CYIENT

LEVERAGING IOT FOR STREAMLINED MANAGEMENT OF PASSIVE NETWORK ELEMENTS IN TOWER OPERATIONS

CONTENTS

Abstract

Monitoring mobile tower operations and active networks through automated systems offers network operators visibility into tower performance and can transform the way they operate—reducing operating expenses and improving efficiency. When an IoT-based approach is used for the process, sensors can be mounted anywhere from doors and energy meters to fuel tanks and fire alarms. These sensors collect and transmit real-time information to the monitoring teams, giving them a holistic view of their current operational conditions and alerting them to the corrective actions required. Today tower management companies depend on service providers for information on passive network elements as the data currently flows into the NOC. Having standalone TOC monitoring would significantly simplify the cumbersome process of data flow from the NOC to tower management companies and thence to field operations. IoT-led tower operations propose to de-bottleneck the entire flow of information of passive network elements and route it directly to tower management companies, thereby significantly reducing the NOC workload. This will help CSPs focus on their core competency—managing active networks.

The Evolving Telecom Market

The global telecom industry has undergone a major transformation in the last ten years. Mobile operators consistently adopted innovative technologies to improve signal strength and data transmission speeds. Cellular network generations moved from 2G to 4G and are advancing to 5G. Amidst these changes, the mobile tower industry has been a significant enabler of the new business models adopted by communications service providers (CSPs).

While CSPs focus on improving their subscribers' experience by offering reliable services throughout their network, shared wireless infrastructure continues to predominate the telecom landscape. Almost all of today's shared infrastructure niches started out as single-use facilities. However, shortened time-to-market and increasing demand for wireless services became catalysts for installing more and more shared tower operations centers.

A number of cellular network operators are shifting from managing captive towers to leasing tower space on shared cell sites from the tower operators—with many CSPs leasing space on the very towers they once owned and managed. While captive ownership of mobile towers is still widespread, the shift toward a co-tenancy model, wherein several CSPs share space on towers, is transforming the telecom domain. The shared model offers a favorable environment to tower companies for enhancing the value of their entire portfolio, positioning them strongly in the market, and making them worthy of acquisition.

This white paper describes the time- and cost-saving infrastructure life cycle management solutions that tower companies can use on complex build-to-suit and co-location projects, while also managing co-tenant leases effectively and improving visibility into passive network elements of the cell tower to ensure always on-networks for CSPs.

What is Driving Growth in Mobile Tower Operations?

The traditional cellular communications business model was based on full ownership of network infrastructure. When this gave way to network infrastructure sharing, it also brought new technical challenges for CSPs despite the reduction in their overall capital expenditure.

Sharing mobile towers is an area where CSPs have effectively collaborated because of the relatively high capital investment involved in building and maintaining individual towers. A shared infrastructure implies common usage of space on the tower. Multiple telecom operators may install their base antennae and microwave link antennae on a single tower unit.

The growth of mobile tower operations and consequent sharing of network infrastructure has been driven by multiple factors:

a) **Data explosion and spectral shortage**
The increasing penetration of smartphones and Internet-enabled devices around the world has led to a growing demand for data. The total smartphone data traffic is expected to rise tenfold between 2016 and 2022 and the total mobile traffic for

all devices by eight times.[1] Being the most populated region, currently the Asia Pacific has the biggest share of mobile data traffic.
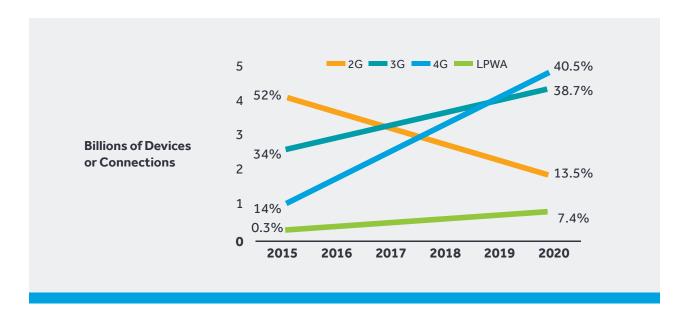
b) **Schematic deleted**
On the other hand, North America and Western Europe have, at present, a bigger share of total traffic volume than what their numbers convey. This is because of greater penetration of high-end devices and well-structured WCDMA and LTE networks harmonized by low-cost packages of substantial data volumes.

c) **Network upgrades and new technology rollouts**
Another reason for increasing dependence on superior mobile tower operations is continuous upgrades in network operations and the rolling out of new data technologies. Telecom growth has traversed through multiple generations in the short span of a few decades. As subscribers use increasingly fast access technologies, data consumption is also growing rapidly.

A report from a study in September 2015[2] reveals that as compared to 2014, the use of 2G came down by 10% while that of 3G went up to 19% and 4G to 140%.

The drop in 2G figures suggests that it will be the first of all generations to disappear. However, there are still plenty of 2G devices in Asian countries, and it continues to remain significant for the M2M market segment. The use of 3G is predicted to peak around 2020 and LTE is expected to catch up with it at a share of 40%.

In addition to data technology generations, changes have also been observed in the percentage of users by mobile technology type: GMS, LTE, CDMA, TD-SCDMA, and HSPA.

d) **New customer segments: businesses and government**
For over a decade, telecommunications service providers have primarily focused on improving their growth in the consumer market. With myriad affordable calling plans, mobile usage became universal, and CSPs focused on the sale of broadband services and digital TV subscriptions for homes. Of late, these companies have started shifting focus to acquiring and growing their business-to-business (B2B) market share. Telecom companies see untapped potential and new opportunities in the business market.

Increasing demand for mobile data and addressable IT solutions comes from businesses whose customer contact centers, online services, and e-commerce operations depend on flawless telecom networks. Over the next two years, the business segment of telecom companies is expected to overtake the residential segment to become the new growth engine. Whereas the consumer market is expected to continue growing **at a rate of about 0.6% yearly, the B2B market is set to grow at a rate of approximately 2.6%.[3]**

Increasing digitalization of government-backed services such as passport applications, tax returns, and application for loans from public sector institutions has also created a significant customer segment for telecom companies.

An intermix of the factors mentioned above results in more demands on telecom networks and this, in turn, implies higher expectations from companies handling mobile tower operations. Is the tower industry ready to fulfill the expectations? What are the pressures on this domain?

GROWING REVENUE PRESSURE DUE TO NETWORK UPGRADES, EVOLVING CUSTOMER SEGMENTS, AND DATA EXPLOSION ARE FORCING TELECOMS TO LOOK TOWARD INFRASTRUCTURE SHARING

Challenges for the Mobile Tower Industry

Maintaining their towers and streamlining operations for clients (the telecom companies) are becoming a challenge for tower operating companies primarily because of the sheer number of units. The complications also arise from:

a) **Infrastructure sharing complexity**
While it is possible for two networks to co-exist in a tower, the sharing brings complexities with the risk of lowering system performance. Technical threats if not adequately evaluated can erode the perceived benefits of tower sharing.

Achieving optimum antenna height for all operators is a major challenge in a shared environment. Mobile towers have specific permissible loading limits. In several cases, the antennas are placed at a height that does not meet specifications. Tower loading begins to cover anything added to the tower that gets exposed to the wind. Most of the older towers were designed for a single operator and are incompatible for sharing. Attempts to share them can be hazardous for people living in and around the vicinity. Tower overload and compromising on antenna size also affects microwave link design and quality

Limited design diversity is another problem for tower operators. The placing of a cellular communications tower is preceded by studies that decide upon its ideal location for maximum coverage and signal quality. Any failure in locating the ideal position or acquiring it leads to non-optimal network design. By sharing towers, operators can replicate traditional failures of existing

networks in their new networks. This is another technical complexity that may jeopardize the quality of newly implemented networks.

b) **Tight service level agreements**
Another aspect that is critical to managing end-user, logical, and physical inventory assets to support service fulfillment is defining and implementing an effective strategy for data migration to scalable NGOSS systems.

c) **Traffic offloading**
Due to heavier traffic volumes expected in the next few years, network operators are expected to offload a significant fraction of traffic on microsites and Wi-Fi, which might cause macro site lease tenures to be shorter than expected.

d) **Fuel pilferage**
Regular supplies of diesel are necessary for sites that use generators, but as prices of fuel continue to rise, cases of pilferage have been on the rise in many areas. This not

only causes losses to the operators but can also cause network downtime due to fuel shortage.

e) **Alternative access technologies**
The entry of new market players such as Google and Comcast poses a fresh threat for network operators and their cell tower managing companies. Technology disruptions in form of MVNOs using Wi-Fi hotspots and Google's gigabit Internet can affect the business of mobile network operators, reducing the demand for tower sites too.

Improving Efficiency and Profitability of Co-Location Mobile Tower Projects

When CSPs approach a tower company for co-location, revenues can be generated quickly and profitably by getting the tower and assets up and running faster and without any glitches. However, storing data and processes in multiple files and systems can make it complicated to access and control data sets and manage work required for feasibility studies, permitting ground leases site visits, and other aspects of project management.

Here are some significant capabilities that must be considered in an infrastructure life cycle management system to improve speed and reduce costs of base transceiver station (BTS) and co-location projects.

a) **Templates to schedule projects for standardized**
With an arrangement for best practices-driven project schedules for tower build and new asset installations, tower companies can initiate new projects seamlessly without beginning from scratch every time. They need to have systems that offer customized process steps, with the flexibility to change the steps as per specific conditions such as weather conditions.

b) **Automated workflows for organized task handoffs**
Companies can deploy a system that lets them automate the progression of projects. It should be able to track the completion of each step and notify the department that needs to take up the next stage. It should also allow for setting up task dependencies between related projects and necessitate documentation of every completed stage to ensure a smooth transfer of responsibilities between team members and third-party vendors. It is also essential to comply with government laws and regulations because such a system can enforce specific processes while also managing documents related to work permits.

c) **Access settings for control over system**
Some of the network data and processes concerning multiple CSPs may be too confidential to share with the tower company. This makes it critical that tower management companies have direct access to passive network element data essential for their towers. The system must give the tower company complete control over who can read, edit, and perform other tasks with information available.

Improving Revenue Generation: Managing Co-Tenant Leases More Effectively

With multiple tenants, it is essential for tower companies to manage their leases accurately for successful revenue generation. However, tracking the fuel consumption levels, progressive rent increases, and lease agreement renewals dates for hundreds of co-tenants can be a complicated task. If leases are managed manually or through multiple disjointed applications, omitting even a single piece of data can pose a very costly risk.

By automating lease management processes, mobile tower companies can enhance the accuracy of their lease administration and increase visibility into their financial data. An IoT-based infrastructure life cycle management system can be specifically built to automate lease administration processes and ensure that key lease agreement dates are acknowledged and addressed in time.

How Can an IoT-Based Platform for Lease and Mobile Tower Infrastructure Management Help?

As networks expand, OPEX increases, and significant security threats emerge, it is becoming difficult to manage mobile tower sites for multiple stakeholders from a centralized base. Poorly maintained assets and unclear energy consumption patterns also add to the complexities of network operation centers (NOCs). The solution for such problems has to be built on a unified platform.

Backed by its internal research and expertise in data analytics solutions, Cyient suggests a holistic mobile tower management strategy that leverages the power of IoT.

Given that there are multiple stakeholders involved in tower site management and that multiple users need to access the site, a variety of protocols across different locations govern such access. In certain cases, health and safety documents are to be necessarily submitted for visiting the site. Contractors may also need different time slots for site access to avoid crowding.

An IoT-based platform in the cloud can have different user groups where digital approvals are issued in line with various processes and requests to secure the integrity of assets. This helps the tower companies to manage multiple assets and gives them insights into others' involvement in tower operations management.

It can also offer a contact list where all stakeholders are listed.

If a company finds stakeholders that they were not aware of and new equipment that was deployed, the system enables them to cross-check with the asset register and identify the unapproved equipment so they can take decisions on increasing the lease rate or shifting the equipment elsewhere. Such a platform can also track milestones so that the stakeholders know the actions they need to take and if any changes are required for their assets.

The value of IoT in the telecommunications industry lies in its ability to get real-time insights into asset performance and key operations. A platform based on IoT can be the turnkey solution for remote monitoring of mobile tower sites in widely spread geographic areas. It also enables smoother site management, energy efficiency, and security of the entire site.
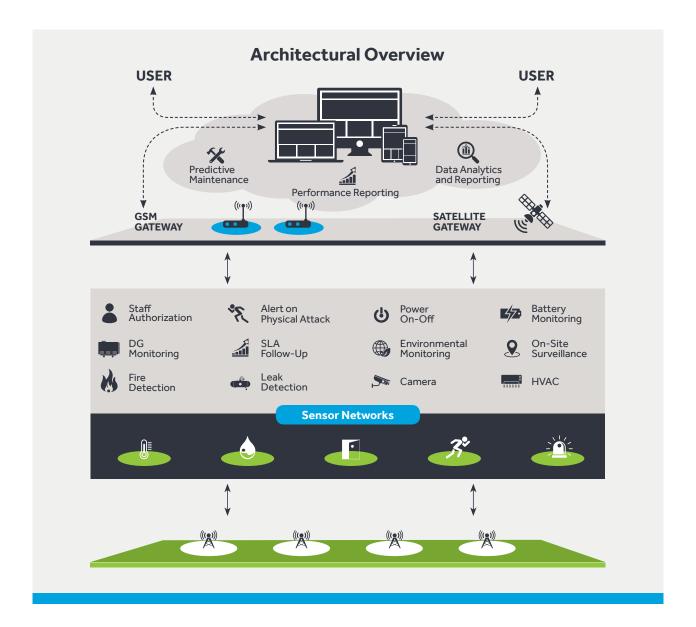
IoT, by design, is a simple mechanism to store and process large amounts of data from alarms, events, engine, battery, HVAC, camera, and environmental conditions. The data transmitted by sensors can also be pushed to the cloud and saved for future analysis.

An end-to-end IoT platform is a software framework that remotely connects all the "things" in mobile tower site architecture. It can manage devices, collect data from both analog and digital systems, and allow analytics, action management, and visualization while also having the ability to be integrated with cloud solutions.

The architecture includes a **gateway** where devices enable communication between sensors and the software application. The information from sensors can be suitably extracted by the gateway and presented to the software application for analysis.

BACKED BY OUR INTERNAL RESEARCH AND EXPERTISE IN DATA ANALYTICS SOLUTIONS, WE RECOMMEND A HOLISTIC, IOT-DRIVEN MOBILE TOWER MANAGEMENT STRATEGY
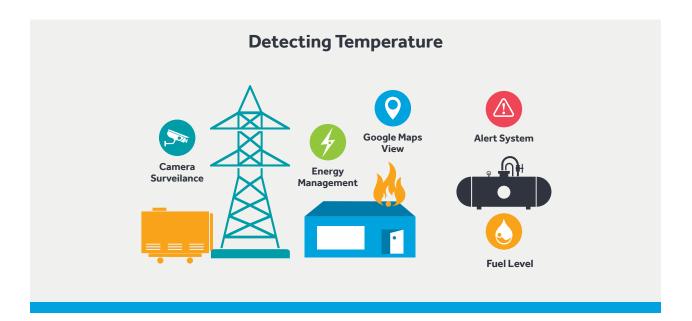
Architectural Overview

The multiple sensors in this architectural framework become the physical touch points that collect and feed data as well as parameters to the gateway device. They may include:

- Sensors on energy meter—for monitoring energy flow through the tower
- Passive Infrared (PIR) motion sensor—for detecting the amount of infrared light radiating from tower assets
- AC-DC current sensor—for determining the quality of power generated
- Door contact sensor—for controlling access to the mobile tower site

- Temperature sensor—for maintaining the optimum temperature at the tower site
- Smoke/fire sensor—for alerts during a fire
- Fuel level sensor—for tracking fuel level and detecting pilferage
- Vibration sensor—for controlling vibrations in tower operations

As an IoT platform tends to follow an open architecture system and can support multiple protocols, adding more sensors to meet the unique requirements of the tower management team is simple.

Detecting Temperature

The different aspects of lease management that can be facilitated by IoT solutions include:

i) **Automated lease execution and billing**
Whether it is the management of a tower lease agreement with the clients or the site lease agreement with the landowner, the automated IoT-based system can enable the extraction of the all key terms of the agreement, the exceptions, the escalations, cost-sharing, and premiums for additional MNO equipment. All of these need to be pulled into a process workflow to automate each review and validation step and to notify the designated employees about the critical targets. These capabilities ensure that all applicable clauses are taken into consideration and opportunities to collect revenue through lease agreements are not missed.

ii) **Estimating new co-location opportunities and potential revenue**
Another advantage of housing all lease agreements in an integrated system is visibility into the available space and revenue generated by all the towers. How many tenants can the towers accommodate? Is there any free space available for more tenants? What will be the tower capacity in the near future? The system should be able to display an overview and the details of existing and projected revenue, possibilities of adding new MNO equipment, and other insights to help the tower company in getting the highest revenue from each of its towers.

iii) **Monitoring assets for profitable operations**
In addition to project and lease management, tower companies also need to track, manage, and maintain their towers and assets more systematically. The infrastructure life cycle management system should help in managing and tracking equipment conditions, wear, and replacements while also automating and tracking preventive and sudden maintenance to ensure that the assets help in increasing and not adversely affecting the profitability of tower operations.

The biggest complexity in tower portfolio management is around the varying legal and commercial regulations in each country. This is where Cyient's experience of working in global markets enables it to build custom solutions that mitigate complexities for users. The IoT-based management platform for tower companies can be integrated with

features such as invoicing, promotional offers for tenured tenants, taxes, and site capacity. We can also integrate the management platforms with multiple systems that tower companies employ including raising of tickets, ERPs, and document management.

In monitoring the mobile tower site, the supportive modules of an IoT-based system can include:

iv) **Power management**
Mobile tower sites have three major sources of power: a (usually unreliable) grid, diesel generator, and battery bank. When the

site is remotely monitored through an IoT platform, operators can swap between the power sources and switch to battery backups only if the grid goes down. This also optimizes battery life.

The IoT solution will also enable operators to acquire information needed for strategic planning. With systematic reports on power consumption by devices and the frequency of outages, they can plan for additional load inputs. Temperature sensors can also be integrated with the cooling system to maintain optimum temperature on the cell tower site, thereby reducing cooling costs.
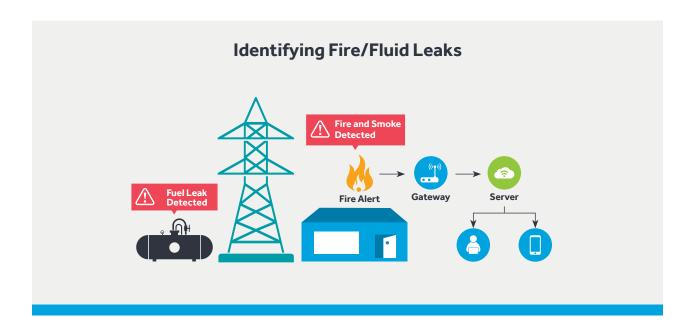

Monitoring Asset Conditions

v) **Asset condition monitoring**
Since mobile towers function at remote sites and have capital-intensive fixed assets, the underutilization of these assets poses a threat of loss caused by downtime. It is therefore essential to monitor the health of these assets in real time and foresee maintenance needs by identifying under-performing assets. The IoT-based platform for tower management turns reactive maintenance to predictive maintenance.

As an example, the quality of power churned out by the diesel generators on

site is ascertained in kWh and it defines the generator runtime. By measuring the changes in cost per kWh operators can identify the generators that need to be replaced/repaired.

Cyient believes that an IoT system for tower operations management can be designed to create customized views on a dashboard feature. It can enable users to get 360-degree views of all their assets on a particular site.

Identifying Fire/Fluid Leaks

More Efficient Workforce and Linked Logistics

Independent mobile tower operating companies and telecom service providers maintain thousands of sites that need a huge number of field technicians to meet the SLAs. Remote monitoring of assets and work at sites through an IoT platform can bring more transparency in the supply chain and streamline workforce allocation.

If a tower site goes down or needs proactive maintenance, technicians can get instant alerts through phone calls or messages. Details about device errors, the corrective remedies needed, and the exact site location can also be transmitted to them. This ultimately helps to save on both maintenance and fuel costs.

A bespoke IoT-oriented platform can support multiple protocols and thereby turns out to be a cost-effective solution that can also be developed quickly. Its gateways have strong computing powers that allow data to be analyzed on edge.

When data is aggregated from multiple tower sites, it also enables identification of trends and anomalies giving insights into what is working and what is not.

The benefits of automated lease management and tower monitoring through an IoT system may be summarized as:

For Mobile Tower Companies	For CSPs
Real-Time Monitoring	Higher Uptime
Early Detection of Problems	Stable Network
Longer Asset Life	Single Point of Contact
Higher Revenue Generation	Satisfied Customers
Process Efficiencies	
Improved CAPEX/OPEX–Productivity	

IoT-Driven Tower Management is the Way Forward

Expanding networks, increasing OPEX, and significant security threats make management of mobile tower sites difficult. Poor maintenance of assets and low visibility into energy consumption patterns also make things complex. An end-to-end site management solution based on IoT can be a panacea against risks and challenges faced by tower operations centers.

Sensors mounted on different devices onsite collect and transmit real-time data to the central management system giving CSPs a comprehensive idea of their operating conditions. Remote monitoring will also enable:

i) **Upkeep of service level agreements with minimum costs**

ii) **Smoother operations of asset-intensive sites**

iii) **Monitoring of fuel refilling and averting fuel pilferage**

iv) **Reduction of OPEX for market competitiveness**

v) **Detecting intrusion into the tower site**

f) **Better environmental practices by reducing carbon emissions**

While IoT platforms simplify management of mobile towers, their initial deployments can be considerably complex, expensive, and involve a huge number of centers to be monitored while linking a mix of devices, networks, and applications. An out-of-box approach by Cyient simplifies implementation and minimizes the time required for configuration. We help our clients choose the finest devices and sensors and bring them alive on a scalable system.

Backed by experience, expertise, and a broad ecosystem of technology partners, Cyient brings tailored, end-to-end solutions for efficient cell tower monitoring and better network coverage.

Sources

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2- https://www.thinksmallcell.com/Opinion/mobile-network-statistics-for-2016.html

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THE CYIENT THOUGHT BOARD

What factors caused mobile network companies to outsource their tower operations and share infrastructure with others?

| Rising demand for bandwidth | New business models | Preference for fixed costs | Focus on operational excellence | Overlapping of sites | Green telecom regulations |

What are the key technical and business challenges faced by mobile tower operating companies?

| Infrastructure sharing | Tight SLAs | Rising energy bills |
| Fuel pilferage | Costly asset maintenance | Alternative data access technologies |

Which aspects of mobile tower operation sites can be remotely managed using an IoT platform?

| Asset management | Alarm management | Temperature management | Predictive maintenance | Fuel management | Workforce management | Tenant lease management |

How can remote monitoring help tower operating companies and their clients in improving a site's business value?

| Monitoring power consumption | Identifying fuel leaks | Detecting intrusions | Escalating alerts to right parties | Reducing OPEX | Enabling eco-friendly practices |

About Cyient

Cyient (Estd: 1991, NSE: CYIENT) is a global engineering and technology solutions company. As a Design, Build, and Maintain partner, for leading organizations worldwide, we take solution ownership across the value chain to help clients focus on their core, innovate, and stay ahead of the curve. We leverage digital technologies, advanced analytics capabilities, and our domain knowledge and technical expertise, to solve complex business problems.

With over 15,000 employees in 20 countries, we partner with clients to operate as part of their extended team in ways that best suit their organization's culture and requirements. Our industry focus includes aerospace and defense, healthcare, telecommunications, rail transportation, semiconductor, geospatial, industrial, and energy.

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