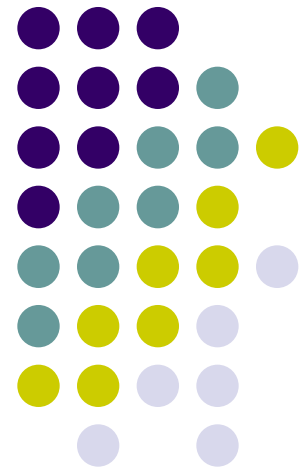


# ME 482 – Rapid Product Development and Manufacturing

## Chapter 4

### Rapid Product Development (RPD) - Part III



**Mechanical Engineering  
University of Gaziantep**

**Dr. Sadık Olguner**



- **IoT-based RPD** is a product development system of interconnected **digital devices, machines, objects, animals or people** provided with unique identifiers and the ability to transmit and share data over the network **without the need of human-to-human or human-to-computer interaction**.
- Bridging the gap between the physical and virtual worlds, IRPD aims creating a smart environments for producing and/or manufacturing products with smarter and more comfortable way. Thus, products are able to produced **quickly, easily, economically, and efficiently**.



device hardware



device software



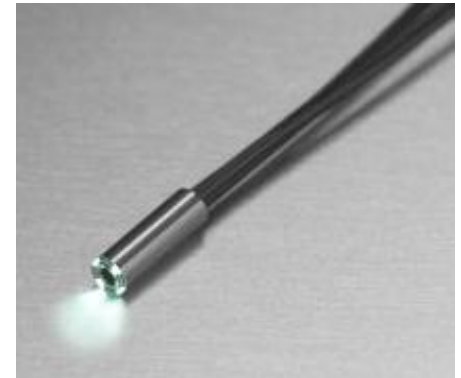
communications



platform



- Acting as an interface between the real and the digital worlds, they may take different sizes, shapes and levels of technological complexity depending on the task they are required to perform within the specific internet based RPD deployment.
- Whether pinhead sized **microphones, cameras or heavy construction machines, manufacturing tools**, practically every material object (*even the animate ones, like animals or humans*) can be turned into a connected device by the addition of necessary instrumentation (*by adding sensors or actuators along with the appropriate software*) **to measure and collect the necessary data.**



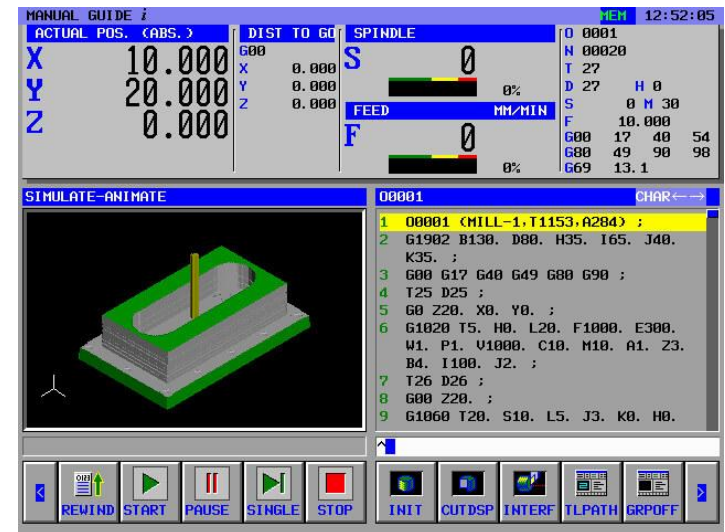
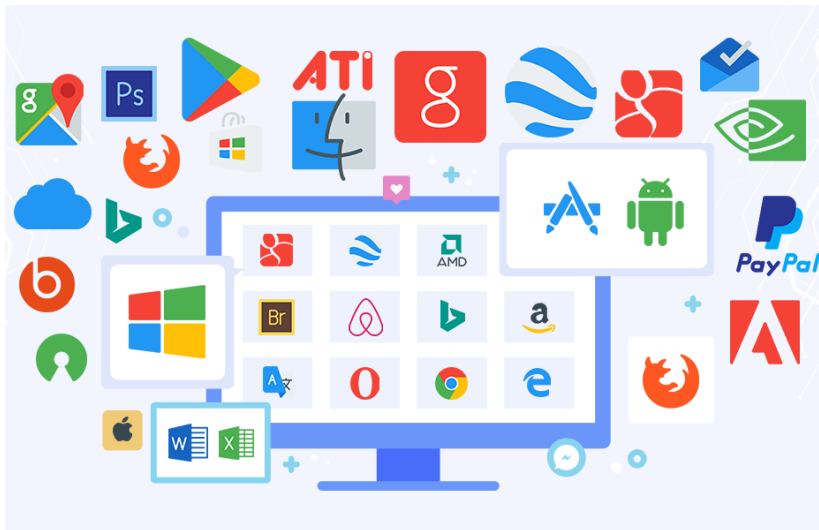


- Obviously, **sensors, actuators or other telemetry gear can also constitute standalone smart devices by themselves.** The only limitation to be encountered here is the actual internet based RPD use case and its hardware requirements (*size, ease of deployment and management, reliability, useful lifetime, cost-effectiveness*)





- Software actually makes the connected devices 'smart'.
- Software is responsible for implementing the communication with the Cloud, collecting data, integrating devices as well as performing real-time data analysis within the internet based RPD network.
- It is device software that also caters for application level capabilities for users to visualize data and interact with the system.





- Having the device hardware and software in place, **there must be another layer which will provide the smart objects with ways and means of exchanging information with the rest of the environment.**
- While it is true that communications mechanisms are strongly tied to device hardware and software, it is vital to consider them as a separate layer.
- Communication layer includes both **physical connectivity solutions** (*cellular, satellite, LAN*) and **specific protocols used in varying internet environments** (*ZigBee, Thread, Z-Wave, MQTT, LwM2M*).
- Choosing the relevant communications solution is one of the vital parts in constructing every IRPD technology stack. The technology chosen will determine not only the ways in which data is sent to/received from the cloud, but also **how the devices are managed and how they communicate with third party devices.**



- **Bluetooth:** Bluetooth is considered to be the key solution particularly for the future of the wearable electronics market such as wireless headphones or geolocation sensors, especially given its widespread integration with smartphones. The Bluetooth Low-Energy (BLE) protocol requires very little power from the device. Yet, this comes with a compromise: when transferring frequently higher amounts of data, BLE may not be the most effective solution.
- **RFID:** Radio-frequency identification (RFID) offers positioning solutions for IRPD applications, especially in supply chain management and logistics, which require the ability of determining the object position inside buildings. The future of RFID technology clearly goes far beyond the simple localisation services, with possible applications ranging from tracking hospital patients to improving efficiency in healthcare to providing real-time merchandise location data to minimize out-of-stock situations for retail stores.



- **Wi-Fi:** Developed based on IEEE 802.11, it remains the most widespread and generally known wireless communications protocol. Its broad usage across the IoT world is mainly limited by **higher-than-average power consumption**. Wi-Fi provides a wide-ranging ground to staggering number of IRPD solutions, yet it also needs to be managed and used in terms of marketing to yield profits to service providers and users alike.
- **Thread:** Designed specifically for **smart home products**. Thread employs IPv6 connectivity to enable connected devices to communicate between one another, access services in the cloud, or interact with the user via Thread mobile applications.
- **ZigBee:** This popular wireless mesh networking standard finds its most frequent applications in *traffic management systems, household electronics, and machine industry*.





## ➤ Long Range IoT Solutions: (Wide Area Networks - WAN) Solutions:

**NB-IoT:** They use existing network infrastructure, which ensures not only global coverage in LTE networks, but also **guaranteed signal quality**.

**LTE-CAT M1:** CAT M1 doesn't require the carriers to build new infrastructure to implement it. It proves to be perfect for **mobile use cases**, as its handling of hand-over between cell sites is significantly better and is **very similar to high speed LTE**.

**LoRaWAN:** is a low-power WAN protocol optimized for **low-power consumption and supporting large networks with millions of devices**.

**Sigfox:** is used for applications requiring **low levels of data transfer** for which the Wi-Fi range is too short, and cellular range is too expensive and too power-hungry.



- An IRPD platform is the place where **all of these data is gathered, managed, processed, analysed and presented** in a user-friendly way.
- Thus, what makes such a solution especially valuable is not merely its data collection and IRPD device management capabilities, but rather its **ability to analyse and find useful insights from the portions of data** provided by the devices via the communications layer.
- There is quite a number of IRPD platforms, with choice depending on the requirements of the specific project and such factors as architecture and **technology stack, reliability, customization properties, protocols used, hardware agnosticism, security and cost-effectiveness**.
- Platforms can be either installed **on-premise** or **cloud-based**.



- Microsoft ActiveX
- DCOM
- CORBA
- Agent Technology
- STEP
- SDAI

