to natural interface

Whenever new technology is introduced to a population, people have to learn how to use it. Automobiles still have a learning curve. Potential drivers need to learn the controls and then pass a test to prove their understanding. Smartphones and tablets are more intuitive but still require time for the user to learn and adapt their behavior to the device. With Digital Cohesion the learning curve is eliminated. There will be no instructions because they will not be needed since the technology will mold itself to the users' natural behavior. The user will instantly be able to use the device or service to its full capability.

2. From user initiated to autonomous

Today when someone wishes to pull up a map, summon a ride-share, or order food, among other tasks, they typically start the process by pulling out their phone and using an application. In the future services will act autonomously, and deploy based on situation, need, location, and feedback from other services or devices. People will not have to summon services, they will appear and serve when needed. This will enable a more frictionless and enjoyable experience.

3. From repeatable tasks to adaptive and predictive services

Hand in hand with the autonomous actions taken by these services are their ability to not just do repetitive tasks but learn, adapt and ultimately predict needs. The service will quickly learn habits and preferences. It will tailor itself specifically to the individual and continuously adapt. The more time spent with the person, the more the service is personalized. Based on the data gathered from the variables surrounding a given situation and data from similar scenarios elsewhere it will start to predict what is needed even before the person does.

4. From many individual services to mega services

Today people have many services resident on their devices. One for driving directions, one for ordering food, one for hailing a ride, one for reserving a hotel room. Each with its own interface, payment method, login etc. In the Digital Cohesion era, many of these services will be offered as a bundle with one interface, login, payment and tight integration that makes them all work seamlessly together. Rather than a one function service, "lifestyle" services will become popular.

5. From negotiated interoperability to open interfaces

Devices from different companies work together only because each company got both of their engineering teams in one room to work out how to make the equipment or services talk to each other. To participate in the Digital Cohesion world—open application programming interfaces (APIs) and interoperability will be table stakes otherwise service companies will not survive.

6. From low trust to high trust

Services today handle highly sensitive information. With the future proliferation of devices, more security vulnerabilities will appear. To gain user adoption of Digital Cohesion a higher trust level must be achieved through new security approaches.

Although it may not feel like it now, when we look back at the Digital Disruption era 10 years from now, we will reflect on it as merely evolutionary change on the path to a true melding of technology and human behavior—Digital Cohesion.

Digital Cohesion in the Real World

There is no limit to the scenarios one can think of where Digital Cohesion will have an impact both personally and on the industry itself.

A Healthier You

The World Health Organization predicts that [chronic diseases will account for almost three-quarters of all deaths worldwide by 2020](#). Related to diet and nutrition, these diseases include obesity, diabetes, cardiovascular, cancer, osteoporosis and dental. There are 400 million diabetics. By 2050, one in three people will be diabetic.

As we briefly described in the beginning of this White Paper, Digital Cohesion will bring more help to patients wherever they are and will offer potentially life-saving service. A diabetic individual will be able to put on a wearable health device that is wirelessly connected to their home sensors and sign up with a personal medical service. By monitoring the patient's vital signs remotely and automatically, and matching them with food the person ate that day, with his medical history, and information of conditions in the home (heat, humidity, etc.), the service will be able to predict if a patient will experience a diabetic coma—and take action, if necessary

A little further into the future, a M-Health Service (Mobile diagnostics, bio-feedback and personal monitoring) will monitor diet and health in real-time. DNA profiling and frequent sampling will lead to early detection and personalized genetic medicine that will prevent disease, saving lives and billions of dollars in healthcare and lost productivity.

The Agile Enterprise

Decision making around major initiatives in an enterprise takes an enormous amount of time and money. People form committees, conduct research, consult with consultants—meanwhile start-ups and more progressive companies are out-maneuvering these traditional enterprises.

In the Digital Cohesion world, services that understand the goals, financials, and culture of a company will be able to connect with a best-practices service which collects and analyzes data derived from thousands of companies in similar situations. These services will then take into account other variables (economic, competitive, customer behavior, societal, and more) and then communicate with a decision service which, through probability analysis and deep learning, determines the best paths forward.

Finally, this mega service then sends this to a presentation services that puts all of the data, analysis and proposal into an executive level presentation. Possible scenarios are presented within minutes instead of months. Your company becomes as agile as your potential disrupters, making better decisions faster.

What's for Dinner?

Each day around 5pm, do you get a phone call or text from a partner, friend, or spouse asking that same age-old question: what's for dinner? Not only is it frustrating, it also takes time out of your day—thinking, gaining consensus, shopping and preparing.

What if you never had to answer that question? In the era of Digital Cohesion, each day your family's fitness/bio monitoring service combines with your medical, food analysis, refrigerator inventory and food supply services to order the delivery of food according to your family's preferences, fitness goals, allergies and medical restrictions. It will put recommended recipes on the kitchen screen when the service determines you are in the mood to cook. Otherwise, it will order your restaurant meal for eat-out or delivery for eat-in according to your habits.

Of course you do not need to do anything and no devices or wallets need to be brought out to make this happen. The services know what you like to eat, have eaten, can eat and when you are most likely to go out and eat (busy schedule, weekends?). By using a little machine learning, it will "suggest" new kinds of food and restaurants based on your habits (what food went untouched in the fridge or was left uneaten at the restaurant) and what other people like you have chosen (a la Netflix).

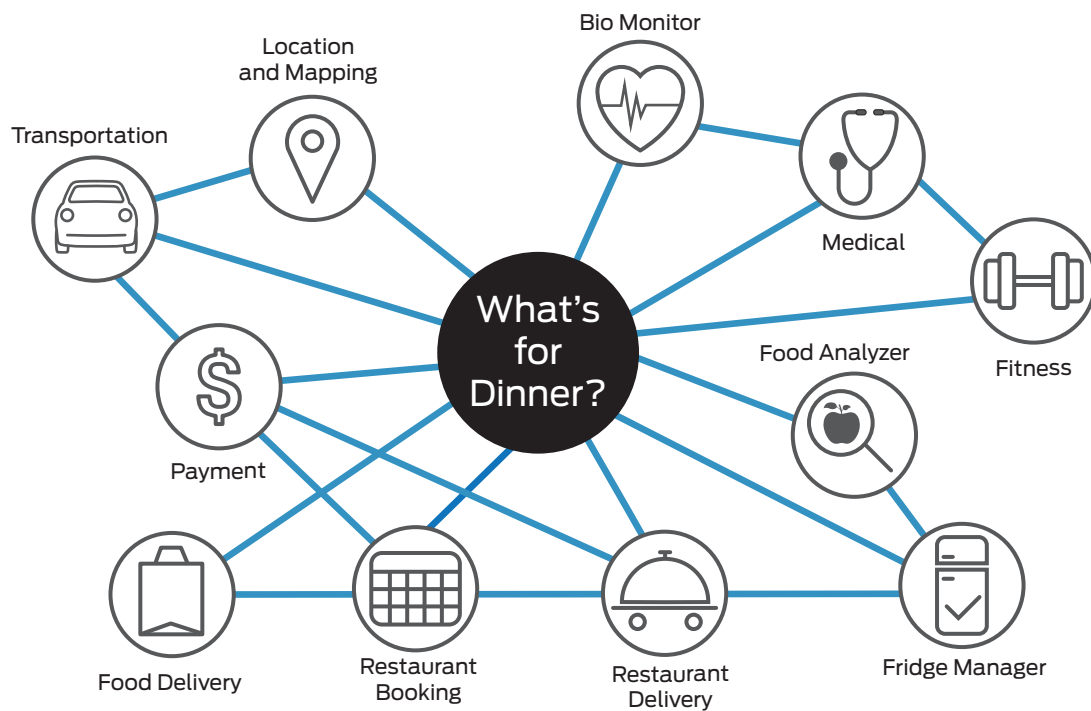


Figure 4 - What's for Dinner Services

All of the individual services to make this happen exist today. So why don't we have this "Dinner Service" today? First, on the business side, no one has yet stepped up to negotiate the partnerships including revenue split, branding, ownership of customer data etc. but you can be sure that the larger players as well as perhaps a company that we don't even know about today is seriously looking at least bundling services with the intent to integrate as described here. Second, on the technology side, security, interoperability and performance issues need to be worked out and will be further explored later in this paper.

The Experiential Learner

Imagine while visiting a market with their parents a child uses augmented reality glasses to play a game where the object is to spend \$50 and buy a balanced meal for their family. Or while walking through a city, the person is getting history lessons with video of the historical characters overlaying the real life scene. Looking up at the Lincoln Memorial they see and hear Martin Luther King Jr. giving his "I Have a Dream" speech. Or, while in Italy "seeing" the gladiators compete in the Roman Colosseum. Even today we have applications such as Skywalk that augment a person's viewing of the stars in real-time.

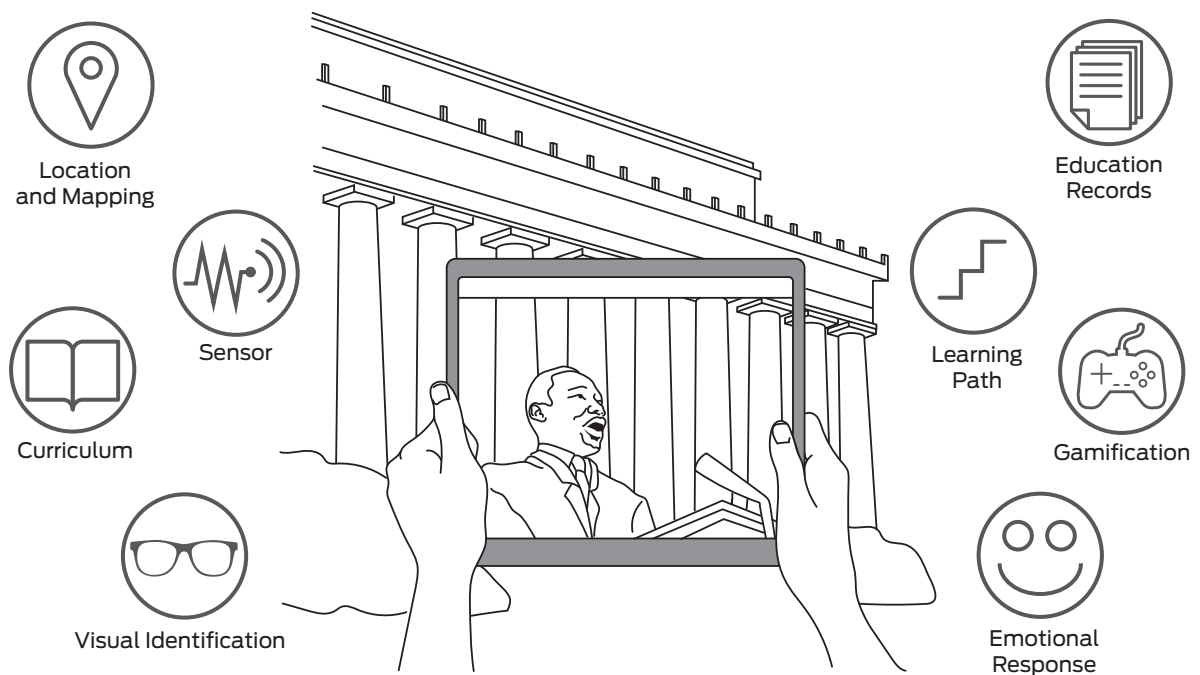


Figure 5 - The Experiential Learner

In the Digital Cohesion era, schools will no longer be the main learning vehicle; the child's own life will be. Augmented reality technology combined with visual recognition, sensors and learning services will present people with real life "classes" that present math, history, language and other lessons in real-time based on their current location and context.

Ecosystem to Enable Digital Cohesion

There are many elements that need to come together to bring Digital Cohesion to reality. From industry alliances and government regulations to artificial intelligence and the technology in between like compute and storage.

Business

With the technology for Digital Cohesion being rapidly developed, there are many business elements that need to be resolved. If a user subscribes to a mega service, how will revenue be shared among many services? Will pre-existing contracts be in place or for spontaneous one-time use will industry standard engagement policies be used? Which brands will be showcased. Who will become the "Lifestyle Service Provider"? A brand we already know or someone new? Will mega providers contract with well-known services that specialize in transportation, food or entertainment or create their own in-house? With so much at stake including privacy there is no doubt the government will be involved regulating how services share information, how and where it is stored and they will certainly be watching for potential monopolies.

Technology

On the technology side, although there are many things that still need work, there are some things that are a given:

The emergence of the Internet of Things. Over 35 billion devices are forecasted to be connected to the internet by 2020. These will range from tiny, low powered devices embedded in building materials to medical devices small enough to be implanted in your body. They will also include devices that monitor industrial equipment, pollution levels and illegal deforestation. In the Digital Cohesion era these devices will provide the data on context, position, bio-feedback, home/office device status etc. to provide the services depicted in the scenarios we just described.

The Proteus ingestible pill sensor is powered by contact with your stomach fluid and communicates a signal that determines the timing of when you took your meds and the identity of the pill. This information is transferred to a patch worn on the skin to be logged for you and your doctor's reference. Heart rate, body position and activity can also be detected.

A jet engine in a Boeing 737 has 30 to 50 sensors on it. These sensors take multiple readings on a continuous basis—fuel efficiency, wear of the blade, heat of the engine, altitude, and more. Airlines can use that data, make minor adjustments and improve their fuel performance or have planes take off differently from specific airports to get more cycles on the aircraft before maintenance is needed. It may be boring but it saves tens of millions of dollars.

Connectivity. The devices and people that interact with the Internet of Things need a ubiquitous and continuous connection to the internet or what some people are calling the “Universal Network.” Bandwidth is increasing and it's cost decreasing worldwide at rapid rates with global fixed broadband speed expected to double to 48Mbps. Put Wi-Fi and the coming 5G technologies together with some pioneering connectivity schemes for less populated areas of the world and this “Universal Network” is becoming a reality sooner than later. Many countries from France to Costa Rica have declared access to the internet a basic human right.

Big and Fast Data + Analytics + Machine Learning + AI. Once connected, these billions of devices will be producing huge amounts of data. It is forecasted that by 2020, global IP traffic will reach 2.3 zettabytes per year, more than double what we have today. And companies or service providers will need to consumer, analyze, and manipulate these data almost real-time to produce knowledge that drives the services we described.

So we have billions of devices generating massive amounts of data that needs to be moved faster than ever before to meet user's rising expectations. The basic building blocks of compute, storage and networking will come under pressure but networking in particular will become critical and need new approaches to some basic design elements.

Barriers to Digital Cohesion

The barriers to innovation in compute, storage and networking are growing—might be fair to say, they've never been this high. Fundamental laws that have predicted past progress, have come to an end. Economics that have fueled past progress are breaking down. We have work to do. Especially given that there has never in the past been, is not today, and will never in the future be a limit to our ability to consume the three building blocks of compute, storage, and networking.



Figure 6 - Barriers to Digital Cohesion


Economics

Next, let's talk about economics. Innovation requires resources. How do we innovate if 90% of what we do in IT today is wrapped up in just keeping the lights on? In maintaining status quo? To free up capacity to innovate, you need to replace old work with new work. The answer lies in automation. Digital Cohesion will require that service providers and enterprises provision numerous services instantly to create a Digital Cohesion customer experience. It will not be humanly possible to keep up with this demand manually. It's not just a hardware cost issue, companies are spending 2-3x on OPEX than CAPEX so even if they got the equipment for free they would still have a problem.

There is a solution Why not apply compute to manage the infrastructure through automation? Automation is the only way to instantaneously anticipate and provision services to individual users based on their context and needs. It also benefits the provider, their staff and the end-users. For the provider of the services, automation enables a much more reliable and agile network with auto provisioning, smart auto-bandwidth and fast resolution (and prevention) of security issues. The providers staff are freed up from doing tedious tasks and enabling them to focus on higher-level, strategic activities. Finally, end-users enjoy a higher service level and requested new services are delivered in seconds not weeks. At Juniper, we call this a Self-Driving Network™.

“Less than 30 percent of business's daily tasks have been automated. 80 percent of businesses experience network errors an average of more than six times per month, caused by human fault”

Source: [Four Ways to Automate Your Network Right Now, Juniper Networks](#)

- Telemetry
 - Big data analytics
 - Machine learning
- 
- Predictive and adaptive networks
 - Efficient networks

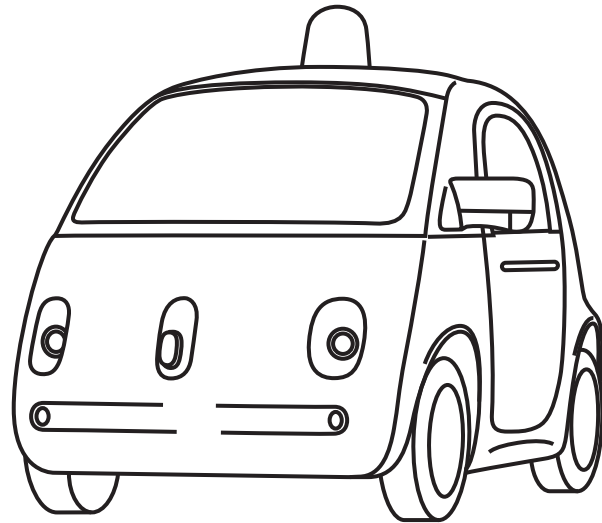


Figure 7 - Self-Driving Network™

Trust

Digital Cohesion will require a level of trust we've never seen before. The growth of the Internet of Things, service interacting with each other and the new level of personal data being exchanged will require new approaches to security to ensure adoption and growth of using these new mega services. That together with diversity of malicious actors and threats continue to grow at an alarming rate, in fact the ability of attackers is starting to outpace the ability to defend. Today's security model does not provide the security and resultant trust level required for the future. A new way of thinking about securing the network is needed.

First, one cannot just rely on the places in the network where the firewalls happen to be in order to detect and stop attacks. Every network element must participate in enhancing the security posture of a network. Every network element must provide insight into traffic patterns and every network element should be able to block attacks.

Second, this will mean security policies that are dynamic and software-based with a view and enforcement across the whole network.

Third, unknown threats need to be turned into known threats and companies need to work together through “collaborative threat protection”—pooling threat intelligence globally, companies will be able to protect themselves from attacks before they happen automatically and certainly contain attacks much faster.

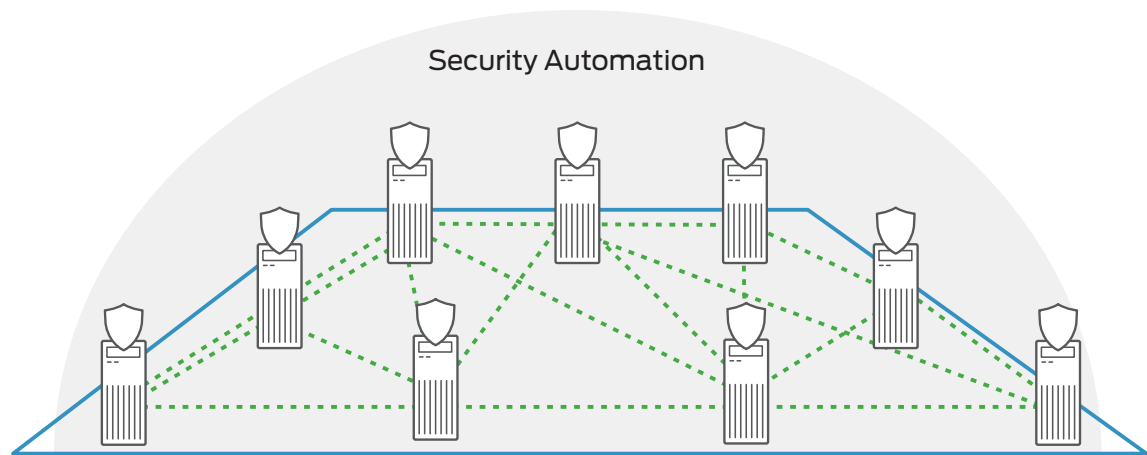


Figure 8 - Software-Defined Secure Networks

And finally we'll need to go beyond security specialists and train everyone else to think "security" in everything that they do. The next generation of network practitioners will need to help enforce consistent policy through automated processes; a systematic approach for a world of digital cohesion.

This vision is called the "Software-Defined Secure Network" and will enable the trust level for wide spread adoption of Digital Cohesion.

Interoperability

In our examples, individual services that have never been used previously may be called upon to communicate with other services to complete the "task." No longer will unopen or proprietary stacks of elements survive in a world where interactions will be instantaneous and spontaneous. This means openness at every layer in the stack. The industry has proven that this is possible—without agreement on the IP protocol, the internet would not exist. This needs to be extended to the application layer and to the networking layers below to ensure interoperability and performance.

Disaggregation will also be important. Companies should not be locked into a proprietary stack of software and hardware. To provide the most agile and highest performing network, software and hardware need to be open so that they can be mixed to optimize for "best-for-need" solutions based on data and application requirements for Digital Cohesion service delivery. This also provides investment protection so providers do not need to worry about what is coming 18-24 months and can invest confidently in equipment now knowing that they modify the components as needed in the future.

A common language is required across the networking elements to not only ensure they work together but to provide common tools and management even when routers, switches and security equipment is updated.

Performance

Performance is one of the key challenges to how fast the era of Digital Cohesion will arrive. A huge issue to overcome is that Moore's Law the prediction that has fueled technology growth for decades has ended. The 18-month cycle of doubling transistor density slowed in 1999 to 24 months. Now it is at 36 months. Getting to 10nm on a production processor is proving difficult and expensive. So much so that providing the processors for the compute power needed at the end user level for Digital Cohesion is almost impossible. Meanwhile users, devices and internet traffic is increasing exponentially.

Therefore, it will become critical that compute and storage move to the cloud where compute for applications analytics, AI and service creation/delivery can happen at scale and provide virtually unlimited compute and storage capacity for the end-user. This means that the connection or network between the end-user and the cloud as well as the network between the clouds becomes the possible bottleneck to the performance that is required. Low latency will become a competitive differentiator as end users demand instantaneous response and service in the Digital Cohesion world. Networking design and performance to, from and in the cloud will become the number one design criteria (before compute and storage) for IT departments in service providers and enterprises.

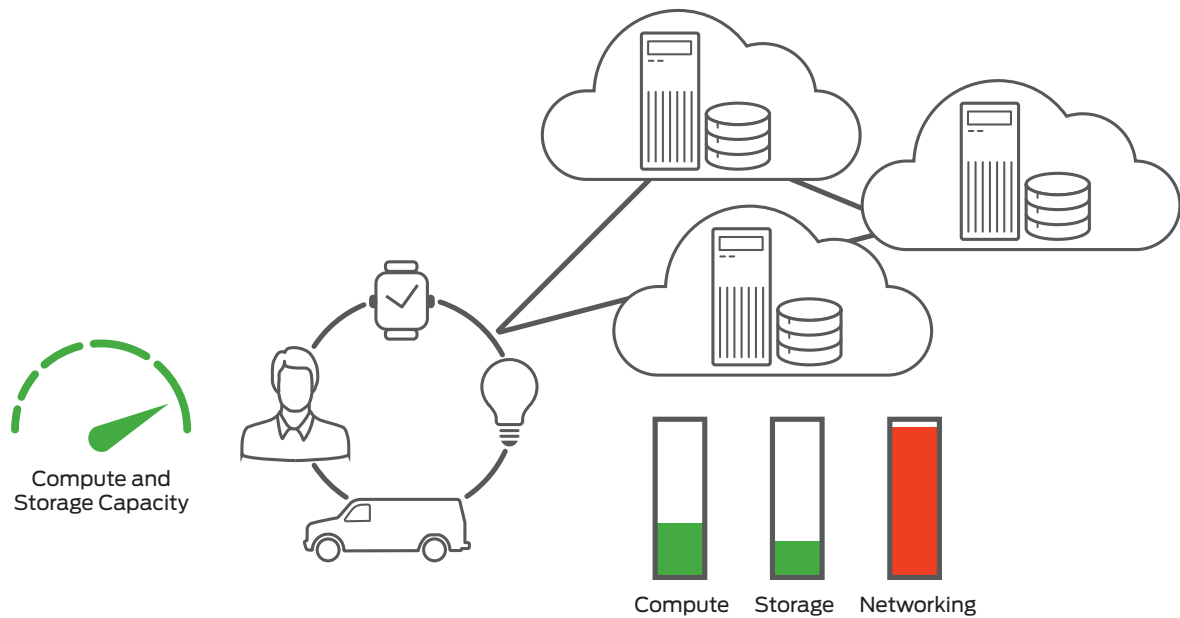


Figure 9 - Networking Becomes Critical

Summary

As identified in this paper, unstoppable forces are leading us to a new era in how people interact with technology. It will be an era in which technology adapts to humans in ways we’ve never experienced before, and which we refer to as Digital Cohesion. This era will lead to fantastic new possibilities in terms of product offerings and tailored services. But this will require changes to how technology is designed. Among the most significant change will be the movement of compute and storage out of devices and into the cloud making networking even more critical with new approaches needed for automation, security, interoperability and performance.

About Juniper Networks

Juniper Networks challenges the status quo with products, solutions and services that transform the economics of networking. Our team co-innovates with customers and partners to deliver automated, scalable and secure networks with agility, performance and value. Additional information can be found at Juniper Networks or connect with Juniper on [Twitter](https://twitter.com/Juniper) and [Facebook](https://facebook.com/Juniper).

For more information: www.juniper.net/digital-cohesion

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