5G THE 5M WAY

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A new age of hyperconnectivity! 5G will fuel smarter factories of the future.

We envision factories of the future to be truly connected and consisting of Man, Machine and Material (MMM), interacting seamlessly with each other to create a diverse ecosystem of 'Connected Things'. Automating and digitising the interplay between MMM will be an enabler to creating comprehensive visibility and cohesion over these critical elements. It will drive enterprise goals of unlocking revenue pools, cost efficiency, and employee and machine productivity, delivering a superior end-customer experience.

Industry 4.0 has primarily been about automation, smart factories, and supply chain optimisation. The next leap for CXOs is industry's digital transformation augmenting digitisation of the human-machine interfaces. An example which most of us would have seen is the Cobot development. There are similar interfaces around the human, machine, and other assets which are forming the foundation stone for the next leap through 5G.

To elaborate :

Man

Are solutions that place people at the centre of digital transformation to achieve one or more business goals such as enhancing employee safety and productivity by using AR / VR solutions for remote monitoring, design, installation and quality assurance
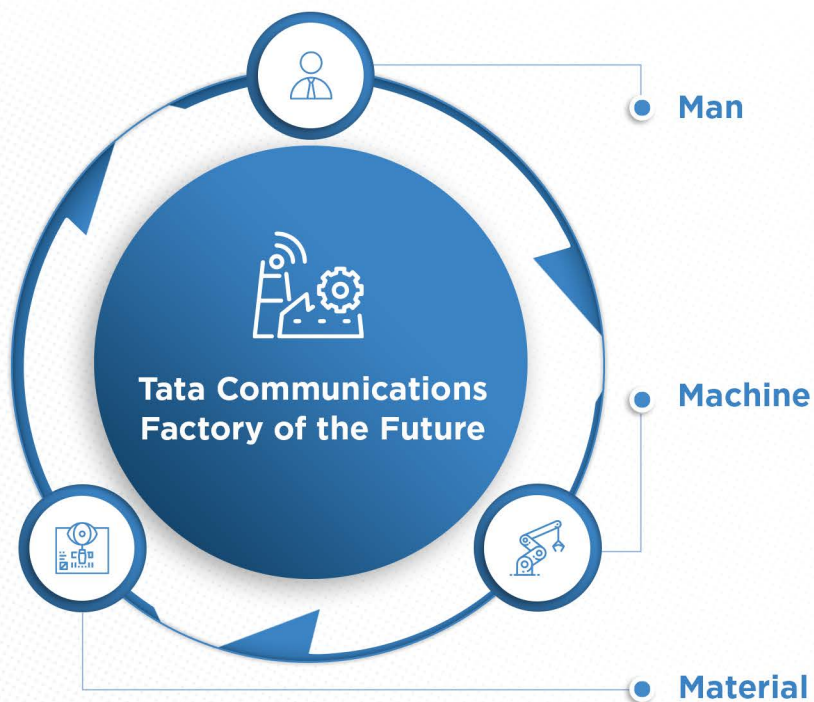
Machine

Revolves around solutions that place operational equipment at the centre of digital transformation to achieve one or more business goals such as predictive maintenance to ensure zero unplanned downtime and avoid catastrophic failure

Material

Are solutions that place the raw material at the centre of digital transformation to achieve one or more business goals such as improving cycle time by monitoring input resources precisely

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**Tata Communications
Factory of the Future**

Man
- Safe interaction between machine and man
- Social distancing (covid requirement)
- Tracking through the factory
- Health parameters monitoring
- Ensuring access controls

Machine
- Tracking from manufacture to installation to end of life
- Maximise uptime
- Minimise service time
- Predictive maintenance
- Remote monitoring and control
- Virtual training
- Virtual designing

Material
- Tracking of material
- Inventory management
- Process adherence
- Optimise utility consumption
- Environment monitoring

Factory of the future

As a digital ecosystem enabler, Tata Communications takes an 'enterprise-first' view. The Tata Communications MOVE™ platform is already enabling multiple use-cases for our enterprise customers using the best-fit for use underlying connectivity option to drive efficiencies across the value chain. However, as we enable enterprises through increased automation by focusing on the triad of Man-Material-Machine, we enable enterprises to unlock two more Ms - Method and Market.

Method

Revolves around the new way or process of achieving business goals and will give rise to new business and revenue models to unlock and create value

Market

The use of new methods of operating will aid the enterprise to address new systems or markets making use of new business and revenue models

We apply a holistic approach with this 5M framework view of industry 4.0, we enable enterprise efficiency, agility and help unlock revenue potential, while ensuring customer service excellence and centricity.

Key elements of the 5G – IoT journey

As Internet of Things (IoT) is a key enabler of digital transformation's MMM, crafting a digital enterprise with IoT means more than just providing IoT connected devices. It is the rigorous process of linking business strategy to the digital transformation journey, enabled by the right set of technology and solution providers and is business-outcome focussed.

There are 5 key elements of digital enterprise enablement with IoT and 5Ms in the 5G era

Network

The core communication layer delivering low latency services across licensed or unlicensed bands. We can enable individual network slices for specific use cases, with options for local or long-range services, addressing a variety of 5G-enabled industrial use cases

Devices

Device connected, activated and managed using an intuitive management portal. IoT-enabled devices can be provisioned for location-specific services, two-way alerts, remote configuration, monitoring and maintenance

Platform

Technology, device and access neutral, and capable of supporting multiple industry use cases

Applications

The Tata Communications MOVE™ platform is supported by a suite of 150+ APIs for ease of integration with 3rd party enterprise applications

Analytics-based insights

Outcome driven, business-focussed insights for informed decision making

As the world becomes more connected, another key element for a digital enterpise is critical - Security. Our platforms are inherently secure by design, employing a multi-layered approach to security, including encryption, zero-trust access and application micro-segmentation. Tata Communication platforms are designed to be hardware, application and connectivity- neutral to enable profitable business outcomes. AI is employed to analyse traffic and automate network connectivity actions, while an analytics engine presents information for both operational and strategic decision support.
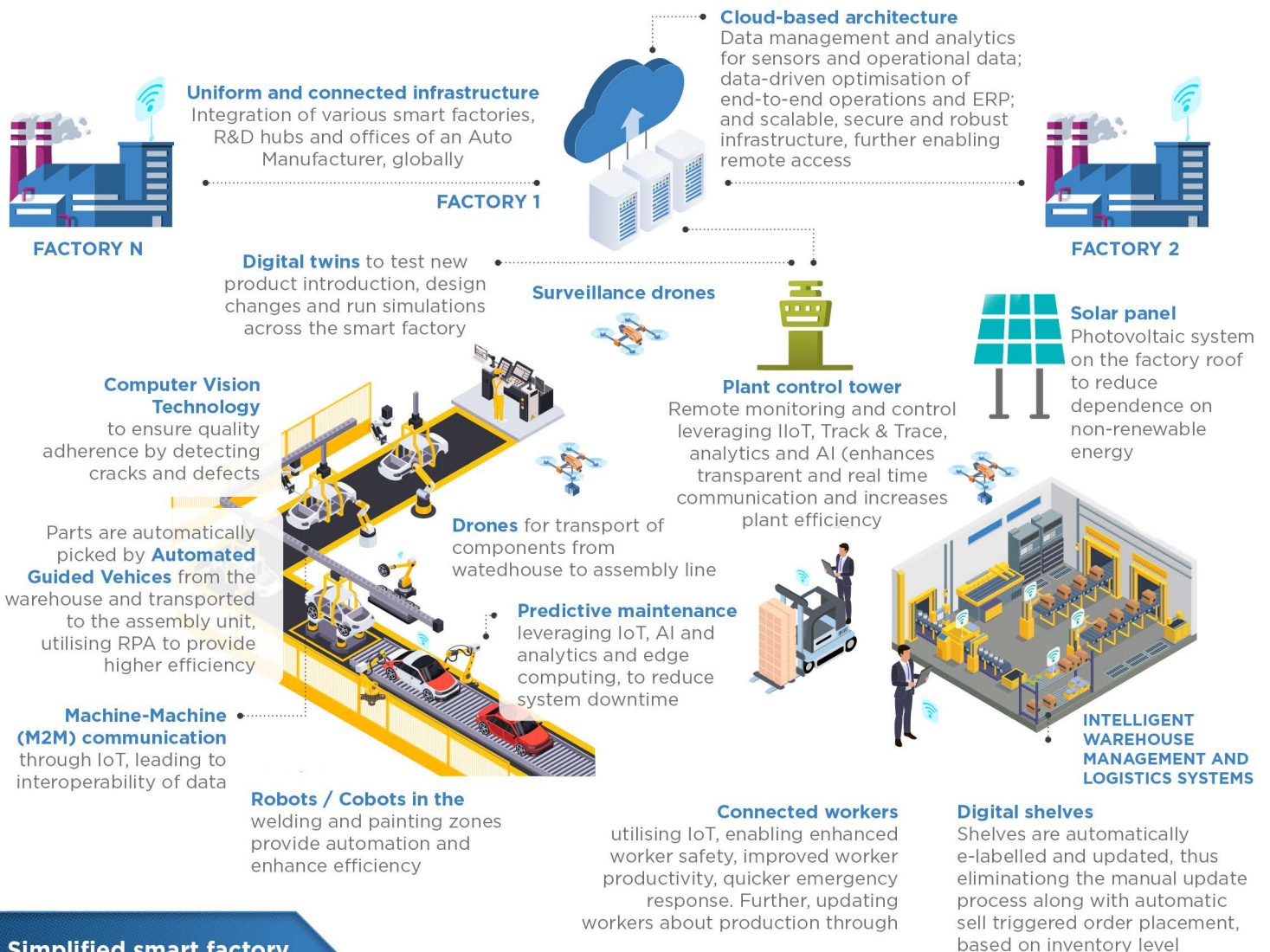
Art of the possible

Our IoT platforms with plug-and-play device enablement, supported by dashboards and predictive business-driven analytics, are transforming enterprises around the world. Our platforms are delivering tremendous value to our enterprise customers across automotive, industrial, logistics, media, healthcare and aviation sectors.

We work with multiple semiconductor industry partners to embed connectivity at the chip level, not only enhancing security of connected devices, but also resolving the traditional barriers of massive deployment and scalability by enabling born-connected IoT devices. This capability is enabled through a common global platform to help enterprises visualise and deploy 5M use cases anywhere, anytime.

Tata Communications MOVE™ platform has always used best-fit-for-use connectivity be it 3G, 4G / LTE and now 5G as we enable use cases relying on private or public mobile networks while being performance-optimal and compliant to local regulations.
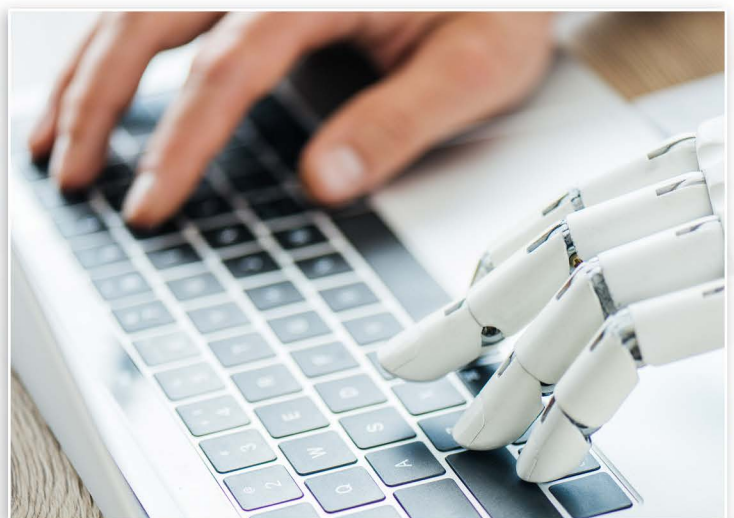
A Tata Communications MOVE™ enabled, simplified smart factory view is shown below

Cloud-based architecture
Data management and analytics for sensors and operational data; data-driven optimisation of end-to-end operations and ERP; and scalable, secure and robust infrastructure, further enabling remote access

Uniform and connected infrastructure
Integration of various smart factories, R&D hubs and offices of an Auto Manufacturer, globally

FACTORY 1

FACTORY N

FACTORY 2

Digital twins to test new product introduction, design changes and run simulations across the smart factory

Surveillance drones

Solar panel
Photovoltaic system on the factory roof to reduce dependence on non-renewable energy

Computer Vision Technology
to ensure quality adherence by detecting cracks and defects

Plant control tower
Remote monitoring and control leveraging IIoT, Track & Trace, analytics and AI (enhances transparent and real time communication and increases plant efficiency

Drones for transport of components from watedhouse to assembly line

Parts are automatically picked by **Automated Guided Vehices** from the warehouse and transported to the assembly unit, utilising RPA to provide higher efficiency

Predictive maintenance
leveraging IoT, AI and analytics and edge computing, to reduce system downtime

INTELLIGENT WAREHOUSE MANAGEMENT AND LOGISTICS SYSTEMS

Machine-Machine (M2M) communication
through IoT, leading to interoperability of data

Robots / Cobots in the welding and painting zones provide automation and enhance efficiency

Connected workers
utilising IoT, enabling enhanced worker safety, improved worker productivity, quicker emergency response. Further, updating workers about production through

Digital shelves
Shelves are automatically e-labelled and updated, thus eliminationg the manual update process along with automatic sell triggered order placement, based on inventory level
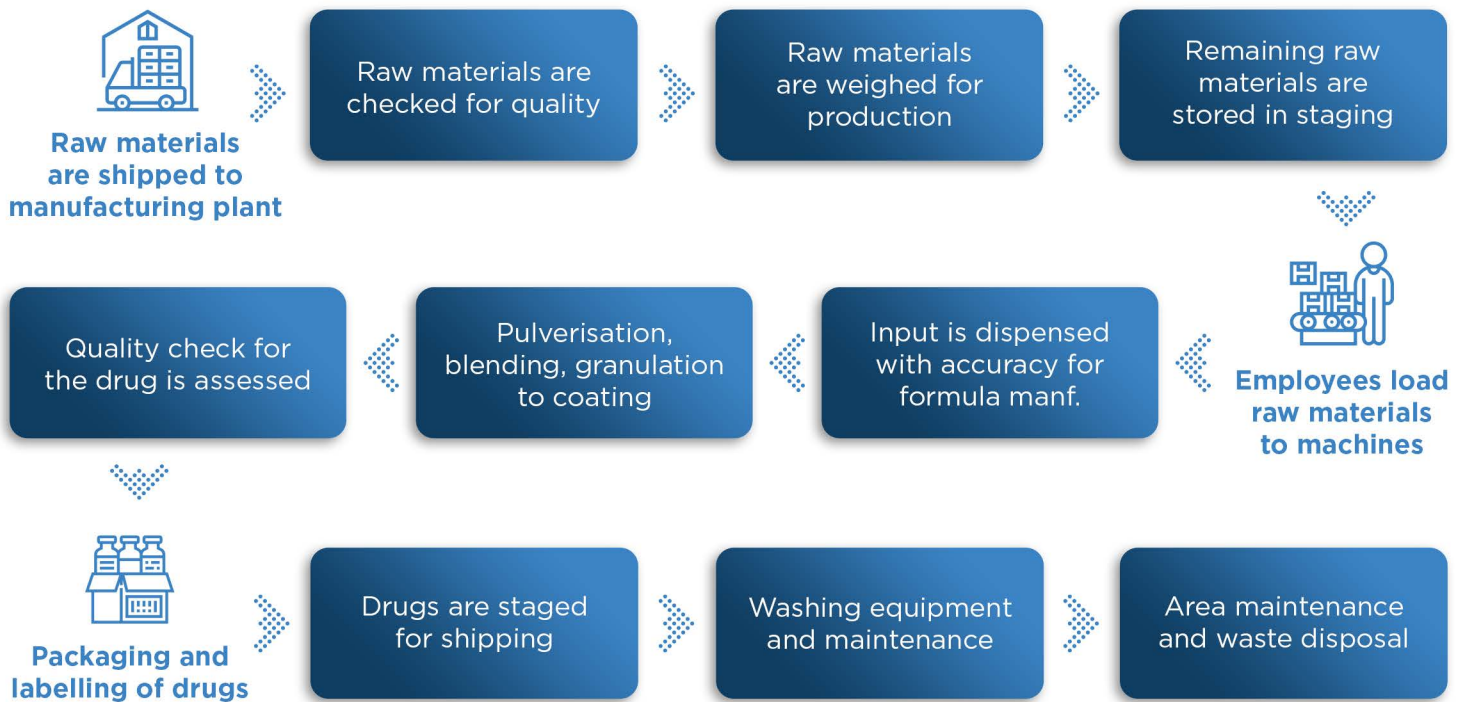
Simplified smart factory

A smart factory can integrate data from system-wide physical, operational, human assets to drive manufacturing, maintenance, inventory tracking and digitisation of operations.

- Efficient and agile systems

- Better work schedule prediction

- Reduced production downtime

- A safer workplace

Raw materials are shipped to manufacturing plant

Raw materials are checked for quality

Raw materials are weighed for production

Remaining raw materials are stored in staging

Quality check for the drug is assessed

Pulverisation, blending, granulation to coating

Input is dispensed with accuracy for formula manf.

Employees load raw materials to machines

Packaging and labelling of drugs

Drugs are staged for shipping

Washing equipment and maintenance

Area maintenance and waste disposal

Expanding the vision for a single use case for raw material handling for a pharmaceutical company above

The above process gives an overview of a standard pharmaceutical manufacturing process. In each of these steps and processes, 5M approach can make a significant contribution to improving its efficiency in the following ways:

- Enable just-in-time manufacturing by ensuring that raw material supply chains are optimised so that components reach the manufacturing plant on time by tracking vehicles providing raw material supply

- Capture input weight automatically for audit and analytics

- View inventory, in-process and finished product status on a single dashboard

- Ensure maintenance of equipment is performed in a timely way, with automated schedules

- Generate real-time insights in resource consumption, outputs, and wastage

- Monitor and control environmental conditions, such as temperature / humidity, which is of particular importance in pharmaceutical manufacturing environment to maintain ambient conditions

- Track manpower and equipment availability to optimise asset utilisation and improve employee performance, safety and accountability

- Create a digital twin of manufacturing processes and equipment to monitor and act on alerts

- Schedule preventive maintenance of plant equipment by leveraging the data generated by the plant equipment and smart alerts generated by IoT-enabled systems
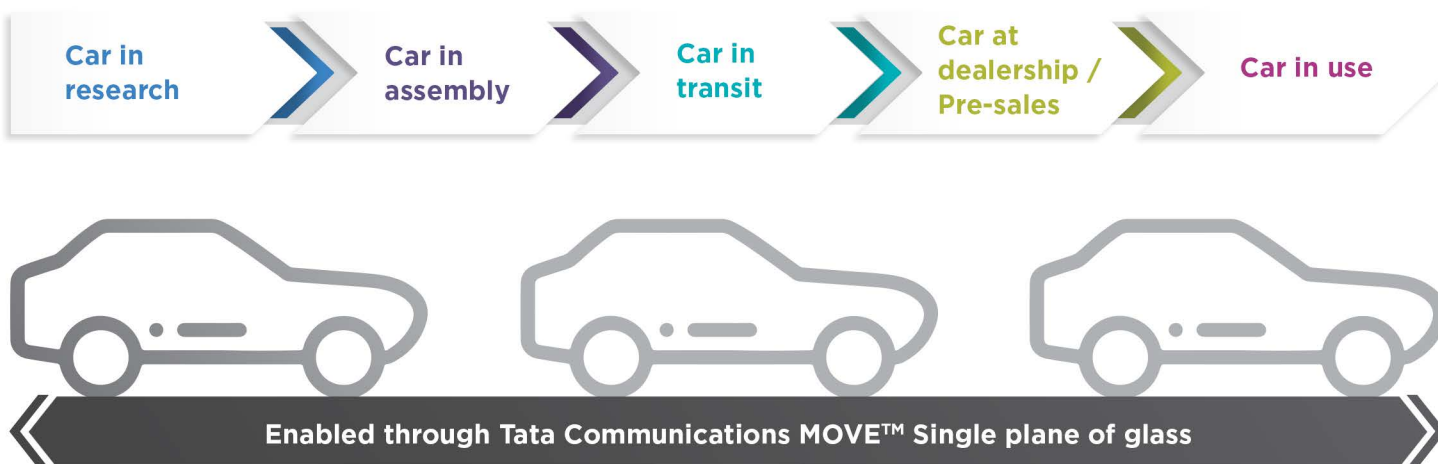
Automotive Industry

As automotive vehicles become increasingly connected, a connected car platform addressing connectivity, information management and monetisation will enable auto-manufacturers to improve efficiencies across their value chain, while delivering next-generation driver experience cutting across safety, infotainment, and Advanced Driver Assisted Systems (ADAS) among others. Further, the use of driver data, AI and data analytics can enable automotive OEMs to solve the complex problem of subscription renewals and enhance the revenue line.

With widespread adoption of 5G, the connected car proposition can go a step further by incorporating mobile edge processing onto the platform. In the automotive sector, Industry 4.0 can bring transformation to how a car is designed, developed, and tested. The new generation of software defined vehicles can offer a next-generation driver experience by relying on 5G networks for infotainment, Software / Firmware Over the Air (SOTA / FOTA) updates as well as real time Vehicle to Anything (V2X) communication resulting in a safer driver experience.

SOTA / FOTA reduces the need for vehicle recalls and ensures a safer and richer driving experience for consumers. 5G introduces a new level of resilience which enables OEMs to run OTA campaigns under best Quality of Service (QoS) conditions and end-to-end security. Tata Communication SOTA optimisation process, supported by connectivity health checks and a dedicated SOTA toolkit can reduce the cost implication of SOTA campaigns by up to a third for OEMs. The global OTA market for the auto sector alone is poised to be worth USD $8.4 billion by 2027 (BrandEssenceResearch).

SOTA / FOTA will enable OEMs to deliver engineering fixes and on-demand features, many of which will be revenue generating for the OEM. Enabling SOTA will impact safety and compliance around the connected car ecosystem, improving the driver experience and resulting in higher revenues.

| Car in research | Car in assembly | Car in transit | Car at dealership / Pre-sales | Car in use |

Enabled through Tata Communications MOVE™ Single plane of glass

Manufacturing industry

Across multiple manufacturing sectors, including high-technology assembly, as well as light and heavy engineering, our platforms help orchestrate and optimise connectivity across - man, material, and machine. We help our customers to improve the productivity of the machines, equipment and devices used in the manufacturing process, tracking and managing equipment across its lifecycle.

A private 5G network can support multiple applications, requiring varying connectivity and data throughput requirements. An example of this is the use of AR / VR to transform the way training, maintenance and design is carried out.

Healthcare

5G enables telemedicine, robotic and remote surgeries, real-time tracking of patient movement, patient monitoring through wearables agnostic of the location of the patient or the doctor. Healthcare solutions can make disseminating such services accurate, efficient, convenient, cost-effective and add substantial scale. Preventive healthcare solutions (wearables and ingestible) lead to decreased long-term healthcare costs.

Our healthcare solution covers the life of the machine right from manufacturing, tracking of the device while in transit, patient analysis, diagnosis prescription to end of life of device enabling a 360-degree view of healthcare.
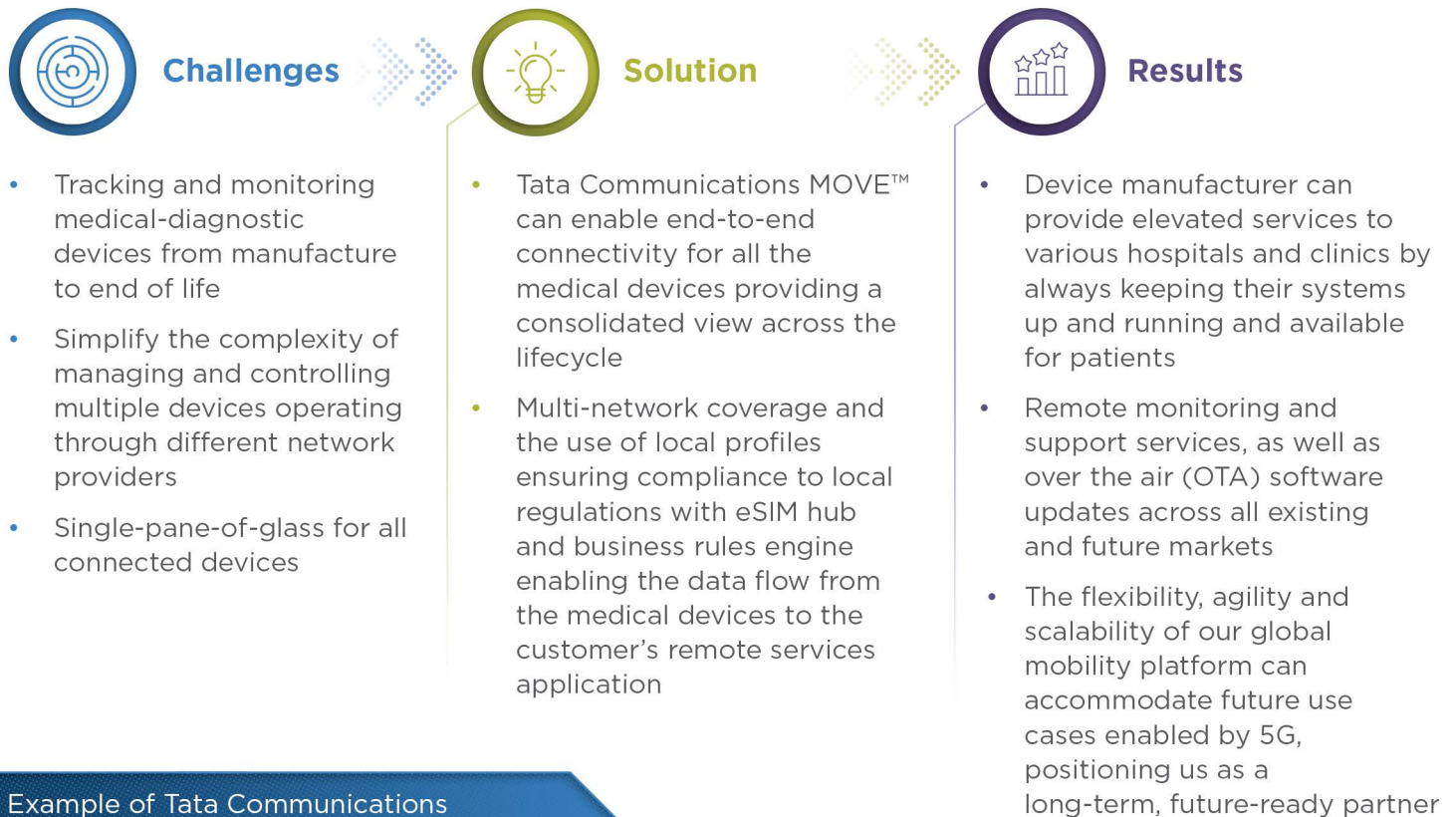
Flexible, agile, and scalable global mobility platform with the ability to support medical device manufacturers to track, monitor and remotely manage devices installed anywhere, anytime

- Remote monitoring and upgrade
- 5G can facilitate a transformation to a 'Collaborative-Diagnostic' model with remote real-time advisory through the Tata Communications MOVE™ platform improving speed of treatment while ensuring accuracy bringing radiologists and diagnosticians on the same platform

Challenges

- Tracking and monitoring medical-diagnostic devices from manufacture to end of life
- Simplify the complexity of managing and controlling multiple devices operating through different network providers
- Single-pane-of-glass for all connected devices

Solution

- Tata Communications MOVE™ can enable end-to-end connectivity for all the medical devices providing a consolidated view across the lifecycle
- Multi-network coverage and the use of local profiles ensuring compliance to local regulations with eSIM hub and business rules engine enabling the data flow from the medical devices to the customer's remote services application

Results

- Device manufacturer can provide elevated services to various hospitals and clinics by always keeping their systems up and running and available for patients
- Remote monitoring and support services, as well as over the air (OTA) software updates across all existing and future markets
- The flexibility, agility and scalability of our global mobility platform can accommodate future use cases enabled by 5G, positioning us as a long-term, future-ready partner

Example of Tata Communications MOVE™ applied for the healthcare industry

How Tata Communications can transform your enterprise with 5G-enabled IoT

Our digital platform offers easy plug-and-play enablement of devices and sensors. Tata Communications MOVE™ platform is already transforming the way enterprises manage their connected assets globally. The platform abstracts the underlying connectivity complexities, using the optimum connections. With the advent of 5G, the diversity of new business models and revenue streams will grow significantly.

Connectivity embedded at chip level will increasingly lower the traditional barriers of massive IoT and 5M deployment. Tata Communications MOVE™ is a technology-agnostic IoT connectivity and data management platform that enables the user to manage the lifecycle of its entire IoT use-case. Accompanied by device management platform and APIs to configure, monitor, and manage your deployed IoT devices, Tata Communications brings in pre-built applications for multiple MMM use-cases.

With the adoption of 5G, our value proposition goes a step further combining platforms, devices, communication layer and Edge PaaS for enhanced analytics capabilities. We enable use cases relying on low latency, high speed, and large volumes of data and with our data analytics layer support real-time informed decision making for improved efficiencies and productivity. Tata Communications end-to-end MMM solutions powers enterprises to deliver personalised user experience through a secure ecosystem:

- Our data insight layer adds value by enabling specific 5G use cases, enhancing revenue, efficiency, and safety across man-machine-material lifecycle

- Empower businesses to better understand consumer patterns and demands and enhance their services to end-consumers
- We combine 5G with multi-edge computing and data analytics to power private networks deployed with most optimally distributed architecture
- Our solution employs zero-touch device activation and management, together with zero-trust security, making the network architecture secure, as well as cost and process-efficient

Conclusion

The shift from automation towards hyperconnectivity on the back of 5G and other new technologies is poised to impact the entire value chain and will transform the way enterprises do business. A CXO needs to consider variables like the right technology, the right partner, flexible modules, ability to scale and balance it with return on investment to successfully transform. At the heart of this transformation is the ability to create an ecosystem which allows for scale, upgrade to future technologies, a single-pane-of-glass management interface and flexible management at the right cost.

At Tata Communications, we enable this digital ecosystem, powering today's fast-growing digital economy including 300 of the Fortune 500 - unlocking opportunities for businesses by enabling borderless growth, boosting product innovation and customer experience, improving productivity and efficiency, building agility, and managing risk. With its solutions-orientated approach, proven managed service capabilities and cutting-edge infrastructure, Tata Communications drives the next level of intelligence powered by its global network, cloud service integration, mobility, Internet of Things (IoT), collaboration and managed security services. Its end-to-end secure digital platforms and solutions are deployed and managed successfully across the world.

In the 5G era, Tata Communications vision focuses on automating the interplay between Man-Machine-Material-Method-Market to enable a holistic ecosystem. This ecosystem will transform enterprises to not only achieve current business goals, but also unlock new revenue sources, business models and the ability to address new markets through secure digital experiences.

We are ready for this transformation, are you?

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TATA

About Tata Communications

A part of the Tata Group, Tata Communications (NSE: TATACOMM; BSE: 500483) is a global digital ecosystem enabler powering today's fast-growing digital economy in more than 190 countries and territories. Leading with trust, it enables digital transformation of enterprises globally with collaboration and connected solutions, core and next gen connectivity, cloud hosting and security solutions and media services. 300 of the Fortune 500 companies are its customers and the company connects businesses to 80% of the world's cloud giants. Its Tier-1 IP network, wholly-owned subsea fibre.

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