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IoT – A Pathway to Smart India – Part 5 (Consumer Applications)

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Abstract **:**In this 5th Part of this exploratory paper, we revealed about Consumer Application provided through web, these are helping us in controlling Smart Home Appliances from work place. Some famous companies providing cloud-enabled services & standards like Ecalipse SCADA, Contiki, Virtual Cloud services by CISCO etc.

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I. IoT CONSUMER APPLICATIONS

Consumers benefit personally and professionally from the optimization and data analysis of IoT. IoT technology behaves like a team of personal assistants, advisors, and security. It enhances the way we live, work, and play.

Home

IoT takes the place of a full staff:

- **Butler –** IoT waits for you to return home, and ensures your home remains fully prepared. It monitors your supplies, family, and the state of your home. It takes actions to resolve any issues that appear.
- **Chef –** An IoT kitchen prepares meals or simply aids you in preparing them.
- **Nanny –** IoT can somewhat act as a guardian by controlling access, providing supplies, and alerting the proper individuals in an emergency.
- **Gardner –** The same IoT systems of a farm easily work for home landscaping.
- **Repairman –** Smart systems perform key maintenance and repairs, and also request them.
- **Security Guard –** IoT watches over you 24/7. It can observe suspicious individuals miles away, and recognize the potential of minor equipment problems to become disasters well before they do.

Figure 11 Smart Stove :**This smart, connected stove from Whirlpool allows two different heat settings on the same surface, remote monitoring, and remote control.**

Work

A smart office or other workspace combines customization of the work environment with smart tools. IoT learns about you, your job, and the way you work to deliver an optimized environment. This results in practical accommodations like adjusting the room temperature, but also more advanced benefits like modifying your schedule and the tools you use to increase your output and reduce your work time. IoT acts as a manager and consultant capable of seeing what you cannot.

Play

IoT learns as much about you personally as it does professionally. This enables the technology to support leisure:

- **Culture and Night Life –** IoT can analyze your real-world activities and response to guide you in finding more of the things and places you enjoy such as recommending restaurants and events based on your preferences and experiences.
- **Vacations –** Planning and saving for vacations proves difficult for some, and many utilize agencies, which can be replaced by IoT.
- **Products and Services –** IoT offers better analysis of the products you like and need than current analytics based on its deeper access. It integrates with key information like your finances to recommend great solutions.

II. IoT THINGWORX

Thingworx is a platform for the rapid development and deployment of smart, connected devices. Its set of integrated IoT development tools support connectivity, analysis, production, and other aspects of IoT development.

It offers Vuforia for implementing augmented reality development, and Kepware for industrial connectivity. KEPServerEX provides a single point for data distribution, and facilitates interoperability when partnered with a ThingWorx agent.

Figure 12 IoT THINGWORX

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Components

Thingworx offers several key tools for building applications. These tools include the Composer, the Mashup Builder, storage, a search engine, collaboration, and connectivity. The Composer provides a modeling environment for design testing. The Mashup Builder delivers easy dashboard building through common components (or widgets); for example, buttons, lists, wikis, gauges, and etc.

Thingworx uses a search engine known as SQUEAL, meaning Search, Query, and Analysis. Users employ SQUEAL in analyzing and filtering data, and searching records.

Interface

The ThingWorx platform uses certain terms you must familiarize yourself with. In the main screen's top menu, you search for **entities** or create them. "Entity" refers to something created in ThingWorx. You can also import/export files and perform various operations on them.

In the left menu, you find entity groups, which are used to produce models and visualize data; and manage storage, collaboration, security, and the system.

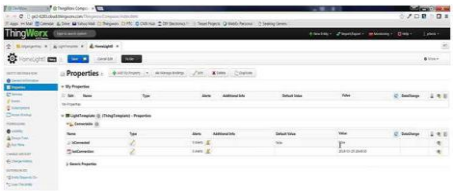

Figure 13 THINGWORX Platform 1

When you select the Modeling category in the menu, you begin the process by creating an entity. The entity can be any physical device or software element, and it produces an **event** on changes to its property values; for example, a sensor detects a temperature change. You can set events to trigger actions through a subscription which makes decisions based on device changes.

Data Shapes consist of one or more fields. They describe the data structure of custom events, infotables, streams, and datatables. Data shapes are considered entities.

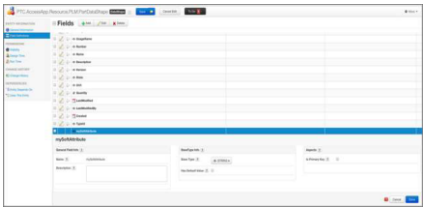

Figure 14 THINGWORX Platform 2

Thing Templates and **Thing Shapes** allow developers to avoid repeating device property definitions in large IoT systems. Developers create Thing Templates to allow new devices to inherit properties. They use Thing Shapes to define Templates, properties, or execute services.

Note a Thing only inherits properties, services, events, and other qualities from a single template, however, Things and templates can inherit properties from multiple Thing Shapes.

Development

ThingWorxactually requires very little programming. Users connect devices, establish a data source, establish device behaviors, and build an interface without any coding. It also offers scalability appropriate for both hobbyist projects and industrial applications.

III. IoT – CISCO VIRTUALIZED PACKET CORE

Cisco Virtualized Packet Core (VPC) is a technology providing all core services for 4G, 3G, 2G, WiFi, and small cell networks. It delivers networking functionality as virtualized services to allow greater scalability and faster deployment of new services at a reduced cost. It distributes and manages packet core functions across all resources, whether virtual or physical. Its key features include packet core service consolidation, dynamic scaling, and system agility.

Figure 15 Cisco Virtualized Packet Core

Its technology supports IoT by offering network function virtualization, SDN (software defined networking), and rapid networked system deployment. This proves critical because its virtualization and SDN support low-power, high flow networking, and the simple deployment of a wide variety of small devices. It eliminates many of the finer details of IoT systems, and conflicts, through consolidating into a single system and single technology for connecting and integrating all elements.

Use Case: Smart Transportation

Rail transportation provides a viable example of the power of VPC. The problems VPC solves relate to safety, mobility, efficiency, and service improvement:

- Rail applications use their own purpose-built networks, and suffer from interoperability issues; for example, trackside personnel cannot always communicate with local police due to different technologies.
- Determining if passengers need extra time to board remains a mostly manual task.

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- Data updates, like schedules, remain manual.
- Each piece of equipment, e.g., a surveillance camera, requires its own network and power source.

Figure 16 Smart MRT sign

VPC improves service by introducing direct communication over a standard network, more and automated monitoring, automatic data updates through smart signs, and native IP networks for all devices along with PoE (Power over Ethernet) technology. This results in passengers who feel safer, and enjoy a better quality service.

IV. IoT SALESFORCE

The Salesforce IoT Cloud is a platform for storing and processing IoT data. It uses the Thunder engine for scalable, real-time event processing. Its collection of application development components, known as Lightning, powers its applications. It gathers data from devices, websites, applications, customers, and partners to trigger actions for real-time responses.

Figure 17 IoT Salesforce

Salesforce, a CRM leader, decided to enter this space due to the need to remain competitive in the coming era. The IoT cloud adds to Salesforce by expanding its reach, and the depth of its analytics.

Salesforce combined with IoT delivers dramatically improved customer service with tighter integration and responses to real-time events; for example, adjustments in wind turbines could trigger automatic rebooking of delayed/canceled connecting flights before airline passengers land.

Electric Imp

The Electric Imp platform is Salesforce's recommended method for quickly connecting devices to the cloud. You develop applications through the Squirrel language; a high level, OO, lightweight scripting language. Applications consist of two modules: the device module, which runs on the device; and the agent module, which runs in the Electric Imp cloud. The platform ensures secure communication between the modules, and you send devices messages with a simple call:

```
agent.send("nameOfmessage", data);
```

Listen for messages on the agent with the following code:

```
device.on("nameOfmessage", function(data) {
//Data operations
});
```

Beyond these basic tasks, coding for device interaction, monitoring, and response resembles standard web application development, and uses a simple, easy-to-learn syntax.

V. IoT GE PREDIX

GE (General Electric) Predix is a software platform for data collection from industrial instruments. It provides a cloud-based PaaS (platform as a service), which enables industrial-grade analytics for operations optimization and performance management. It connects data, individuals, and equipment in a standard way.

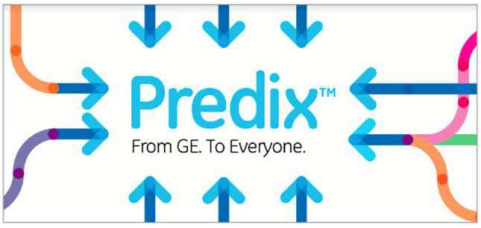

Figure 18 IoT GE Predix

Predix was designed to target factories, and give their ecosystems the same simple and productive function as operating systems that transformed mobile phones. It began as a tool for General Electric's internal IoT, specifically created to monitor products sold.

Ge Predix Partnered with Microsoft Azure

Microsoft's Azure is a cloud computing platform and supporting infrastructure. It provides PaaS and IaaS, and assorted tools for building systems. Predix, recently made available on Azure, exploits a host of extra features like AI, advanced data visualization, and natural language technology. Microsoft plans to eventually integrate Predix with its Azure IoT suite and Cortana Intelligence suite, and also their well established business applications. Azure will also allow users to build applications using Predix data. Note AWS and Oracle also support Predix.

Developer Kits

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GE offers inexpensive developer kits consisting of general components and an Intel Edison processor module. Developers have the options of a dual core board and a Raspberry Pi board. Developers need only provide an IP address, Ethernet connection, power supply, and light programming to set data collection.

The kit automatically establishes the necessary connection, registers with the central Predix system, and begins transmitting environmental data from sensors. Users subscribe to hardware/software output, and GE Digital owns and manages the hardware and software for the user.

This kit replaces the awkward and involved assemblies of simulations and testing environments. In other simulations, developers typically use a large set of software (one for each device), and specific configurations for each connection. They also program the monitoring of each device, which can sometimes take hours. The kit reduces much of the time spent performing these tasks from hours to only minutes.

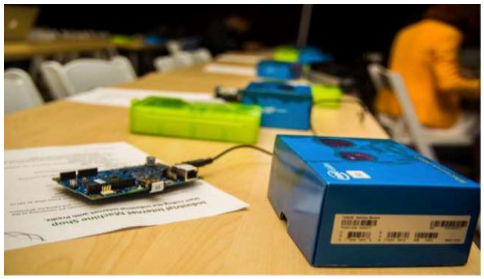

Figure 19 Predix Developer Kit

The kit also includes software components for designing an IoT application that partners with Predix services. GE plans to release other versions of the kit for different applications.

VI. IoT-ECLIPSE IoT

Eclipse IoT is an ecosystem of entities (industry and academia) working together to create a foundation for IoT based exclusively on open source technologies. Their focus remains in the areas of producing open source implementations of IoT standard technology; creating open source frameworks and services for utilization in IoT solutions; and developing tools for IoT developers.

Figure 20 IoT - Eclipse IoT

Smarthome Project

SmartHome is one of Eclipse IoT's major services. It aims to create a framework for building smart home solutions, and its focus remains heterogeneous environments, meaning assorted protocols and standards integration.

SmartHome provides uniform device and information access to facilitate interactionbetween devices. It consists of OSGi bundles capable of deployment in an OSGi runtime, with OSGi services defined as extension points.

OSGi bundles are Java class groups and other resources, which also include detailed manifest files. The manifest contains information on file contents, services needed to enhance class behavior, and the nature of the aggregate as a component. Review an example of a manifest below:

```
Bundle-Name: Hi Everyone                    //Bundle Name
Bundle-SymbolicName: xyz.xyz.hievery1       //Header specifying an identifier
Bundle-Description: A Hi Everyone bundle    //Functionality description
Bundle-ManifestVersion: 2                   //OSGi specification
Bundle-Version: 1.0.0                       //Version number of bundle
Bundle-Activator: xyz.xyz.Activator // Class invoked on bundle activation
Export-Package: xyz.xyz.helloworld;version="1.0.0" // Java packages available externally
Import-Package: org.osgi.framework;version="1.3.0"// Java packages needed from
// external source
```

Eclipse SCADA

Eclipse SCADA, another major Eclipse IoT service, delivers a means of connecting various industrial instruments to a shared communication system. It also post processes data and sends data visualizations to operators. It uses a SCADA system with a communication service, monitoring system, archive, and data visualization.

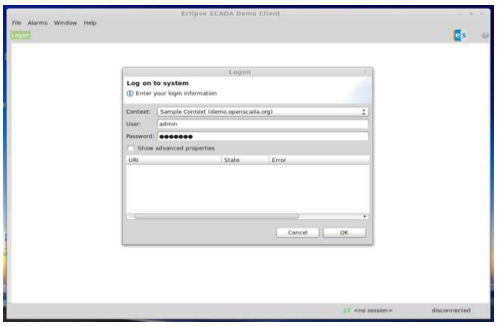

Figure 21 Eclipse SCADA Platform

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It aims to be a complete, state-of-the-art open source SCADA system for developing custom solutions. Its supported technologies and tools include shell applications, JDBC, Modbus TCP andRTU, Simatic S7 PLC, OPC, and SNMP.

VII. IoT – CONTIKI

Contiki is an operating system for IoT that specifically targets small IoT devices with limited memory, power, bandwidth, and processing power. It uses a minimalist design while still packing the common tools of modern operating systems. It provides functionality for management of programs, processes, resources, memory, and communication.

Figure 22 IoT Contiki

It owes its popularity to being very lightweight (by modern standards), mature, and flexible. Many academics, organization researchers, and professionals consider it a go to OS. Contiki only requires a few kilobytes to run, and within a space of under 30KB, it fits its entire operating system: a web browser, web server, calculator, shell, telnet client and daemon, email client, vnc viewer, and ftp. It borrows from operating systems and development strategies from decades ago, which easily exploited equally small space.

Contiki Communication

Contiki supports standard protocols and recent enabling protocols for IoT:

- **uIP (for IPv4) –** This TCP/IP implementation supports 8-bit and 16-bit microcontrollers.
- **uIPv6 (for IPv6)** – This is a fully compliant IPv6 extension to uIP.
- **Rime –** This alternative stack provides a solution when IPv4 or IPv6 prove prohibitive. It offers a set of primitives for low-power systems.
- **6LoWPAN –** This stands for IPv6 over low-power wireless personal area networks. It provides compression technology to support the low data rate wireless needed by devices with limited resources.
- **RPL –** This distance vector IPv6 protocol for LLNs (low-power and lossy networks) allows the best possible path to be found in a complex network of devices with varied capability.
- **CoAP –** This protocol supports communication for simple devices, typically devicesrequiring heavy remote supervision.

Dynamic Module Loading

Dynamic module loading and linking at run-time supports environments in which application behavior changes after deployment. Contiki's module loader loads, relocates, and links ELF files.

The Cooja Network Simulator

Cooja, the Contiki network simulator, spawns an actual compiled and working Contiki system controlled by Cooja. Using Cooja proves simple. Simply create a new mote type by selecting the **Motes** menu and **Add Motes > Create New Mote Type**. In the dialog that appears, you choose a name for the mote, select its firmware, and test its compilation.

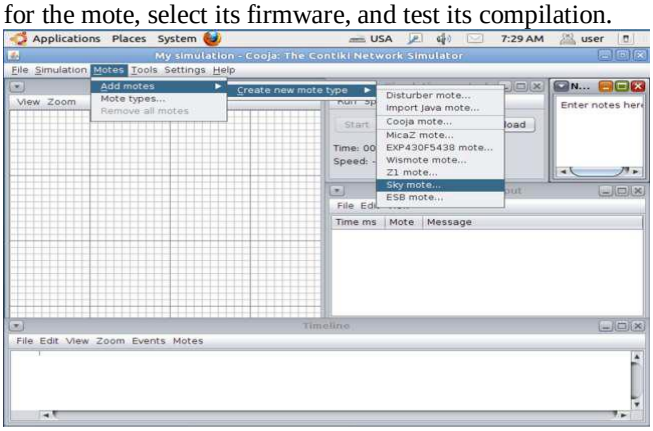

Figure 23 Cooja : Contiki Network Simulator

After creation, add motes by clicking Create. A new mote type will appear to which you can attach nodes. The final step requires saving your simulation file for future use.

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