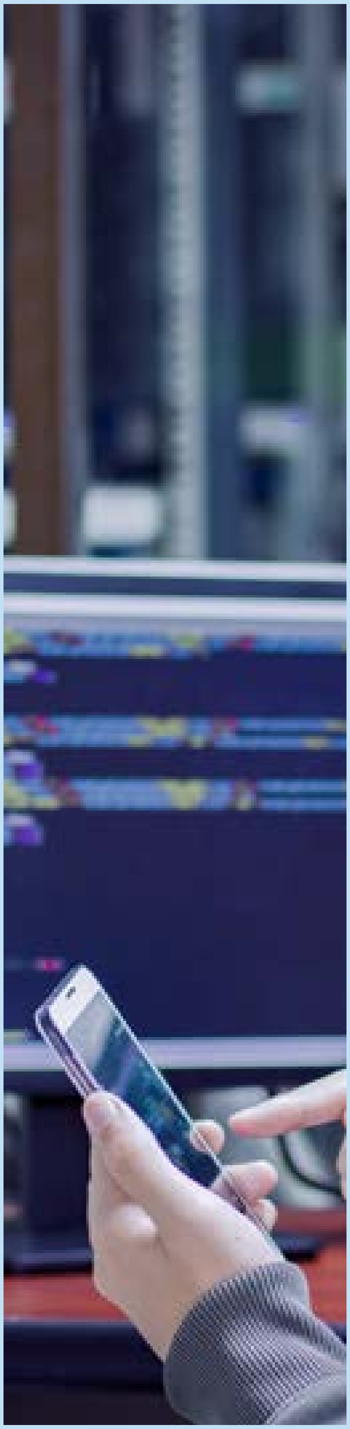
VIEW POINT



TESTING IOT APPLICATIONS - A PERSPECTIVE

- Manjunatha Gurulingaiah Kukkuru,
Principal Research Analyst

Infosys®
Navigate your next

Introduction

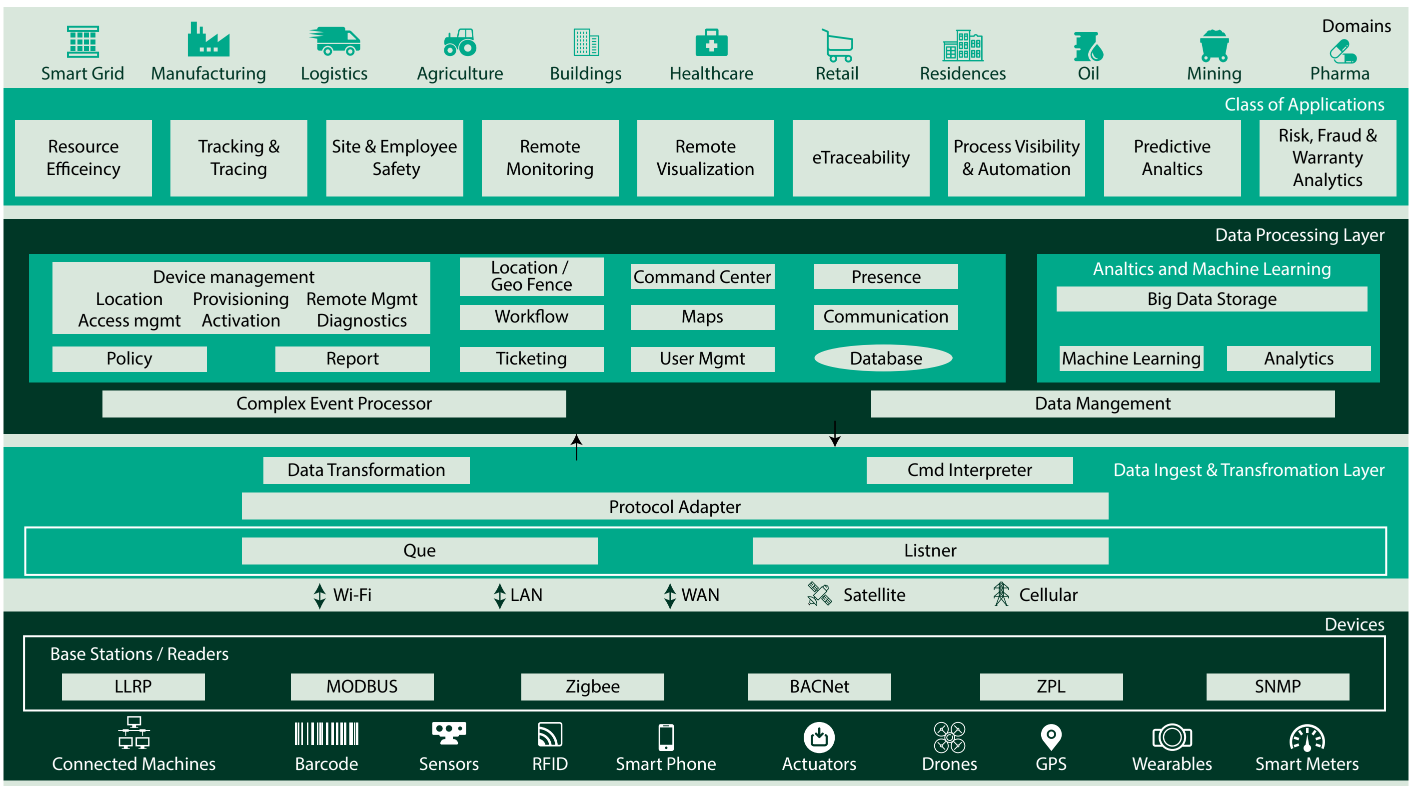
The Internet of Things (IoT) is a network of physical objects (devices, vehicles, buildings, and other items) that are embedded with electronics, software, sensors, and network connectivity to collect and exchange data.

According to a recent report by McKinsey, around 30 billion objects may be connected through IoT by 2020.

Enterprises are adopting IoT solutions for the benefits they offer; such as, optimization in operations, reduction in costs, and improvement in efficiency. The development and adoption of IoT is being driven by multiple factors, including easily available low-cost sensors, increase in bandwidth and processing power, wide-spread usage of smartphones, availability of big data analysis tools, and scalability of internet protocol version 6. Organizations are now starting to focus on external benefits such as generating revenues from IoT-enabled products, services, and customer experiences.

IoT: A web of interconnected layers

The following figure indicates a reference architecture for IoT, comprising of multiple layers built on top of each other to create industry-specific solutions. The components in each layer include devices, protocols, and modules that need to work in sync in order to effectively convert data to information, and subsequently to insights.



- **Device layer:** Consists of various devices like sensors, wearables, smart meters, radio frequency identification (RFID) tags, smartphones, drones, etc. With such a diverse set of devices, a huge set of standard and custom communication protocols — including ZigBee, BACnet, LLRP, and Modbus — are implemented.
- **Data ingestion and transformation layer:** Data from the device layer is transformed through different protocols to a standard format for further processing by the data processing layer. This data could be from sensors, actuators, wearables, RFID, etc., received via TCP/IP socket communication or messaging queues like MQTT, AMQP, CoAP, DDS, Kafka, and HTTP / HTTPS over Rest API.
- **Data processing layer:** With data available from millions of devices, performing image, preventive, and predictive analytics on batch-data provides meaningful insights. Modules like a 'complex event processor' enable the analysis of transformed data by performing real-time streaming analytics — such as filtering, correlation, pattern-matching, etc. Additionally, multiple APIs for geo-maps, reporting, ticketing, device provisioning, communication, and various other modules aid in quick creation of dashboards.
- **Applications layer:** With the availability of such rich datasets from a multitude of devices, a gamut of applications can be developed for resource efficiency, tracking and tracing, remote monitoring, predictive analytics, process visibility and automation, etc. and can also be applied to different industries and segments.

Unique characteristics and requirements of IoT systems

Compared to other applications, IoT applications are characterized by several unique factors, such as:

- Combination of hardware, sensors, connectors, gateways, and application software in a single system
- Real-time stream analytics / complex event processing
- Support for data volume, velocity, variety, and veracity
- Visualization of large-scale data

Challenges that thwart IoT testing

These characteristics consequently present a unique set of challenges when it comes to testing IoT applications. The primary challenges include:

- **Dynamic environment:** Unlike application testing performed in a defined environment, IoT has a very dynamic environment with millions of sensors and different devices in conjunction with intelligent software
- **Real-time complexity:** IoT applications can have multiple, real-time scenarios and its use cases are extremely complex
- **Scalability of the system:** Creating a test environment to assess functionality along with scalability and reliability is challenging

Apart from the above challenges, there exist several factors that present operational challenges:

- Related subsystems and components owned by third-party units
- Complex set of use cases to create test cases and data
- Hardware quality and accuracy
- Security and privacy issues
- Safety concerns

Types of IoT testing

The complex architecture of IoT systems and their unique characteristics mandate various types of tests across all system components. In order to ensure that the scalability, performance, and security of IoT applications is up to the mark, the following types of tests are recommended:

Edge testing

Several emerging, industrial IoT applications require coordinated, real-time analytics at the 'edge' of a network, using algorithms that require a scale of computation and data volume / velocity. However, the networks connecting these edge devices often fail to provide sufficient capability, bandwidth, and reliability. Thus, edge testing is very essential for any IoT application.

Protocol and device interoperability testing

IoT communication protocol and device interoperability testing involves assessing the ability to seamlessly interoperate protocols and devices across different standards and specifications.

Security and privacy testing

This includes security aspects like data protection, device identity authentication, encryption / decryption, and trust in cloud computing.

Network impact testing

Network impact testing involves measuring the qualitative and quantitative performance of a deployed IoT application in real network conditions. This can include testing IoT devices for a combination of network size, topology, and environment conditions.

Performance and real-time testing

This covers complex aspects like timing analysis, load testing, real-time stream analytics, and time-bound outputs, under the extremes of data volume, velocity, variety, and veracity.

End user application testing

Includes the testing of all functional and non-functional use cases of an IoT application, which also includes user experience and usability testing.

Infosys IoT Validation solution

Infosys has developed a comprehensive quality assurance (QA) strategy to handle the unique requirements and challenges associated with validating IoT applications. The Infosys IoT Validation solution enables testing with a combination of actual devices, tools, and frameworks. In addition, the Infosys IoT Test Framework provides all the capabilities required to perform functional validation, load simulation, and security verification. It can easily integrate with various IoT protocols and platforms, thus providing interoperability. This is just a glimpse of our capabilities, as we have various tools and solutions that can be leveraged to perform end-to-end testing of IoT solutions. To find out more about our IoT services, download the IoT testing flyer here.

Infosys®
Navigate your next

For more information, contact askus@infosys.com