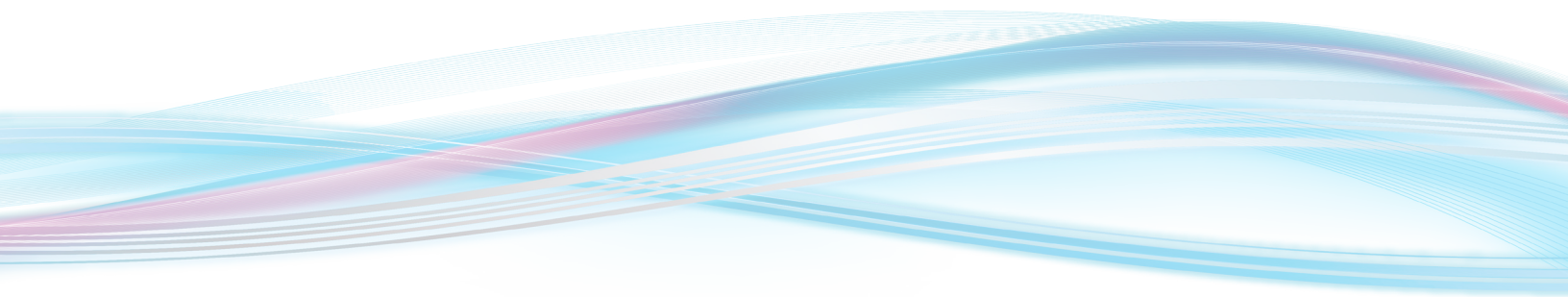


PREPARE YOUR BUSINESS FOR THE INTERNET OF THINGS

Solutions for Optimized IoT Networks

New device technologies and ubiquitous connectivity enable the advent of innovative business ideas based on data collection and analysis. The Millennial generation uses these tools that result in a transformation of how enterprises structure their business processes. This digital generation is inventing new business models by extracting value out of massive amounts of data from an increasing number of devices through a process which forms the Internet of Things (IoT). This white paper provides an overview of IoT, describes how carriers can expand their business by addressing IoT, and suggests how access and transport networks can be optimized.



SMART DEVICES AND APPLICATIONS ENABLING DATA COLLECTION

Hand in hand with the development of devices, our digital lives are influenced by data collection through applications. Smart watches and fitness bands collect information about our health and through this data, our lives are intertwined with the IoT.

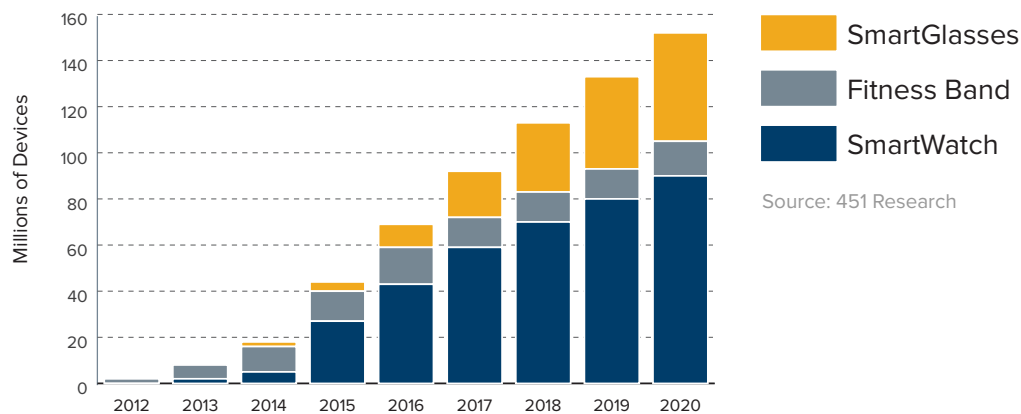


FIGURE 1 – Technologies fuel the growth of devices which enable data collection

As another example of data collection, information obtained about individual driving habits can enable car insurance companies to personalize policies. This data can be compared to benchmarks and used to help drivers improve their skills. Furthermore, advanced car diagnostics and innovations like Pirelli's Cyber Tire vision, where a small device is installed in every tire to check air pressure and tire condition, allow for preemptive maintenance measures, which help to reduce vehicle breakdowns and optimize fuel consumption.

M2M APPLICATIONS MOVING TO IoT

The forerunner of IoT is machine-to-machine (M2M) communications, which has been in existence for more than two decades. Its economic impact has been rather modest, although GSM/GPRS has enabled some global data services including advances in fleet management. New sensor technologies, ubiquitous broadband, and the rise of the data center are now truly taking the M2M idea to the next level. Together with massive cost reductions, these technologies turn many IoT application ideas into positive business opportunities.

KEY ENABLERS FOR THE INTERNET OF THINGS

- Ubiquitous connectivity
- Low power, low cost sensors
- Low power, low cost wireless connectivity
- Data center and cloud technologies
- Big Data analysis

Like a self-fulfilling prophecy, while the IoT is being built by a significant number of connected devices, its success will also fuel a further explosion in the number of connected devices. Overall, the number of connections is predicted to increase by a factor of x10 in the coming years. Although the bandwidth need per device might be low, the sheer scale of connections will impose new requirements on network technologies and designs. As a result, the IoT will form a second inflection point in the telecommunications industry with an impact on the network as significant as the introduction of mobile telephony itself.

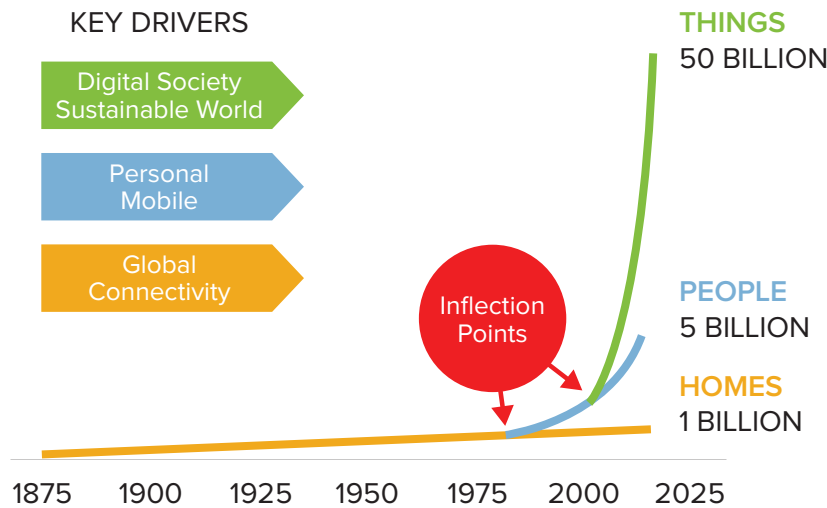


FIGURE 2 – IoT forms a second inflection point in the telecommunications industry after the advent of mobile telephony

The drivers for IoT are global digitization and an increasing amount of competitive pressure in all industries. With IoT, existing business models can experience massive cost reductions, while new business models become possible.

According to a Vodafone study, 52% of surveyed companies who introduced IoT solutions recognized a competitive advantage. Another 45% of the respondents identified that productivity and customer service improved. One out of every three enterprises achieved a revenue increase by introducing IoT applications.

This feedback shows a clear market adoption of IoT. 451 Research quantified this finding by stating that 8% of enterprises already use IoT. An additional 25% of enterprises are considering the introduction of IoT solutions. Finally, a large percentage of enterprises are aware of IoT potential, although they have not implemented it yet.

POTENTIAL PERFORMANCE GAINS IN KEY SECTORS

INDUSTRY	SEGMENT	TYPE OF SAVINGS	ESTIMATED VALUE OVER 15 YEARS
AVIATION	Commercial	1% Fuel Savings	\$30B
POWER	Gas-fired Generation	1% Fuel Savings	\$66B
HEALTHCARE	System-wide	1% Reduction in System Inefficiency	\$63B
RAIL	Freight	1% Reduction in System Inefficiency	\$27B
OIL & GAS	Exploration & Development	1% Reduction in Capital Expenditures	\$90B

Note: Illustrative examples based on potential one percent savings applied across specific global industry sectors
Source: GE estimates

FIGURE 3 – *IoT solutions offer the potential for enterprise savings*

CARRIERS ADDRESS IoT OPPORTUNITIES TODAY

Carriers are recognizing current IoT opportunities. Traffic figures published by Verizon demonstrate the acceptance of new service offerings and note that benefits related to the implementation of IoT data collection and analysis apply to all vertical industries, including healthcare, power, oil, and gas.

The increase in 2013 to 2014 M2M connections per industry does not yet include the anticipated upswing for new wearable devices, such as smart watches and fitness bands. These wearables collect information about personal activities, offer health monitoring, enable exercise performance improvements, and ensure accurate and optimized intake of medication. Giving healthcare providers access to the data obtained through wearables allows the transfer of detailed background information for analysis during health checks. While the data gathered through wearables may be modest for an active individual, information obtained from a hospitalized patient could peak at 2GB per day. In addition, during patient examinations, healthcare providers are using statistics to benchmark their performance and cost effectiveness against competitors. Key requirements of these applications include access rights, security, and instant availability – all involving multiple customers per application.

The IoT opportunities are independent of the size of the enterprise, as IDC (International Data Corporation) learned in a 2014 survey. This information is helpful to consider as enterprises are rethinking their IT structures and communications needs. Outsourcing IT equipment into data centers and evolving to cloud technology offers growth opportunities and relays a synergy with IoT.

When enterprises build hybrid networks by combining their own transport networks with carrier services, new solutions are necessary to handle the deployment challenges. This type of hybrid network scenario typically occurs in the transportation, energy, and utilities sectors.

Meanwhile, oil and gas industries are facing the challenge of cutting costs in new oil and gas field exploration and relying on simulations based on sensor data. IDC expects that data connectivity will increase by a factor of x3 through 2018, and the amount of generated data will explode by a factor of x40 through 2020.

IOT BY THE NUMBERS

HERE'S HOW M2M CONNECTIONS ON VERIZON'S NETWORK INCREASED FROM 2013 TO 2014 BY SECTOR

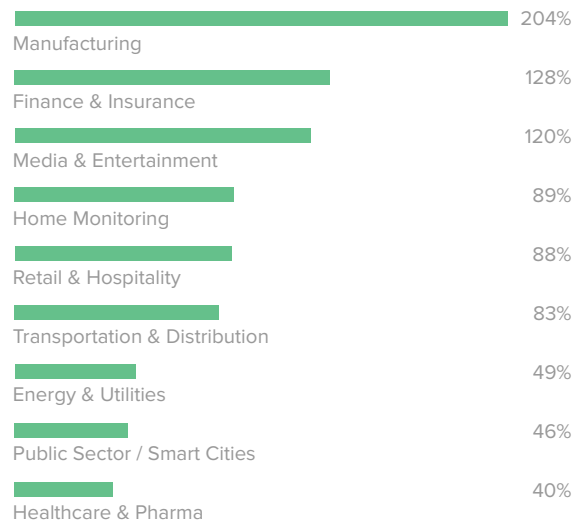


FIGURE 4 – Figure 4: Increasing M2M connections by industry

NETWORK OPTIMIZATION REQUIRED FOR IoT PERFORMANCE

Carriers can immediately begin to address IoT opportunities. However, for many applications, network optimization is advisable or even critical. This section gives a short overview of key requirements for IoT optimized networks.

CONNECTING THE IoT DEVICE

ARMADA

IoT is characterized by zillions of small, chatty devices with low bandwidth demand. To manage the demand, the upcoming 4.5G and 5G networks will focus on high connectivity rather than high bandwidth.

Alternative technologies like LoRa™ focus on low power and low cost sensors. Both high connectivity and low power solutions will address the demand for a large number of outdoor cell sites.

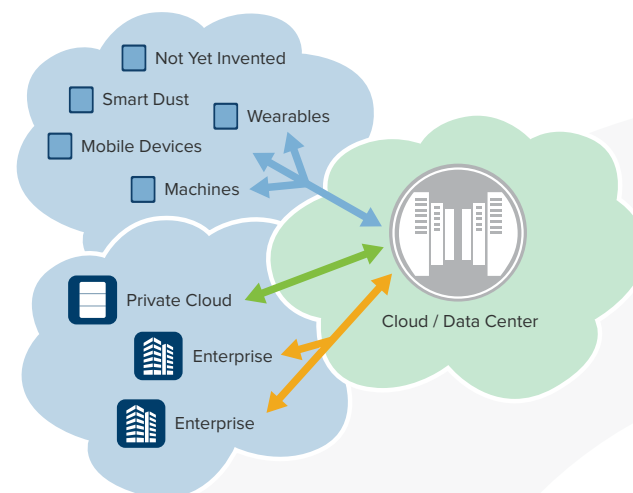


FIGURE 5 – Three network areas with optimization potential for IoT

IoT implementation challenges include:

- Industrial machinery will remain in the field for many more years, which requires carriers to support and seamlessly integrate legacy protocols like FR or ATM. Likewise PDH and SDH will continue to play an important role into the future.
- Signaling storms caused by large sets of devices waking up at the same time will impact the network.
- Financial applications are highly time sensitive and will challenge the latency and jitter performance of the network along with availability of services.
- Advancing IoT control to entities such as cars will have a significant impact on time sync requirements.
- Carriers will need the capability to address the data storms appropriately, beyond pure access and aggregation.

CONNECTING THE DATA CENTER

In most cases, the IoT data will cumulate in one central carrier-hosted data center for analysis. Extremely crucial data may even need backup in a geographically separated data center. Key data will be replicated in on-premises data centers. The enterprise IT department will need to integrate these WAN connections into their LAN network, which will call for self-provisioning capabilities. In certain industries, special access rights and multi-tenancy requirements may be necessary.

CONNECTING THE ENTERPRISE

State-of-the-art enterprise connectivity is based on Carrier Ethernet (CE) 2.0. The new challenge is the integration of hybrid data centers or even hybrid network concepts. Emerging technologies like SDN/ NFV promise new tools for IT departments to better integrate LAN and WAN and develop their own network-aware applications.

CORANT SOLUTIONS FOR AN IoT OPTIMIZED NETWORK

Coriant offers a full suite of solutions that enable carriers to optimize their network for IoT applications and empower enterprises to build their own networks and integrate them with carrier services.

CORANT CONNECTS IoT DEVICES

Access products are key components of IoT network solutions. The Coriant® 8600 Edge Routing Solutions offer several options to support IoT requirements and devices:

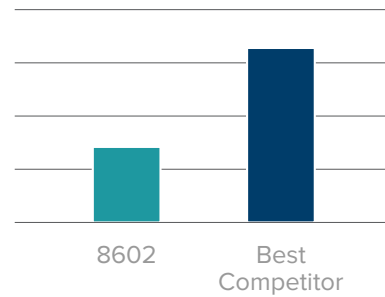
- The Coriant® 8602 Smart Router is the industry-leading IP/MPLS cell site router offering the smallest footprint and lowest power consumption in the market. The 8602 supports not only all fundamental IoT requirements, including IPv6 or IPSec, but also offers the best time synchronization behavior exceeding 5G requirements. Combined with the unique GPS SFP clock, this feature set provides the most robust network solution.
- The Coriant® 8665 Smart Router supports up to 1 Tbps of switching capacity, which allows enough headroom for future IoT applications.
- The Coriant® 8615 Smart Router offers first stage aggregation and provides the highest logical scalability in the market to support a large number of connections.

The Coriant® 8000 Intelligent Network Manager (INM) provides intuitive management and control of 8600 Series IP/MPLS solutions, with support for a dedicated SDN controller that allows network operators to easily provision, monitor, and manage the network. Coriant also offers solutions that support all non IP/MPLS interfaces, including FR, ATM, PDH, and SDH, of various speeds to connect industry machines.

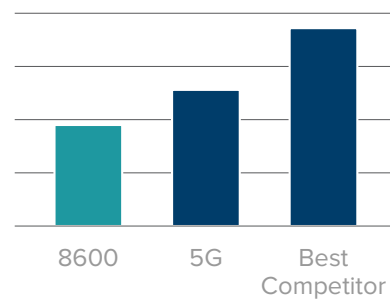
CORIAN CONNECTS THE IoT DATA CENTER

The data center is a key technology allowing large-scale collection of data and a platform for Big Data analysis. In repurposed central offices, carriers can host outsourced IT equipment from enterprises. The connections between the data centers, backup data centers, and on-premises data centers form a unique type of network. Coriant solutions for data center networking support data rates up to 100G on metro networks and beyond 100G on long haul distances.

POWER CONSUMPTION



SYNC ASYMMETRY



SIZE (TOP VIEW)

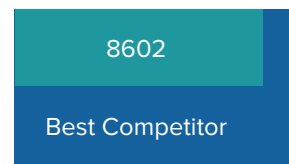


FIGURE 6 – Coriant® 8600 and competitor comparison

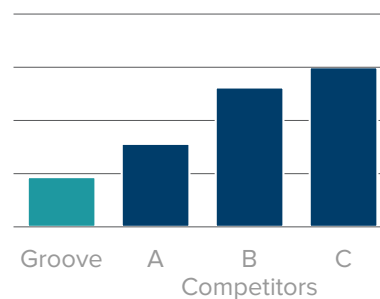
Central to the Coriant Data Center Interconnect (DCI) solutions portfolio is the Coriant Groove™ G30 DCI Platform – the most energy saving and dense data center interconnect product in the market based on a comparison of datasheet specifications from different vendors. The product delivers the most economical pay-as-you-grow concept and high flexibility to mix and match 10G, 40G, and 100G clients. Encryption for increased security is an optional solution component. Enterprises can administrate the provided DCI bandwidth on their own, as enabled by the Coriant Transcend™ SDN and NFV applications.

CORIAN CONNECTS THE IoT ENTERPRISE

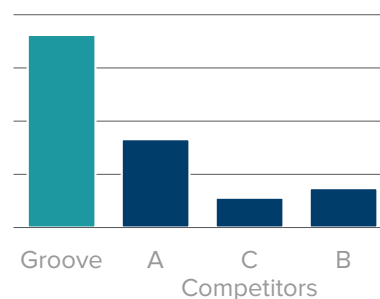
To connect enterprises to the network and all remote sites, Coriant offers CE 2.0 certified solutions through the Coriant® 7090 CE Packet Transport Platforms. Enterprise connectivity for the 7090 Series is supported by the same 8000 INM and SDN controller as the Coriant DCI solutions. Open northbound interfaces allow enterprises to develop and operate applications to establish and operate a uniform hybrid LAN/WAN network.

As with IP/MPLS backhauling solutions for devices, Coriant differentiates in enterprise connectivity with low power consumption and size-optimized equipment for cell sites and customer premises. The low power design allows for the installation of efficient Power over Ethernet (PoE) functionality. Outdoor versions are also available to support enterprises from certain vertical industries with connectivity needs beyond traditional office spaces. The solution is based on state-of-the-art CE 2.0 technology and full interworking with other Coriant products. This solution can be extended to integrate legacy technologies such as SDH or PWE for smooth migrations to full packet networks.

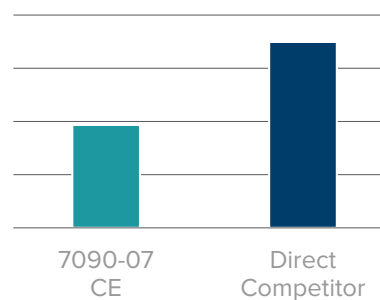
POWER CONSUMPTION



TBPS PER RACK



POWER CONSUMPTION



VOLUME

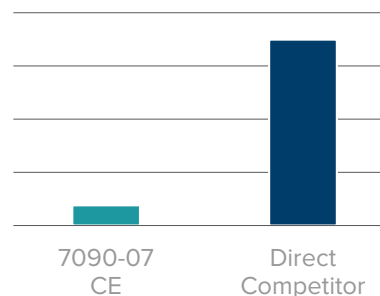


FIGURE 7 – Competitor comparison with Coriant Groove™ G30 and Coriant® 7090

SUMMARY

IoT transforms the way we are doing business and enables new business models. While the vast majority of enterprises still use data to steer business operations or to ensure just-in-time delivery models, IoT allows enterprises to improve competitiveness and capture market share. Ultimately, IoT offers a great opportunity for carriers to generate new revenue streams, as networks await optimization for the next big wave of devices and bandwidth usage.

Coriant is a leading provider of transport, switching, and routing solutions for carrier networks, offering a global reach with local presence in more than 100 countries. Our customer base encompasses mid to super scale carriers, cable companies, wholesalers, research and government network operators, as well as transportation, utilities, energy, oil, and gas industries.

ABOUT CORIANT

Coriant delivers innovative, dynamic networking solutions for a fast-changing and cloud-centric business world. The Coriant portfolio of SDN-enabled, edge-to-core transport solutions enables network operators to reduce operational complexity, improve utilization of multi-layer network resources, and create new revenue opportunities. Coriant serves leading network operators around the world, including mobile and fixed line service providers, cloud and data center operators, content providers, cable MSOs, large enterprises, government agencies, financial institutions, and utility companies. With a distinguished heritage of technology innovation and service excellence, forged by over 35 years of experience and expertise in Tier 1 carrier networks, Coriant is helping its global customers maximize the value of their network infrastructure as demand for bandwidth explodes and the communications needs of businesses and consumers continue to evolve. Learn more at www.coriant.com.

These trademarks are owned by Coriant or its affiliates: Coriant®, Coriant Dynamic Optical Cloud™, Coriant Transcend™, Coriant CloudWave™, mTera®, Nano™, and Pico™. Other trademarks are the property of their respective owners. Statements herein may contain projections regarding future products, features, or technology and resulting commercial or technical benefits, which may or may not occur. This publication does not constitute legal obligation to deliver any material, code, or functionality. This document does not modify or supplement any product specifications or warranties. Copyright © 2016 Coriant. All Rights Reserved. 74C.0086 Rev. A 04/16

