Internet of Things

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UNIT - V

FACULTY

Dr. R. A. ROSELINE M.Sc., M.Phil., Ph.D.,
Associate Professor and Head,
Post Graduate Department of Computer Applications,
Government Arts College (Autonomous),
Coimbatore – 641 018.

UNIT-V

The Role of the internet of things for increased Autonomy and agility in collaborative production environments:

- Market is continuous to change by innovation.
- The rate of market changes grew steadily over the previous decades, especially due to the improvement as well as the development of existing and new information and Communication technologies (ICT).
- Potential technologies that can confer this behaviour to collaborative production environments are the Internet of Things and autonomous objects
- The future Internet of Things will use protocols and algorithms which will be based on those we use in the Internet today; it will just extend the capabilities of a more extensive machine-to-machine and human-to-machine communication, resulting in a higher number of specialised communication participants within the Internet.
- Autonomous objects are objects which are equipped with intelligence (small central processing units (CPUs) and algorithms) to be capable of making contextual routing decisions or handling activities. Both, the Internet of Things concepts and the autonomous objects, are complementary.

Emerging Challenges of Networked Enterprises

- Basic challenge of enterprises challenge their rivals through product innovations, strategic partnerships, procedural efficiency, pricing policies, acquisitions or in exploring new market opportunities more extensive an enterprise network is, the more complex are control, synchronisation, fault recovery and reorganisation of the overall process flow.
- Data Communication
- Collaborative Research Centre (CRC)
- Globalisation has created an international competition of the cheapest production sites as well as very efficient global logistics providers so that distances do not play the same important role as before.
- For the purpose of agile and autonomous processes, the enterprises have to integrate high density informational and control networks, which provide extensive real-time data and enable fine-grained controlling and objective specification for management. This feature can be served by the Internet of Things.

Agility

"Agility in manufacturing involves being able to respond quickly and effectively to the current configuration of market demand, and also to be proactive in developing and retaining markets in the face of extensive competitive forces."

"Agility relates to the interface between the company and the market. Essentially it is a set of abilities for meeting widely varied customer requirements in terms of price, specification, quality, quantity and delivery."

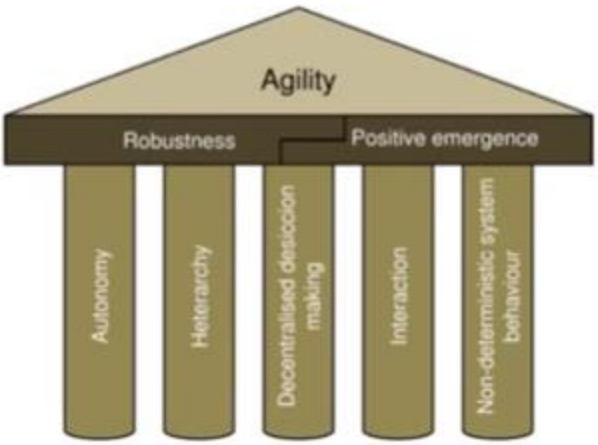
Core Concepts of Agile Manufacturing

Autonomous Control

"Autonomous Control describes processes of decentralized decision-making in heterarchical structures. It presumes interacting elements in non-deterministic systems, which possess the capability and possibility to render decisions independently. The objective of Autonomous Control is the achievement of increased robustness and positive emergence of the total system due to distributed and flexible coping with dynamics and complexity."

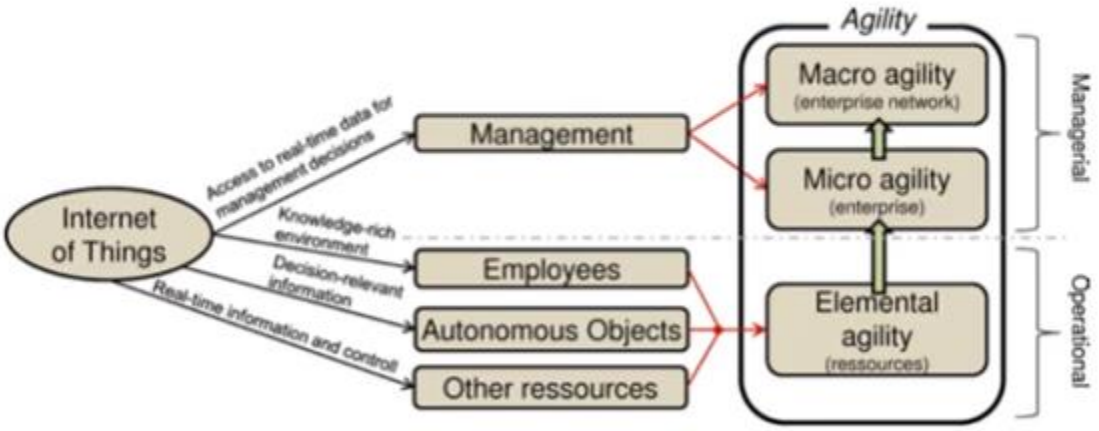
- The objective of *increased robustness* is based on the assumption that autonomous objects can react much faster to unforeseen events than higher planning and controlling instances.
- *Positive emergence* means that the sum of the individual and context dependent decisions, which are made by autonomous objects, gain a better achievement of the total system objectives than it can be explained by the behaviour of every single element

Degree of Autonomous Control :



Correlation between Characteristics and Objectives of Autonomous Control

Enabling Autonomy and Agility by the Internet of Things



Ways of Impact of the Internet of Things onto the Systems Agility

Technological Prerequisites

- ***Technological Prerequisites***
- **Metal Cast RFID**
- **Multi-Agent-System**
- **Decision Algorithms**

Challenges by Developing the Internet of Things

- **Authenticity, Encryption and Integrity of Data**
- **Authentication**
- **Legal Safety for Data Protection**
- **Scalability**
- **Billing and Business Model**
- **Data Management and Synchronisation**
- **Human-to-machine Communication**
- **Technological Improvements**

Resource Management in IoT:

Clustering:

•Clustering is a popular method of organising wireless network topologies, in which a few nodes, the cluster heads (CH),are elected as representatives to route the traffic originated in the entire network.

•Clustering used in Wireless Sensor Networks (WSN) and Mobile Ad-hoc NETworks (MANET).•MANET:meshed networks without central authorities.

•MANETs are generally built to handle objects in dynamic environments

all nodes act as routers with their own routing tables.

clustering approaches of WSN:hierarchical- star,Mesh topology

WSN are traditionally used to cluster more or less static nodes

We would first like to compare those ad-hoc wireless clustering protocols that consider both mobility and energy-efficiency.

•The studied properties are the following:

1.Type:If the protocol is specifically for WSNs or for more general MANETs.

2.Controlled variable CH period: CHs may be elected for periodic oraperiodic time intervals.

3.CH election according to node conditions: If a node is elected according to its own conditions.

4.Synchronisation: If the nodes need synchronisation for either electing the CH or operating inside the cluster

5.Global cluster information: If the cluster nodes need to store information about all the cluster members in order to perform the CH election or to operate. Global information implies poor scalability with the number of network nodes.

6.Multi-hop routing Multi-hop: routing mechanisms are beneficial because they can route communication packets between two nodes that are not directly connected5

7. CH election complexity: lower the complexity, the more efficient is the proposed algorithm.

Software Agents

•Agent Based Systems are an evolving software paradigm that strives to create software that can possess human characteristics, such as autonomy, adaptability, sociality, judiciousness, mobility and reactivity
.•Intelligent agents are software programs that continuously perform following functions:

1.perception of dynamic conditions in the environment;

2.reasoning to interpret

3.perceptions,

4.solve problems,

5.draw inferences, and determine actions

•software entity to be named an agent, it should maintain thefollowing properties
.1.the environment consists of other agents, the agent needs to have“social-ability
2.goal-directed behavior

3.Agents might also “learn” to improve their behaviour using feedback from its performance

Data Synchronization:

Data synchronization is the ongoing process of synchronizing data between two or more devices and updating changes automatically between them to maintain consistency within systems.

While the sheer quantity of data afforded by the cloud presents challenges, it also provides the perfect solution for big data. Today’s data solutions offer quick and easy tools to bypass monotonous tasks, resulting in data in harmony throughout the system.

Data synchronization ensures accurate, secure, compliant data and successful team and customer experiences. It assures congruence between each source of data and its different endpoints. As data comes in, it is cleaned, checked for errors, duplication, and consistency before being put to use. Local synchronization involves devices and computers that are next to each other, while remote synchronization takes place over a mobile network.

Data must always be consistent throughout the data record. If data is modified in any way, changes must upgrade through every system in real-time to avoid mistakes, prevent privacy breaches, and ensure that the most up-to-date data is the only information available. Data synchronization ensures that all records are consistent, all the time.

Data synchronization: The key to trusted data

The importance of data synchronization grows in step with increased accessibility to cloud-based data as well as access to mobile devices. Mobile devices use data for basic operation as well as personal information for apps, websites, and email. Updates to information generated by the user as well as the end target must be constant and secure. This synchronization process requires clean, consistent data for product and service competence, but also for data governance issues like security and regulatory compliance.

Data conflicts can result in errors and low data quality, which consequently leads to a lack of trusted data down the line. With data synchronization properly implemented throughout a system, a business will see performance improvement in many areas, including:

- δ Logistics and transportation
- δ Sales team productivity
- δ Order management
- δ Invoice accuracy
- δ Business systems
- δ Cost efficiency
- δ Reputation management

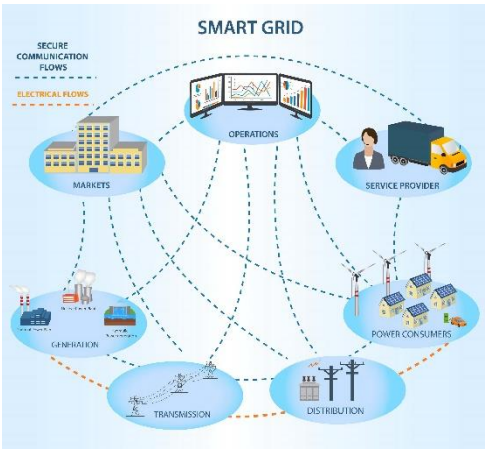
Data accessibility and error resolution afford time savings, allowing emphasis to be put on important business development processes like marketing, new product development, and strategic decision-making. Virtually everyone benefits from clean, synced data.

1. Customers receive product information and service that meets their specific needs
2. Business users can interact with all department members using up-to-date information, in real-time, even globally
3. Executives receive the latest data when making important strategy decisions
4. Stockholders can easily stay on top of their business interests
5. Manufacturers access the most recent updates or changes for accurate design and production
6. Distributors have access to the most recent product and marketing information

Smart Grid

As the traditional grid system is aging and barely keeps up with the growing electricity demand, the governments around the world focus on adopting and integrating smart grid technology.

It has been in focus in the European Union as a system to “efficiently deliver sustainable, economic and secure electricity supplies” for years. In the United States, the efforts for shifting towards smart and clean energy have started a decade ago when the country established the first policy in this direction. From this point, the investment, technology research and development for the smart grid were officially supported by the U.S. government.



The simplest smart grid definition would sound something like this:

It's an electricity network that consists of a system of infrastructural, hardware and software solutions that enable two-way communication between all system parts and participants and provide efficient power generation and distribution in the supply chain.

Smart grid is often characterized as a self-sufficient distributed system. It can provide energy from different power sources, including renewables and storage. Moreover, the implementation of this system enables suppliers and consumers with unprecedented control and management capabilities.

How Smart Grid Works

Unlike a traditional grid with one-way communication, a smart grid is a complex network that implies multiple two-way interactions between equipment and participants in the supply chain. This structure enables various scenarios of how generated power can move and be managed. Here's the most basic step-by-step scenario.

1. Generate
Switch to the smart grid allows using the power generated from different and often distributed sources. It includes traditional power plants, renewable solar and wind as well as plug-in electric vehicles and energy storage.

2. Distribute
Using a network of transmission lines, substations and automated distribution systems, the power is transformed to the correct voltage range if needed (in case of solar or wind) and distributed among the end-users.

3. Use
End-users get broad power management capabilities and visibility thanks to smart grid applications such as smart meters, sensor-enabled appliances, smart sockets, plugs, etc. Using these tools, consumers become active participants in managing their electricity consumption — use mobile or web apps to monitor and remotely control power usage, configure automated regimes, respond to load changes and control their spending and emission in real time.

4. Control

People, utility companies and other professionals in the energy industry expand their control and management capabilities in a smart grid. Connected homes, communities and the whole cities use electricity and create data on the consumption and loads. This data can be used by any authorized participant in the supply chain. Thanks to data analytics and visualization tools, energy consumption data is turned into insights that make the basis for future decisions.

For example, energy companies can manage grid assets and perform predictive maintenance, utility companies can build demand response programs, residents can dynamically respond to the difference in loads and cut on the consumption when energy is the most expensive.

5. Store

Not only do households practice a more prudent energy use, but also store enough power to provide a house in the off-grid scenario. Using storage, households save extra energy, choose the loads they need to back up and use this energy in the case of an outage, for example. Apart from giving management benefits, storage becomes one of the innovative smart grid technologies essential for independent residential grids that fully rely on renewables and generate much surplus.

Innovative Smart Grid Technologies

The operation of smart grid relies on a broad range of technology and infrastructure solutions. Smart grid based on IoT and data technologies is prevailing and includes several important components:

Smart sensors and meters. These are the very basic components of a smart grid that enable to track energy consumption on the consumer's side. Sensors in smart appliances continuously create and report status data to enable monitoring and control. Smart meters accumulate energy use data and show the full picture of energy consumption in the house, including loads and estimated cost.

Automated distribution. Advanced distribution systems use real-time data to dynamically respond to the changes in loads, detect blackouts and correct power distribution to enable both safety and economic savings. This is the part where smart grid using IoT introduces automation and self-management.

Charging stations and smart storage. In the concept of smart grid, energy storage and charging stations play an important role. Not only do these technologies allow households to safely go off-grid in cases of outages or accidents. They also reflect the growing demand for independent residential renewable systems.

Intelligent EV Charging Station Management

With the growing concerns on energy conservation and the escalating emission of carbon dioxide, electric vehicles such as V2Gs, also known as vehicle to grids, have become prevalent all over the world owing to its zero-emission, low-noise, low maintenance and shrinking operation cost. It is expected that the global electric car stock may reach 40-70 million by 2025. (Source: IEA analysis based on EVI country submissions, complemented by EAFO 2017a).

However, a large quantity of decentralized EV charging stations would be hard to remotely manage as well as run into the following challenges:

- δ A weak point, first of all, lies in its capability of data transmission. Many stakeholders will be delayed to receive the field data of charging and metering.

- δ The full suite of services are offered by various providers for which it would be hard for troubleshooting when any issue occurs.

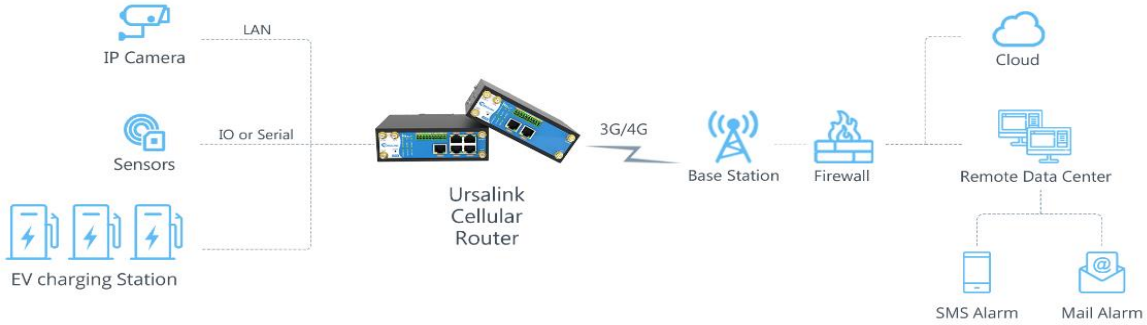
- δ Most charging points are deployed in challenging environment where it would be critical to approach.

- δ The scattered charging stations with complex structure will bring a great difficulties to on-site technical personnel for the devices maintenance and management.

- δ Redundant link support, sometimes however, is also in the list of technical requirements.

In view of the above issues, Ursalink, a united team of qualified professionals that have over 12-year experience in the field of communications, not only provides an easy-setup, operational efficiency, and cost optimization plan for EV charging station, but makes it possible to realize remote control with the wireless 3G/4G design as well.

The solution comes with EV, EV charger, Ursalink 3G/4G cellular router, and cloud management software from EV charger manufacturer or a third party. Wherein, the Ursalink industrial cellular router plays a crucial role of providing a high-speed and stable networking and transparent link for the charging and metering data transmission so as to analyze and monitor the devices with prompt response, by which leads to a desired outcome of cost reduction.


IP Camera
LAN
Sensors
IO or Serial
EV charging Station
Ursalink
Cellular
Router
3G/4G
Base Station
Firewall
Cloud
Remote Data Center
SMS Alarm
Mail Alarm

Benefit & Features

1. Ursalink router helps connect to the Internet via wireless 4G/3G/GPRS technology for the charging point placed in an environment where it's too difficult or expensive to deploy optical network
2. Automated fail-over/fail-back between Ethernet and cellular (dual SIMs) feature ensures all data to be sent to the management software timely
3. Multiple options of VPN (IPsec, OpenVPN, DMVPN, GRE, L2TP, PPTP) with different encryption methods ensure the secured and stable communication
4. Featuring 2 or 5 Gigabit Ethernet ports, an Ursalink cellular router is all you need for each charging station and gets you into light transmission of large data from multiple EV chargers
5. Offer serial ports (RS232 & RS485) and I/O interface for receiving and transferring EV chargers' voltage, current, power distribution and other operating parameters
6. SMS alarm & mail alarm system provide ability for engineers to take corresponding actions in no time by sending them the alerts of those out-of-compliance equipment
7. Embedded Ursalink SDK (Python 2.7/C) for secondary development in SSD/Micro SD card
8. Featuring industrial design with IP30 protection class to function properly in the most demanding environment, from cool to crucial

THANK YOU

Study material for this course is taken from the Text Books and Reference Books, mentioned in the Syllabus.