SAMSUNG

Driving 5G Opportunities with IoT Early Adopters

5G creates a new data economy with massive density, high bandwidth, and low latency



5G networks are enabling unprecedented levels of productivity and innovation, heralding a new era characterized by automation, autonomy, and artificial intelligence. 5G is the fuel for driving the growth of a new IoT-enabled data economy. As 5G networks fuel denser concentrations of smart sensors and devices, the continuing IoT innovation provides new growth opportunities for service providers and enterprises in the form of use cases for Massive IoT (MIoT) and Critical IoT (CIoT). While MIoT applications utilize high connection volumes and small data traffic volumes, low-cost devices and low-energy consumption, CIoT applications seek ultra-reliability, availability, low latency, and high data throughput.¹ 5G facilitates the development, adoption, and evolution of both MIoT and CIoT.

5G has several differentiators from legacy networks that can create positive economics for IoT. The first differentiator is the increase in device density – or the number of connections it supports in an area. The support of one million 5G connections within a square kilometer establishes the foundation for the positive economics for next-generation IoT. 5G's broad bandwidth support provides those large numbers of devices with the ability to send and receive data at significantly higher rates of speed. Low latency capabilities, which is the amount of time it takes the device to send the data to the intended destination, can create new opportunities for real-time monitoring in business environments across many verticals. The combination of high bandwidth, high connection-density, and low latency capabilities of 5G are what will allow IoT solutions to expand into new business applications.

Early-adopters can harness 5G to create new IoT applications, monetize IoT-enabled data to develop more revenue streams, and create sustained leadership in their areas of expertise. This paper focuses on two immediate 5G-enabled applications: continuous real-time monitoring and smart city applications, with examples of use cases and their economic benefits from selected industries.

Continuous Monitoring Leads to Faster and Better Outcomes

The success of any business depends on its ability to monitor its production and results. 5G networks open up the opportunity for boosting

the speed and quality of data to facilitate datadriven decisions. 5G is not "a better 4G" – it is a catalyst for taking IoT to a different level.

5G-enabled smart devices and sensors can deliver the foundation of a new data economy, where businesses possess the ability to use realtime data and leverage it to create monetization opportunities.

Manufacturing: IoT-Enabled Real-Time Monitoring for Proactive, Connected and Adaptive Production

Increased 5G bandwidth can create new opportunities for factories looking to leverage IoT applications and devices to be true digital enterprises. Nearly 54% of manufacturers in the US have an ongoing smart factory initiative.² Smart factories are expected to boost the global economy by adding US\$ 500B to US\$ 1,500B annually to the global economy over the next three years. Critical IoT applications, such as remote machine operation and industrial application and control, are realistic possibilities that 5G can enable as these applications require ultra-reliable, low latency and highly available network connectivity, that can now be powered by 5G.

5G provides the capacity to send high-resolution video streams to monitoring systems that use AI-based machine-learning techniques to enforce highly consistent visual quality controls, as well as track production quotas. When architected properly, 5G networks will also enable the local data orchestration and processing via edge computing to address the real-time analytics needs of manufacturing environments. As per a survey by IQMS, 72% of manufacturers consider real-time monitoring essential for streamlining and making inventory reconciliation more efficient.³

Wirelessly enabled 5G cameras can send realtime high-resolution video to the monitoring system to detect deviations and quality flaws as a Critical IoT service. Removal of defective products from the production line can be automated. Deloitte Insights indicates that many smart factories are applying artificial intelligence (AI) with increasing sophistication

Smart Factories Realize 17-20% Production Gains

- Capgemini, 2017 Report

to computer-controlled systems to automate increasingly complex decisions typically made by workers.⁴ Connected processes and automation allow smart factories to be proactive in decision making, a step ahead from being just reactive.

An additional benefit of real-time faultdetection monitoring is that the system knows the number of completed items. This accurate tracking creates manufacturing efficiencies by automating the production of only the number of successful units needed. Not only does this approach reduce waste, but it enables a moretimely transition of the line to different products, which facilitates faster order fulfillment. This optimization enables factories to adapt to manufacturing practices that result in more transparency and agility.

Utilizing the growing cloud-based software around IoT, AI and computing horsepower, applications at the edge of the network can monitor feeds and alert when it detects defects, assembly, temperature, or safety issues.

² Capgemini Digital Transformation Institute, Smart Factories: How Can Manufacturers Realize The Potential Of Digital Industrial Revolution, May 2017

⁴ Deloitte Insights, The Smart Factory: Responsive, Adaptive, Connected Manufacturing, August 2017

 $^{^{\}rm 3}\,$ IQMS, Real-Time Monitoring Fuels IoT Growth In Manufacturing, July 2018



Healthcare: Patient Monitoring and Wearables for Improved Outcomes

5G network's massive capacity and speeds offer a game-changing environment that can improve healthcare outcomes with MIoT solutions.

Hospitals continue to look for ways to improve patient outcomes while also reducing their costs. Readmission rates are a key indicator of how improving patient outcomes can directly affect hospital bottom lines. The Hospital Readmission Reduction Program began in October 2012, to financially penalize hospitals when their discharged patients required readmission within 30 days. From 2012, the program has assessed US\$ 2.5B of penalties. Hospitals are implementing programs to reduce readmissions to eliminate the costs from these penalties.⁵ With IoT-based patient monitoring, the real-time information from wearables that continuously monitor temperature and other vital signs can present an opportunity to identify infection or other symptoms that, if left untreated, would lead to readmission to the hospital.⁶

Juniper Research indicates that revenues from healthcare-related wearables will reach US\$ 20B by 2023, and that adoption of wearables will grow based on improvements in patientmonitoring technology. The high capacity and low latency of a 5G network make it a natural fit for providing data to medical providers enabling quick and accurate identification of individuals who are at risk from worsening health conditions. Transferring real-time data to AI-enabled software analytics can improve confidence among medical practitioners and regulators regarding sensor accuracy.⁷

5G will Enable US\$ 1.1 T (between 2020 and 2035) Sales in Healthcare:

- IHS Economics/IHS Technology

Hospital readmission reduction programs, established to ensure patients only left the hospital when they were truly well, point to success here with the reduced 30-day and 1-year hospitalization rates, which also results in a positive reduction in health care costs.⁸ However, statistics also indicate an increase in 30-day and 1-year mortality, which is not the positive outcome expected.⁹ With a patient wearing a real-time monitoring device, the doctor has the opportunity to capture the data necessary at the time it happens, allowing for immediate patient follow up.¹⁰

- ⁵ https://www.aha.org/hospital-readmission-reduction-program/home
- ⁶ IoT For All, How IoT Can Improve Data Access For Remote Patient Monitoring Solutions, December 2018

- ⁸ American College of Cardiology, AHA 2019 Heart Disease And Stroke Statistics, February 2019
- $^{\rm 9}\,$ American College of Cardiology, AHA 2019 Heart Disease And Stroke Statistics, February 2019
- ¹⁰ The Doctor Weighs In, Wearable Heart Rhythm Monitors: Which One, When, And Why?, February 2019

⁷ Juniper Research, Healthcare Spend In Wearables To Reach \$60 Billion By 2023, As Monitoring Devices & Hearables Become "Must Haves" In Delivering Care, January 2019



Transportation: Tracking Tire Pressure, Truck Route and Driver Behavior for Fleet Optimization

Long-haul trucking companies, whose drivers use the US highway system to move goods from manufacturers to consumers, comprise a significant component of the US economy. The most recent study conducted by the Bureau of Transportation Statistics reported that for-hire transportation contributed US\$ 482.3B (2.6 percent) to the US GDP.¹¹

Continuous fleet monitoring can offer essential data for companies to use to identify costcontainment opportunities. Sensors on tires that report tire pressure to the driver are important but conveying the continual low pressure to the headquarters over a 5G network allows direct followup with the driver to ensure that tires are at the proper inflation. Why? Tires are the second largest maintenance expense, behind fuel, for a truck fleet.¹² According to the Technology and Maintenance Council of Council of American Trucking Associates, a constant 20 percent underinflated condition reduces the life of a tire by 30 percent, and 40 percent underinflation reduces tire life by 50 percent, due to increased flexing and heat buildup within the tire components. These conditions deteriorate tires and increase OPEX due to replacing tires more frequently.¹³

Transportation companies can continuously monitor rig-specific and driver-specific data based on their 5G-enabled mobile devices. Sensors in the diesel engine can share constant feedback with the driver and company about thetruck's performance. Using this data, companies can implement programs that improve fuel savings and reduce insurance rates based on safety performance records.

¹¹ United States Department of Transportation, Bureau of Transportation Statistics, Freight Facts & Figures 2017 - Chapter 5: Economic Characteristics of the Freight Transportation Industry, October 2017

¹² https://www.ttnews.com/articles/tire-technology-offers-cost-savings-reducedmaintenance-fleets-industry-reps-say

¹³ https://www.trucking.org/ATA%20Docs/About/Organization/TMC/Documents/ Position%20Papers/Study Group Information Reports/Tire Pressure Monitoring and Inflation%20Maintenance%e2%80%94TMC%20I.R. 2010-2.pdf

Transportation companies can also save operating expenses by making real-time adjustments to trucking routes. The shortest path, while efficient during certain times of the day, may add significant fuel costs over periods if the route regularly encounters high traffic/low-speed driving or is currently experiencing an event that is impacting all traffic. The rig's sensors capture and send the vehicle's speed, location, time of day, and other driving data over the 5G network to corporate headquarters for historical trend analysis, while the 5G network allows the regional offices to adjust routes around problematic traffic areas. The insights from the study can lead to route changes that result in lower fuel consumption.

5G networks enable the ability to provide real-time data of driver habits, truck efficiency, and traffic challenges, trucking companies who monitor the constantly changing operating conditions of their fleet have the information that allows them to seek better conditions resulting in decreased fuel expenses and insurance costs.

Connectedness Beyond The Highway

Fleet	& Route	Optimization
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Idling Behavior

Asset Tracking

Geofencing

Load Matching and Customer Communications

Empower Fleet Managers

Enable Truck Drivers

Roadside Assistance

In-Cab Entertainment

Wellness & Safety

Predictive Maintenance

Remote Diagnostics

Driver Profiling





Smart City 2.0: A Platform for Better Engagement and Higher Quality of Life

Most smart city initiatives aim to provide a platform that will enable urban areas to manage better their resources and help their citizens make better decisions for themselves using data collected through the connected infrastructure. 5G can drive the next leap in smart city initiatives.

Mobility: Integrated Infrastructure for Expanded Mobility Options

City planners are using IoT-enabled technology and solutions to optimize traffic flow, reduce traffic congestion, and provide expanded mobility options such as ridesharing, and multi-modal solutions. 5G-driven smart city applications will allow the faster flow of traffic information and parking space availability to commuters and public transport agencies, enabling precise trip planning. Smart transportation technology, passenger information systems, improved ticketing models, and V2V communication will help address traffic congestion and improve commuting times and offer safety benefits. Large scale adoption of 5G and expanded networks will also support safer and smarter autonomous vehicles (AV). According to Boston Consulting Group, wide-scale adoption of AVs could cut down road fatalities by 30,000, reduce travel time and fuel consumption each by 40%, and recover time lost to commuting and congestion by up to 80 billion hours, translating into a US \$ 1.3T benefit for the US economy.¹⁴

Smart Cities are More Efficient, Responsible and Sustainable



Urban Public Safety: Reactionary to Proactive

The high-bandwidth ability of 5G, coupled with the power of AI, can provide significant improvements in public safe and private security. 5G infrastructure allows property owners to install higher quality equipment to monitor at-risk areas like their parking areas. Historical trends indicate that more than 1 in 10 property crimes occurs in parking lots or garages, and monitoring can provide valuable information to law enforcement. One of the challenges that law enforcement encounters is the low-quality images offered by many security systems. By increasing camera resolution, the image quality provided by these systems improves dramatically. Through the use of wireless cameras, property owners can reduce the cost and ease of installation by eliminating the need to run cabling. Since these higherresolution cameras need a connection that can handle the increased bandwidth, 5G is an ideal connectivity solution.¹⁵ Also, a 5G network with edge computing can enable automated realtime surveillance of parking areas by AI-based systems that can identify problems early and notify authorities sooner.

The economics improve further when tying high-resolution cameras to smart street lighting systems. In 2018, North America accounted for 31% of the global smart street light market.¹⁶ The single structure LED light, coupled with the high-resolution camera, can create a solution where live video can help law enforcement identify persons and vehicles involved in a crime or others who might be witnesses to the incidents.

In addition to providing security in those areas, real-time updates on parking space availability create another economic benefit for smart cities.¹⁷ While parking alerts is not a service that demands high-speed real-time connectivity enabled by 5G, the high user density enabled by 5G lends economic benefits as the 5G service can replace solutions on other technologies, driving down operating and maintenance costs for cities for these services.

Samsung - Driving a Connected World Through 5G

The creators of 5G are designing the network of tomorrow to handle several different services – enhanced mobile broadband, massive IoT, and ultra-reliable and low-latency communications. Samsung is at the forefront of bringing 5G mobile networks and technology to market to address these new service capabilities. It envisions a connected world that brings together multiple technologies—artificial intelligence, IoT, cloud data and computing—to transform everyday experiences.

Samsung's end-to-end solutions are unlocking the power of 5G by optimizing the use of spectrum using the advancements in cell-site coverage technologies. For example, rather than blanket the area with each radio signal, as current cellular telecommunications do, Samsung is deploying systems that use adaptive multi-layer beamforming technology to tightly focus the radio waves into a beam that targets each user device – enabling a much better mobile broadband experience for each user while providing better spectral efficiency for the network operator.

Samsung is a leader in the 5G market with firstto-market deployments of leading-edge, end-toend 5G solutions in Korea and the United States. These commercial deployments are enabling operators to realize the benefits of 5G today.

¹⁵ IoT Analytics, 5 Key Insights From 350 Smart City IoT Projects, March 2019

¹⁶ Enterprise IoT Insights, Revenue From Smart Street Lights To Hit \$1.7B By 2026, April 2019

¹⁷ IoT Analytics, 5 Key Insights From 350 Smart City IoT Projects, March 2019

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