



5G for Business Transformation

New Era in Digital Transformation

The fifth generation (5G) cellular network technologies ushering in a new era in digital transformation in the telecom sector and enterprises across many industries. With the promise of extreme bandwidth (nearly 100 times faster than 4G), ultra-low latency, high levels of security and reliability, 5G holds the promise to transform industries in ways we're just beginning to comprehend. Services that we used to perceived as futuristic such as e-health, connected vehicles, advanced traffic systems and elevated experience of extended reality (XR) have arrived. The 5G technologies will change the way we connect, consume information and work. More importantly, it brings new capabilities to businesses, enabling them to deliver ground breaking solutions that reach across societies.

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Overview

With unparalleled capabilities, 5G is enabling business to transform in a way that we are just beginning to experience. This unforeseen potentials accelerating success in the 4th industrial revolution.

However, one of the critical imperatives of the 5G infrastructure that often forgotten yet defacto, is time synchronornization. Without proper consideration to accurate time synchronization, 5G will be operationally ineffective.



Fourth Industrial Revolution

Dubbed as Industry 4.0, the 4th industrial revolution fuses advanced technologies with high-speed wireless connectivity to blur the lines between the physical, digital, and biological spheres. The ensuing impact on our systems will transform how we produce, manage and govern our world and ourselves.

As 5G overhauls the telecom sectors rendering unparalleled on-demand services to businesses across industries, it innately enables fusion of the physical and digital worlds. The ensuing transformative connectivity promises to supercharge the IoT, autonomous vehicles, augmented reality, smart cities, mission-critical manufacturing, 3D videos, remote healthcare and regenerative medicine. Each of these and other 5Genabled applications could change the shape of legal, risk, and regulatory environments, and collectively, they will usher in the Fourth Industrial Revolution.

Hyper Connectivity

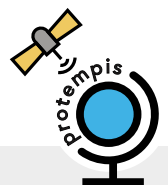
The explosion of ubiquitous connectivity is staggering and the world is entering a new period of hyper connectivity, an evolving state of communications in which evrything is talking: person to person, person to machine and machine to machine. The ensuing impact on our systems will transform how we produce, manage and govern our world and ourselves.

It is estimated that by 2025 more than 100 billion devices will be connected and 75 percent of global homes will have access to high speed broadband services. The fifth generation technologies playing a critical role in this hyper connected world by bringing together people, societies and business in a way that have not been possible before.

Through hyper connectivity comes the need for countries, government, corporations, enterprises, and communities to digitally transform and accelerate access to new information and accelerate and produce the best outcomes for their businesses.

Time is Critical

Time is everywhere yet when it comes to 5G and industry 4.0, highly accurate distributed time plays critical role in optimized connectivity and overall operational efficacy of the system. Without time synchronization, real time and near real time application will render in failure and more importantly, 5G network cannot be operational without highly accurate distribute clocks. Additionally, time sensitive networking is also critical to the connectivity that facilitate industry 4.0.



Timing is everything.



Time Synchronization in 5G

The fifth generation (5G) technologies enable decomposition and virtualization of entire wireless network from air interface to the very processing of user data and control functions of the network. For 5G deployments, mobile network can be divided in two parts: RAN (Radio Access Network) and Core Networks. Both RAN and core network by design requires highly accurate time synchronization. For example, 5G radio spectrum uses single frequency for uplink and downlink communication. In order to achieve this, radio spectrums are divided in timeslots and transmitted over the air for uplink and downlink.

Such technique allows efficient use of radio spectrum than using two frequencies for uplink and downlink which was dominant in 3G and 4G. This means, 5G RAN devices must maintain highly accurate time at nanoseconds level. The overall network design must adhere at a maximum of 1.5 microseconds time error for end to end communications. Therefore, all devices

in the 5G network that process traffic must synchronize to a common clock without much drift.

Time in 5G Telecom Cloud

5G brings a greater benefit to telecom infrastructure by enabling decentralization and scalability of mobile networks to serve more customers with better on demand service. This is possible to due to improvements in technologies and software that allows processing of much network services in servers. there is an increase momentum of public cloud companies such as Google, Amazon, Facebook bring their server based services to operators to define new service to 5G users.

While the server based 5G offering allow network simplification and greater capabilities of on-demand and enhanced services. To keep these services operational and optimized, highly distributed and precise synchronization is integrated at various subsystems.

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To summarize, time synchronization is key to delivering operational efficacy to modern mobile network communications while offering unparalleled services to end users.

Enterprise 5G

Industry initiatives around 5G technologies have created the possibilities of vendor agnostic solutions that can be leveraged as both private and public network. These initiatives have shaped telecom infrastructure and now offering better wireless network solutions for Enterprises.

Additionally, flexibilities in radio spectrum usage enables enterprises to create their own private 5G network without overly relying on traditionally operators. Enterprises can now choose from a plethora of solutions to build cost effective, secured private wireless network with better control.

For enterprise, 5G offering comes in different flavours that are known differently in different countries. For example, a shared radio spectrum based solution in the USA known as CBRS (Citizen Band Radio Spectrum) is gaining momentum in enterprise 5G deployments. Similar solutions are also available around the world. CBRS and other midband spectrum enterprise 5G solution uses distributed synchronization to keep the network optimal and operational.

Subsequently, other 5G technologies such as cloud based 5G solutions known as cloud native 5G and open industry initiatives like OpenRAN are also penetrating the enterprise 5G landscape.

Irrespective of these 5g technologies and solutions being deployed, time synchronization is critical to enterprise 5G.

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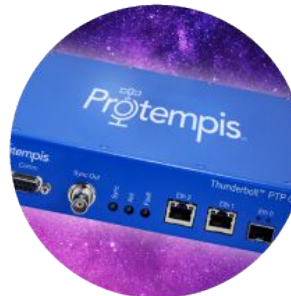
Resilient Time for Resilient 5G



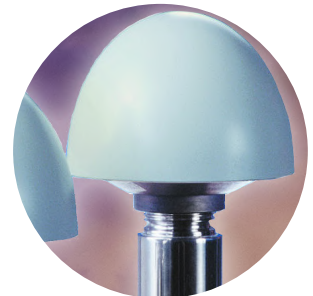
Timing Modules



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Antenna



Disciplined Clock