A Beginner's Guide to IoT Projects

A Read-Me-First primer on starting and planning your own IoT Project

Bridgera

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Bridgera, LLC - A Beginner's Guide to IoT Projects
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An Introduction to the **Internet of Things**

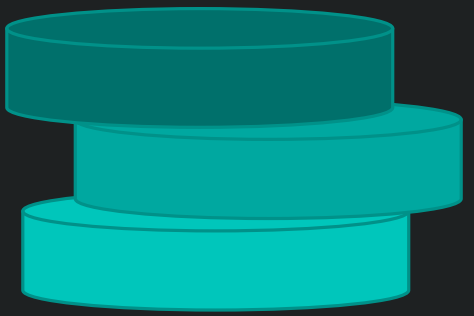
An Internet of Things (IoT) Project: Creating a product that leverages internet technology to combine the physical (hardware) with the virtual (software) and eliminates the need for proximity.

As companies venture into IoT projects, they first discover that they cannot build an end-to-end solution without help from suppliers and partners. Unfortunately, supplier and partner selection has become a buyer-beware effort especially without a good understanding of IoT terminology and critical components.

This white paper will review the IoT system at the component level but is not intended to be a comprehensive buyer's guide nor are all components required to satisfy every case. We also understand that solution providers integrate components into an infinite number of combinations to create platforms.[1] This will become more clear as you look at how each of these platforms are defined.

1. A **platform** combines low-level functionality ready-made as an accelerator to a consumable solution. (e.g., Device Module and Communication Module, Device Cloud and Application Cloud).

The **IoT System**, or **IoT Stack**



There are diverse definitions of the internet of things including what is and is not an **Internet of Things System.** For the purpose of this paper, we'll use the following definition:

The IoT System includes "Things" (e.g., physical objects) equipped with sensors for data input, a processor to interpret data, a transmitter to send interpreted data via internet technology to a remote location where a system will receive, further interpret, and make the data available for people, systems, and other "things" to consume.

We'll use the following outline of major components of an IoT System as our guide:

- Things[2]
- Device Module
- Communication Module
- Edge (Hub) Module
- Transport Layer
- Device Cloud
- Application Cloud
- People[3]

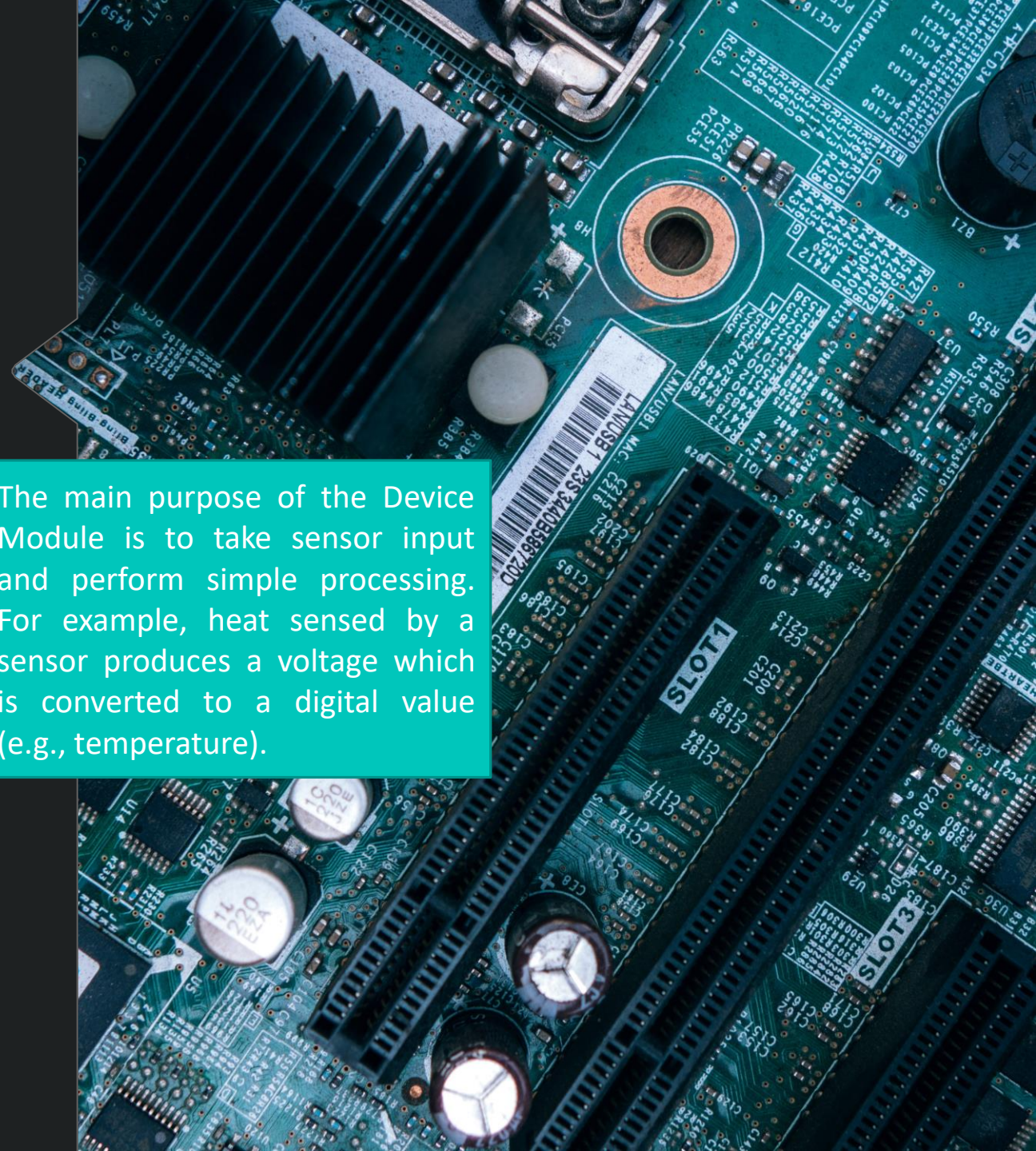
2. **Things** can be a piece of metal machinery that a device is attached to. Consider the non-electronic, non-people item.

3. **People** can be stand-alone consumers of or controllers of the IoT System or they can be integrated with a device via a "wearable" or implant.

Device Module

- Packaging – Physical boundaries of a Device
- Sensors – Touch, sight, hear, smell, taste (produces raw data often in the form of an electrical impulse)
- Memory – retained data in raw and converted forms
- Printed Circuit Board (PCB) – Nervous System (transmit data from sensor to memory to processor)
- Processor – Brain (runs embedded software to convert raw data)
- Embedded Software – knowledge, logic, behavior (what to do with data)
- Actuator – Movement, LEDs, Sound (reaction to data)
- Communication Module (required to transmit)

Device Module components are often sold as integrated platforms, without sensors or packaging, and commonly referred to as microcontrollers or MCUs.



The main purpose of the Device Module is to take sensor input and perform simple processing. For example, heat sensed by a sensor produces a voltage which is converted to a digital value (e.g., temperature).

Communication Module

Microcontrollers (MCU's) often contain the input/output capability of a Communication Module with integrated memory, processor, and embedded software.

- Memory – retained converted data
- Processor – Brain (runs embedded software to package data for transmit)
- Embedded Software – knowledge and logic about how to send data
- Data Profile:
  - Data Fields (Field Definitions) – text, values
  - Data Type (e.g., JSON, XML) – standard way to group data fields and values
  - Internet Protocol (e.g., MQTT, TCP) – common language between transmitter and receiver
- Security – Access control and permission to be heard
- Input / Output Capability
  - Short range Wireless Transmit Technology (e.g., BLE) – sender and receiver are close
  - Medium/long range Wireless Transmit Technology (e.g., WiFi, Cellular, LoRa, LPWAN) – Sender and receiver are further apart

The Communication Module's purpose is to take device data and wirelessly transmit it to a receiving system.

Learn how Bridgera IoT simplifies device integration with their Device/App Cloud capability

Edge Module

You will commonly hear the term **"Gateway", "Hub", or "Edge Device"** as a synonym to an Edge Module.

- Input: Communication Module that receives data (generally from short range technology)
- Microcontroller Capability
  - *Memory – retained data in raw and converted forms*
  - *Printed Circuit Board (PCB) –transmit data input to memory to processor to output)*
  - *Processor – Brain (runs embedded software to convert raw data)*
  - *Embedded Software – knowledge, logic, behavior (what to do with data)*
- Output: Communication Module that sends data via Medium or long range Wireless Technology
- Security – Access control and permission to be heard

Edge Modules are not always required. They generally act as a "middle-man" receiving data from a short range transmitter and transmitting it over a medium or long range. Edge modules also provide more sophisticated data processing when that processing cannot be perform on the Device Module or in the Application Cloud.

Transport Layer

We cover a range of these technologies in our eBook, "A Reference Guide to the Internet of Things".

The **Transport Layer** is the network service employed to move data wirelessly (and ultimately wired) from the Communication Module on the device side (or Edge Module) to an internet access point operated by an internet service provider (which leads to the entry point to the Cloud components).

Some network services are open and available without a license (e.g., WiFi) while other services require a license from a service provider (e.g., SIM/Cellular).

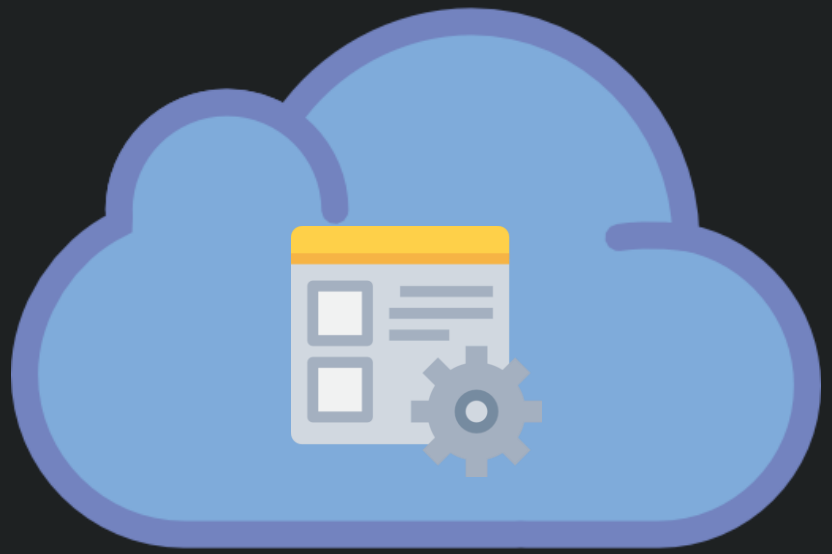
The technology choice is often directed by constraints on cost, security, speed, availability, and reliability.

Integrated Device and Application Clouds are often referred to as **IoT Cloud Platforms,** Bridgera IoT being an example.

Device Cloud

The Device Cloud functions as an integration point between a "fleet" of devices and the Cloud Applications, and, also provides an administration function.

- Device Activation – Pair a device by establishing a common data profile:
  - Security – access privileges to be heard and to listen
  - Internet Protocol (e.g., MQTT, TCP) – common language between transmitter and receiver
  - Data Type (e.g., JSON, XML) – standard way to group data fields and values
  - Data Fields (Field Definitions) – text, values
- SIM Card Activation – a unique step for long range cellular transport solutions
- Device Management – Manage the population of devices paired with the ingestion capability (e.g., power, status, on/off, unique characteristic)
- User Access Control – Manage role based administrator user access
- Security – guard access and control permissions



Application Cloud

- Data Ingestion – Accept data via a common data profile (see Device Cloud) and prepare data for processing
- Device Communication – Reverse of data ingestion (transmit to a Device)
- Security – guard access and control permission to enter (to be heard)
- Processing – Apply logic to data values to determine meaning and take action. Capabilities exist to process in real-time (prior to reading to a database) and or in batch.
- Alerts – Immediate action taken after processing (send signal)
- Unstructured Storage Capacity – Retain data and actions in any format
- Structured Storage Capacity - Retain data and actions in a tabular / relational format
- API capability – common way for one system to communicate with another system without people
- User Applications – visual interfaces for people to interact with the system (examples being web applications or mobile applications)
- Dashboards – visual interfaces for people to consume system data
- User Access Control – Manage role based user access

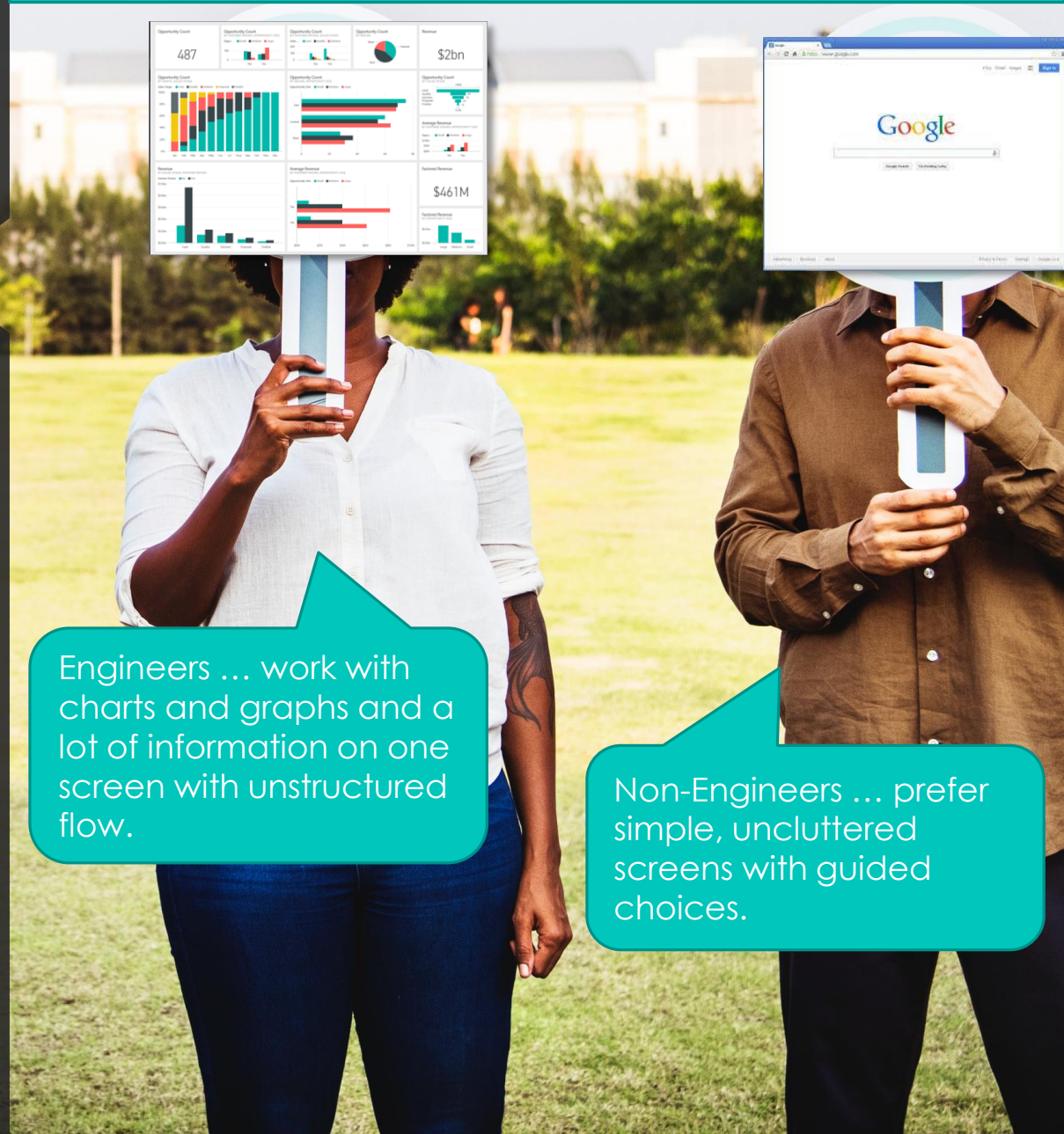
The Application Cloud is often the most visible component of an IoT System (See People on next slide). It's capability provides interfaces for people, complex data processing and analytics, and integration with other systems.

People

Three common ways People interface with IoT Systems:

1. **Administration Portals**: Manage the System
   - Setup and manage the system
   - Generally a Web Browser Interface[4]
2. **Dashboards**: Consume data via static or real time reports
   - Generally a Web Browser Interface
   - Charts, Graphs, Streaming Data
   - Output is generally technical (operationally focused)
3. **Applications**: Interact with the system
   - Web Browser Interfaces or Mobile Apps
   - Generally interactive and workflow based
   - Role based access

Tailor interfaces to the user profile to ensure adoption and avoid long learning curves.



4. Web Browser interfaces are ideally made responsive, allowing them to be accessed and usable on any screen size or device.

Summary
Internet of Things

Your mission now, based on **your** project specification, is to understand what technical components you require.

Create your picklist! We provide a simple checklist on the last two pages of this paper.

Then evaluate component/solution alternatives including:

- Will you Make, Partner, or Buy
- Does it make sense to integrate with other components
- Are viable platforms available that integrate components
- Does it meet performance requirements
    - Scale
    - Reliability
    - Power Consumption
    - Flexibility
    - Cost
    - Long term viability beyond prototype

Want to learn more?

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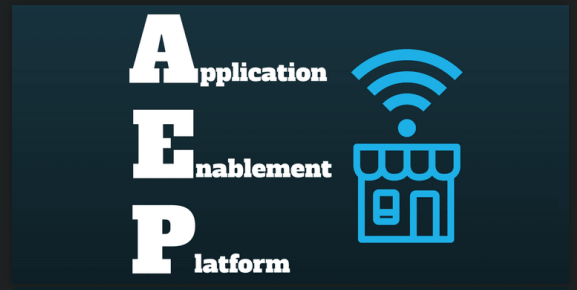
Related Reading



[Is an Application Enablement Platform right for your business?]

[How to Outsource Software to Enhance Physical Products]

IoT Project Parts Picker

Device Module

Notes	Component	Details
	Packaging	Physical boundaries of a device
	Sensors	Produces raw data
	Memory	Retains data
	PCB	Circuit board
	Processor	Brain of device
	Embedded Software	Knowledge, logic, behavior
	Actuator	Detects movement
	Communication Module	Required for connection

Communication Module

Notes	Component	Details
	Memory	Retains converted data
	Processor	Brain
	Embedded Software	Determines how to send data
	Data Profile	Data fields, type, and Internet Protocol
	Security	Access control
	Input/Output Capability	Short/Med/Long wireless tech

Edge Module

Notes	Component	Details
	Input	Wireless technology
	Output	Wireless technology
	Microprocessor	Capacity
	Embedded Software	Knowledge, logic, behavior
	Security	Access control

Use this worksheet as a parts list tracker as you are evaluating each component and selecting to build, partner, or buy.

IoT Project Parts Picker

Device Cloud

Notes	Component	Details
	Device Activation	Pair device with ingestion capability
	SIM Card Activation	Enables long-range cell transport
	Device Management	Manage device population
	Security	Guard access
	User Access Control	Manage role based admin users

Use this worksheet as a parts list tracker as you are evaluating each component and selecting to build, partner, or buy.

Application Cloud

Notes	Component	Details
	Data Ingestion	Accept data from devices
	Device Communication	Push data to devices
	Security	Access and control permissions
	Processing	Real-time and batch
	Alerts	Real time
	Data Storage, structured, unstructured	Database and file storage
	API Capability	Interface capabilities
	User Applications	Interactive user interfaces
	User Dashboards	Consumable data visualization
	User Access Control	Role based control

IoT Project Parts Picker

Things

Characteristics	Notes
What are you monitoring?	
Describe the behavior	
How will sensors interact with the Thing?	

People

Characteristics	Notes
How will people interact with the system	
Administration Role Description	
Data Consumer Role Description	
Application Specifications	
Workflow Description	

Capture your use case from the “book-ends” / Thing and People.