IoT

Technology and Architecture

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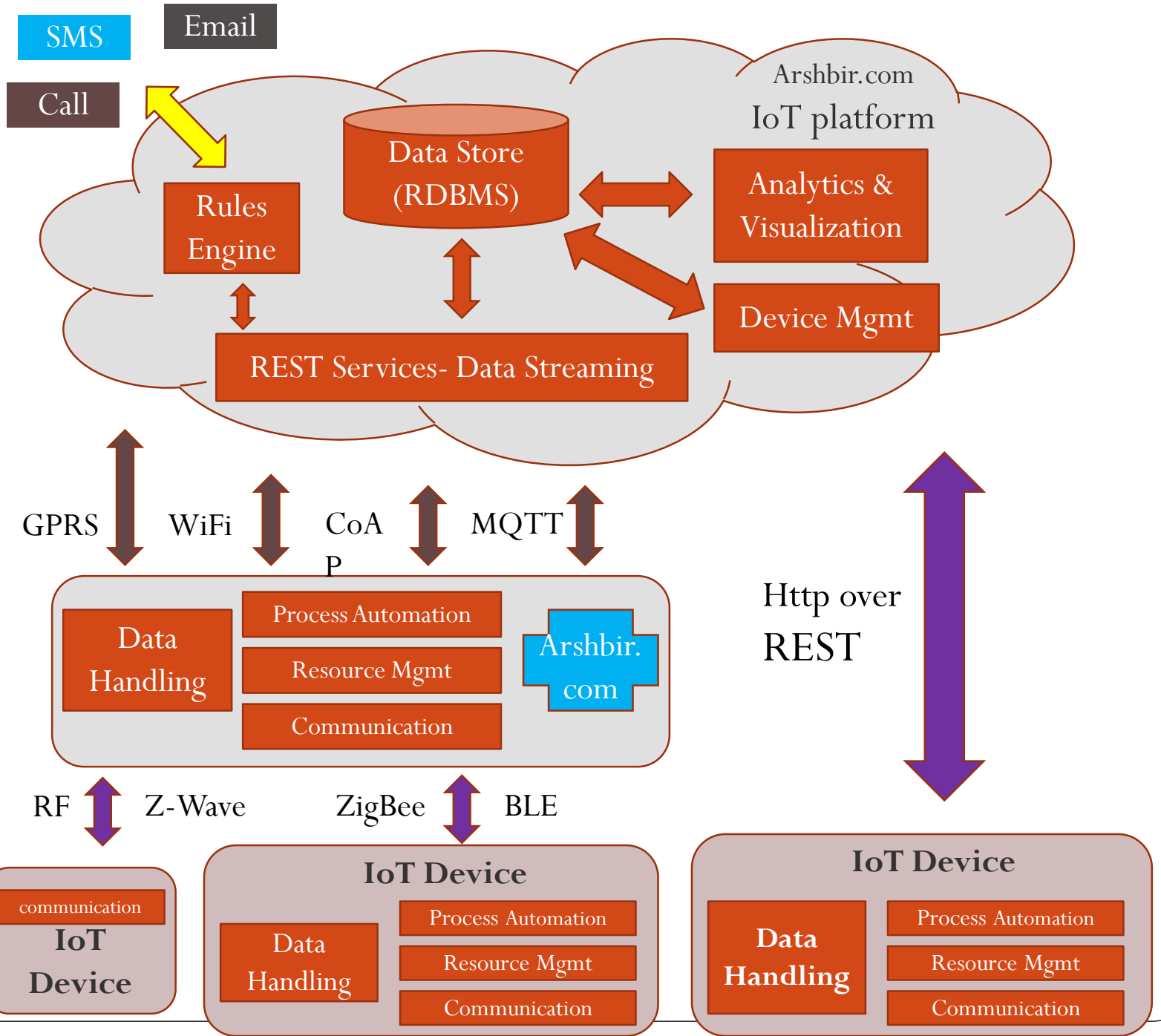
Deputy Director(S)

NIELIT Chandigarh

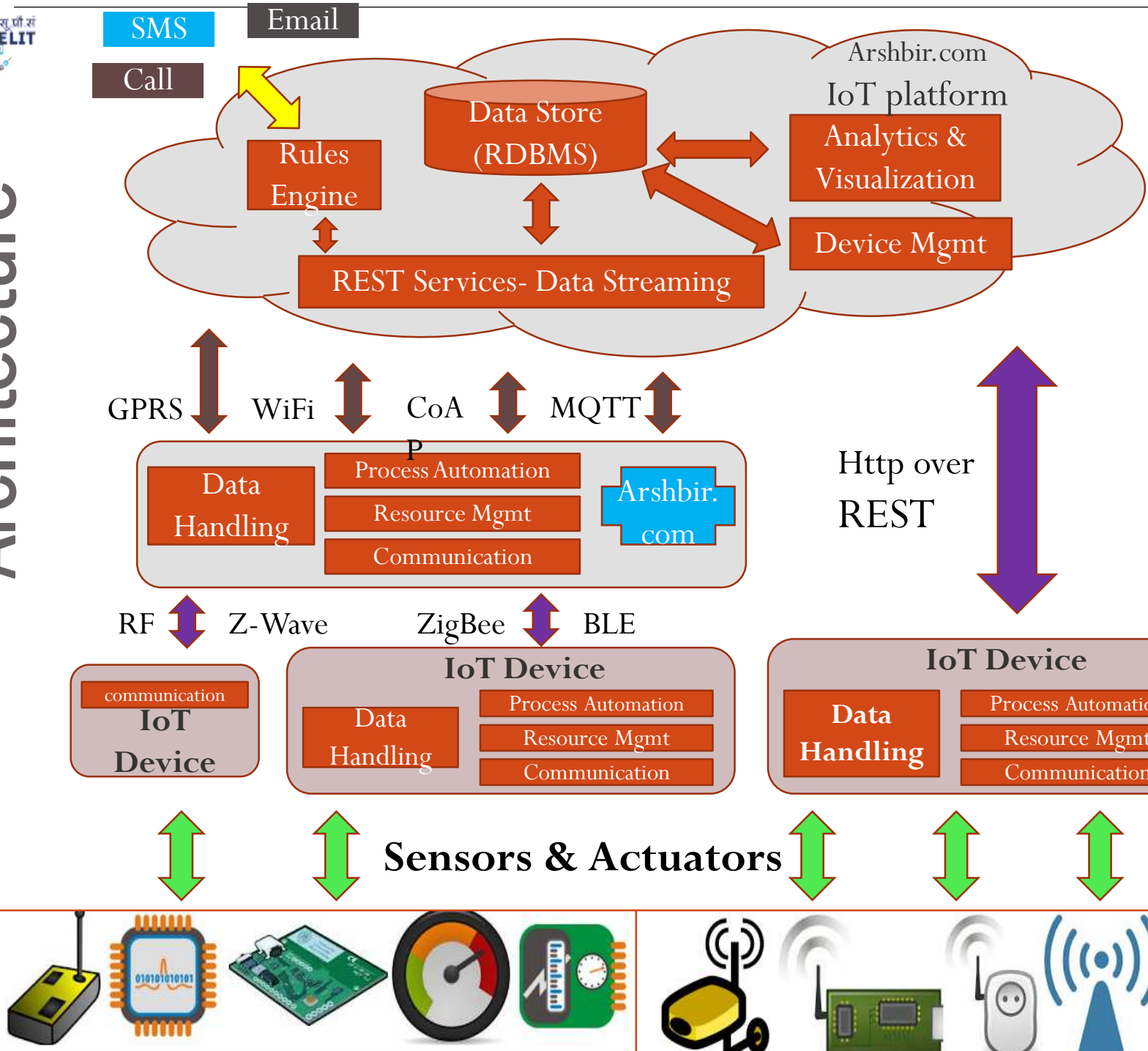
With Amazon testing its Drone Delivery Program, and the launch of Google Glass

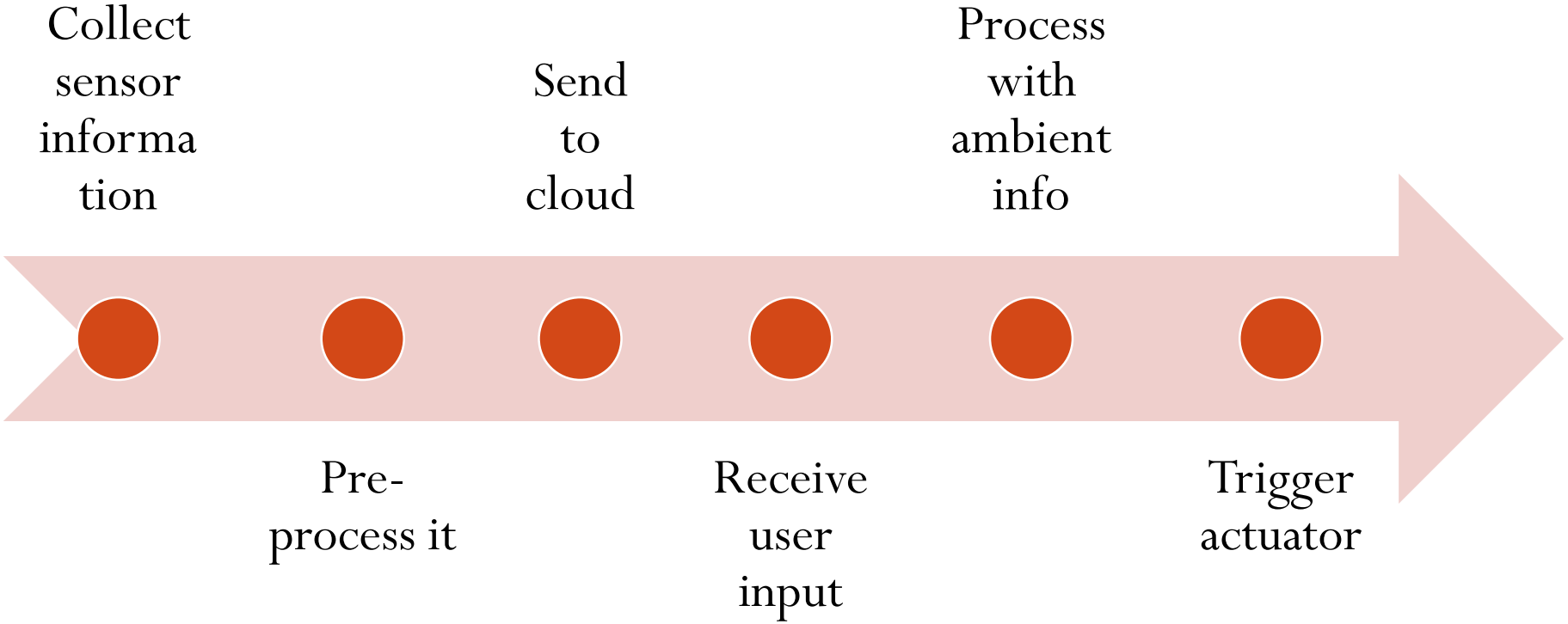

TIMER
0:22
Sensitiv
NACHRICHTEN
MtGox findet
200.000 Bitcoins
34°C
31°C
2013
11:14

Architecture

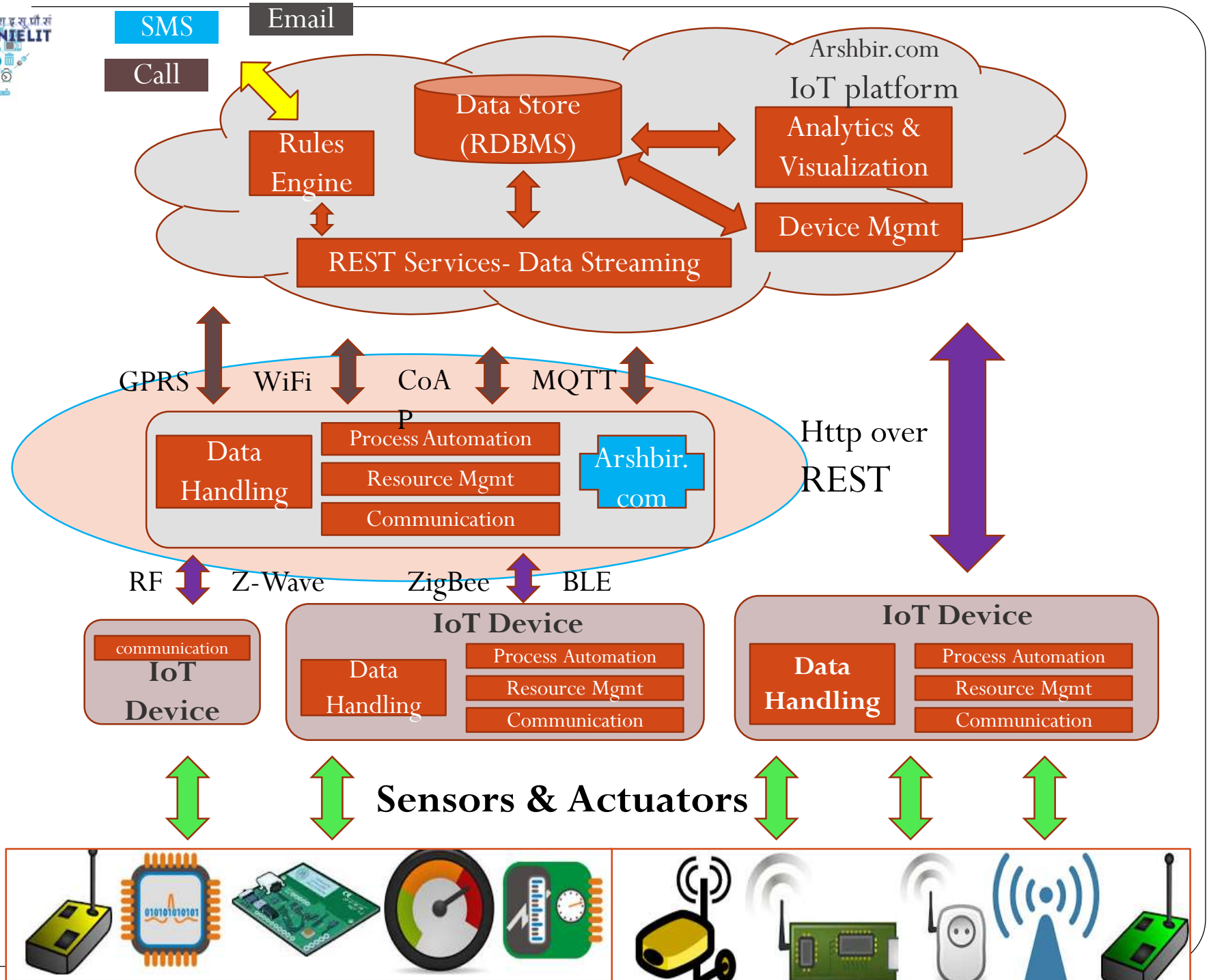


Architecture




Collect sensor information
Pre-process it
Send to cloud
Receive user input
Process with ambient info
Trigger actuator

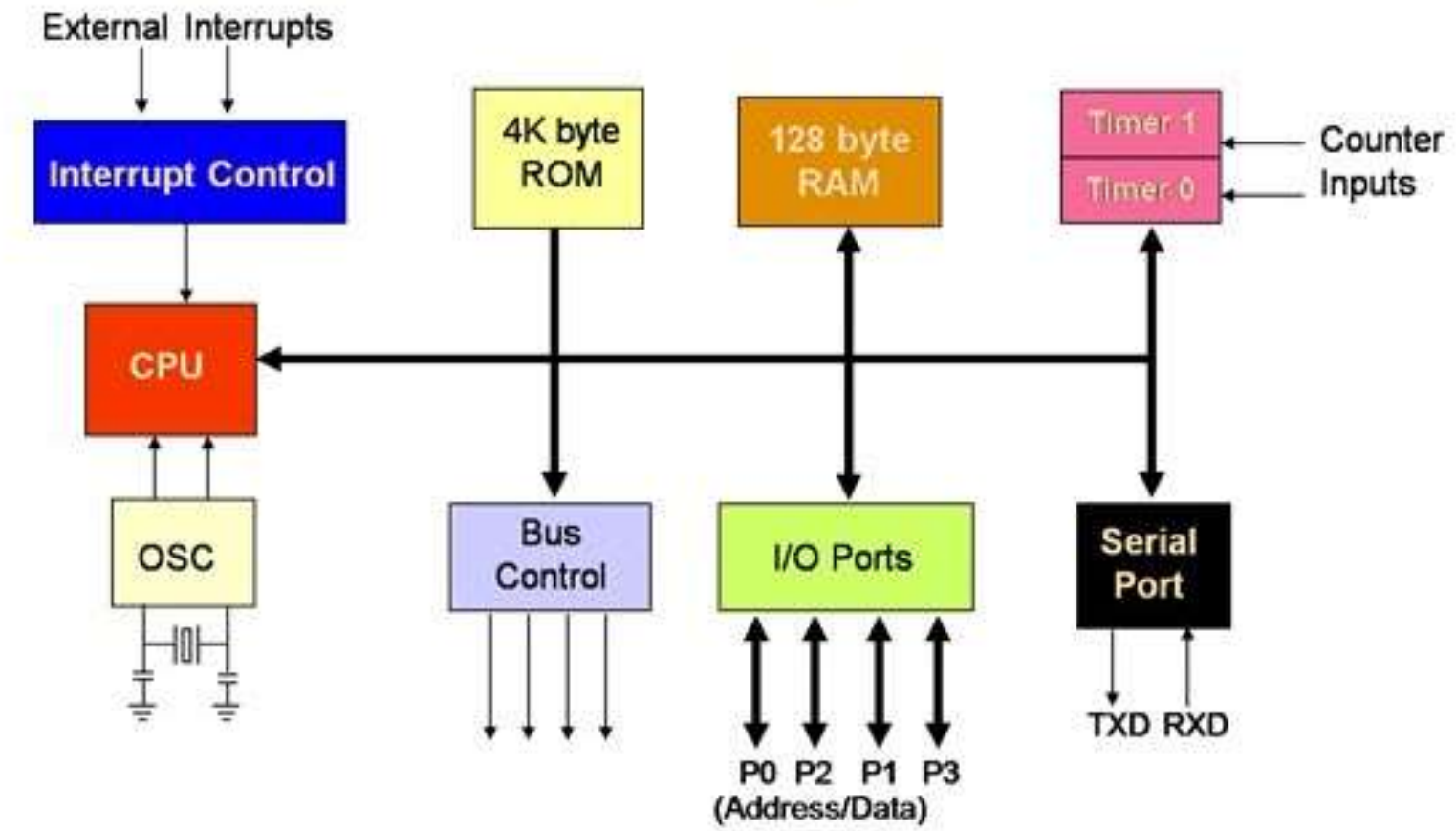
Architecture



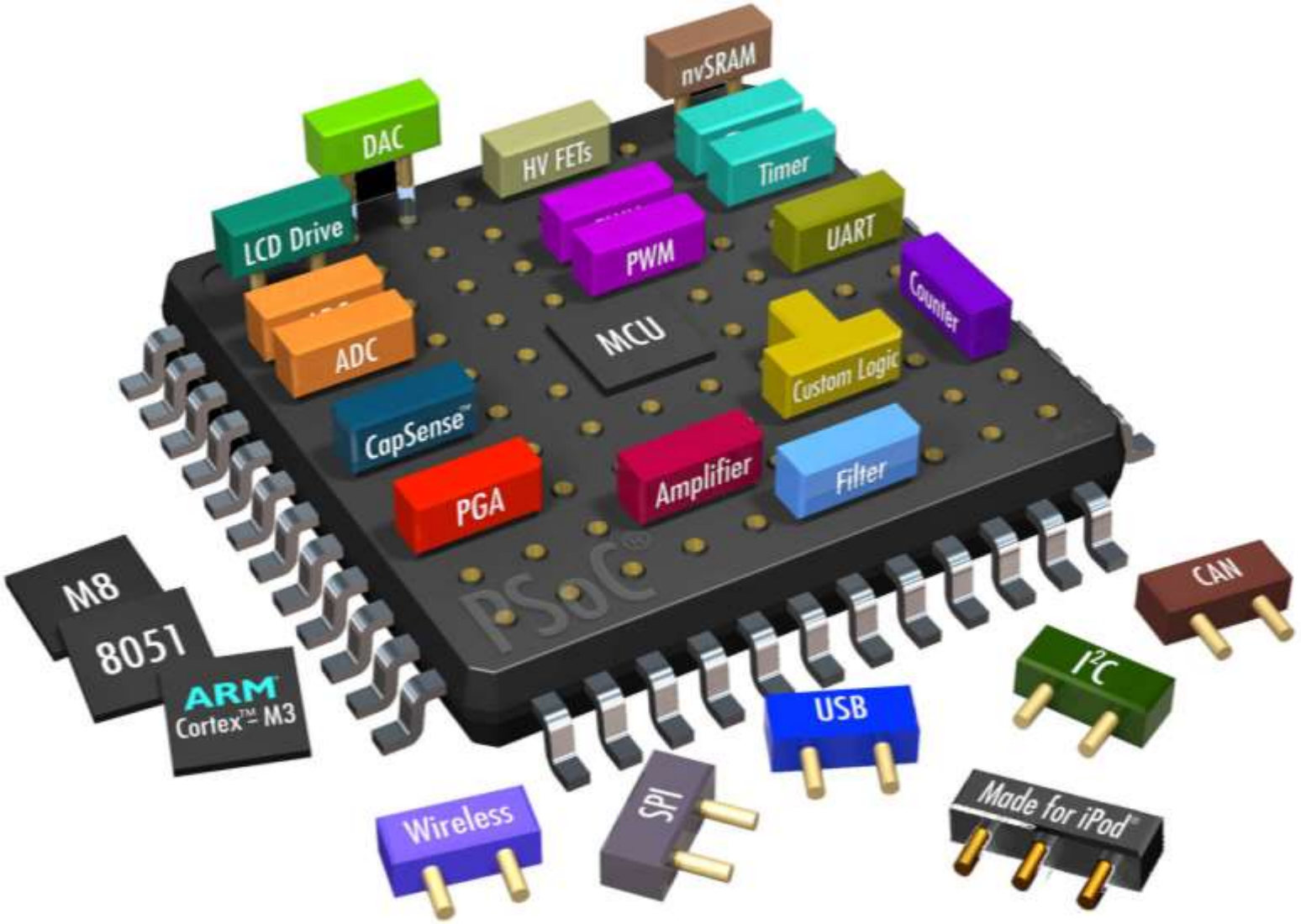
Hardware

Types	Chip vendors	Development boards
• Microcontroller • Microprocessor • SoCs	• ARM • Atmel • TI • Intel	• Arduino • ARM • Raspberry Pi • Beaglebone • Atmel • Intel Galileo/ Gen2/ Edison

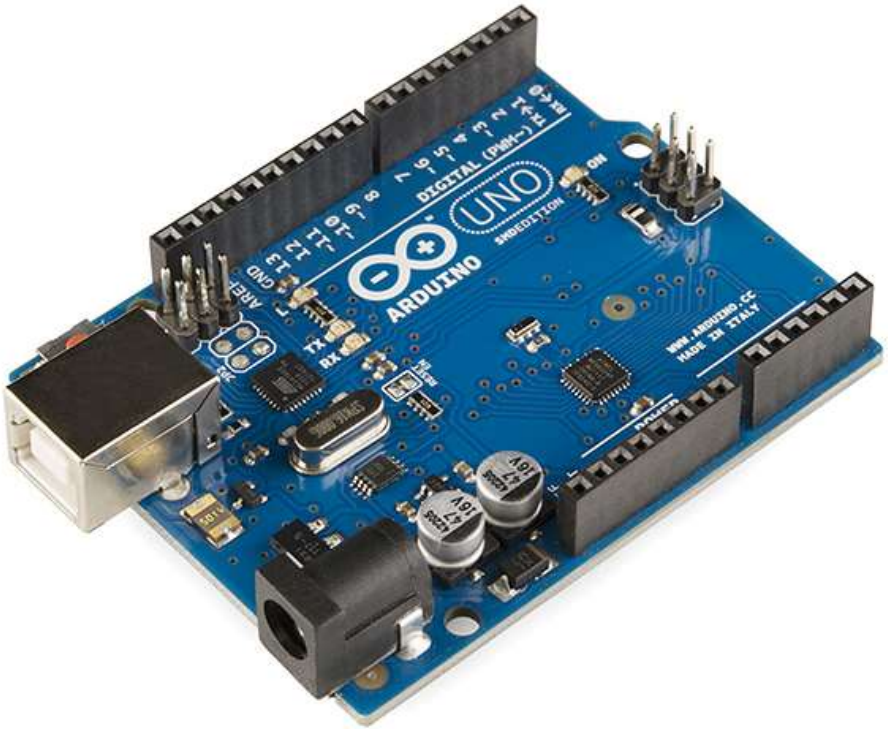
Microcontroller

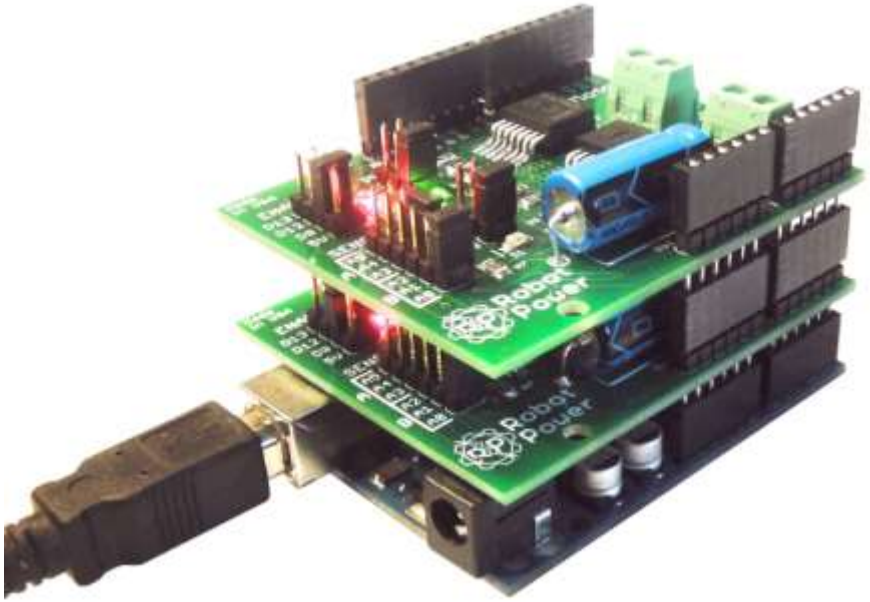


System on Chip

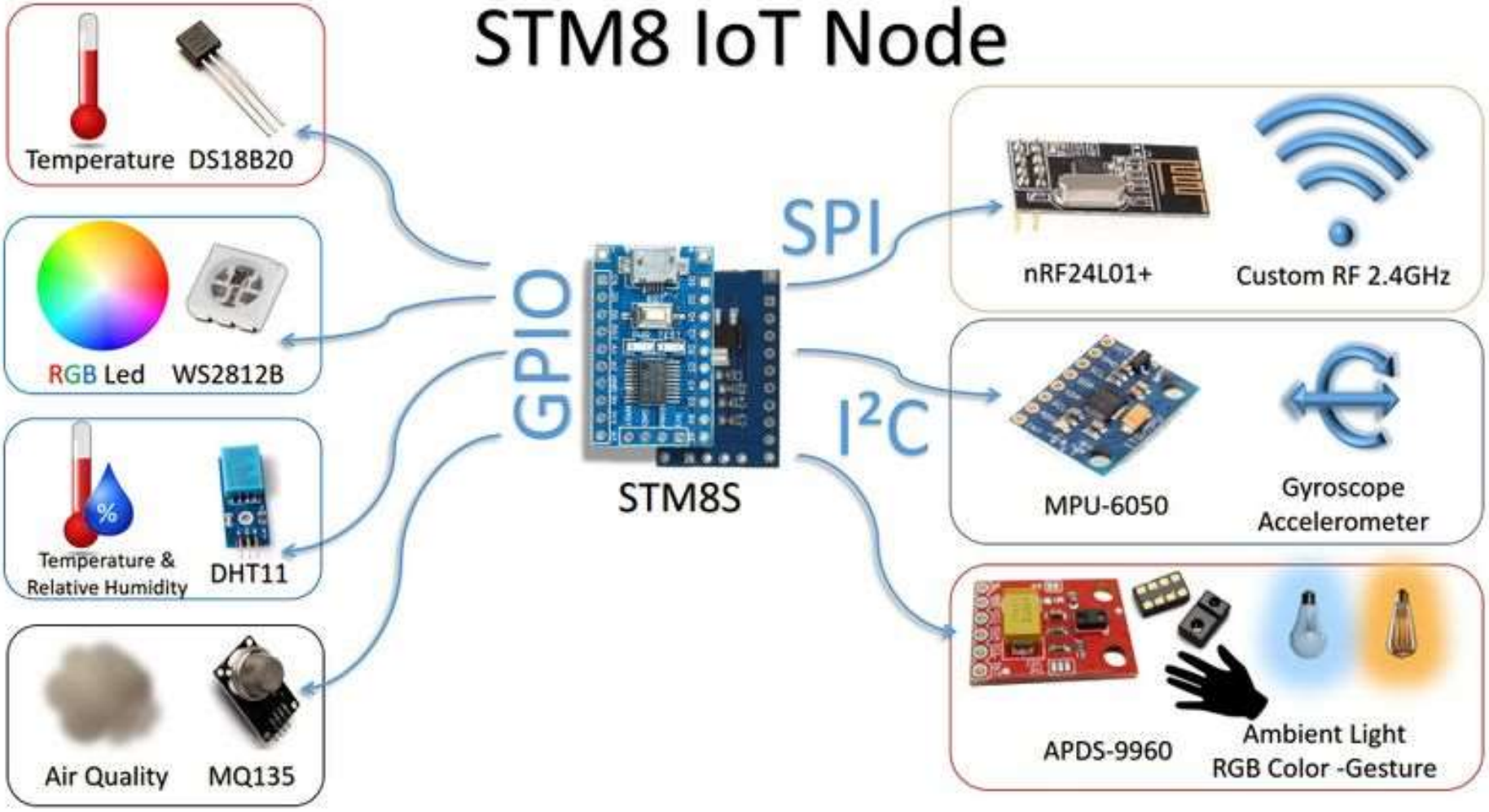


Arduino + Shields





STM8 IoT Node

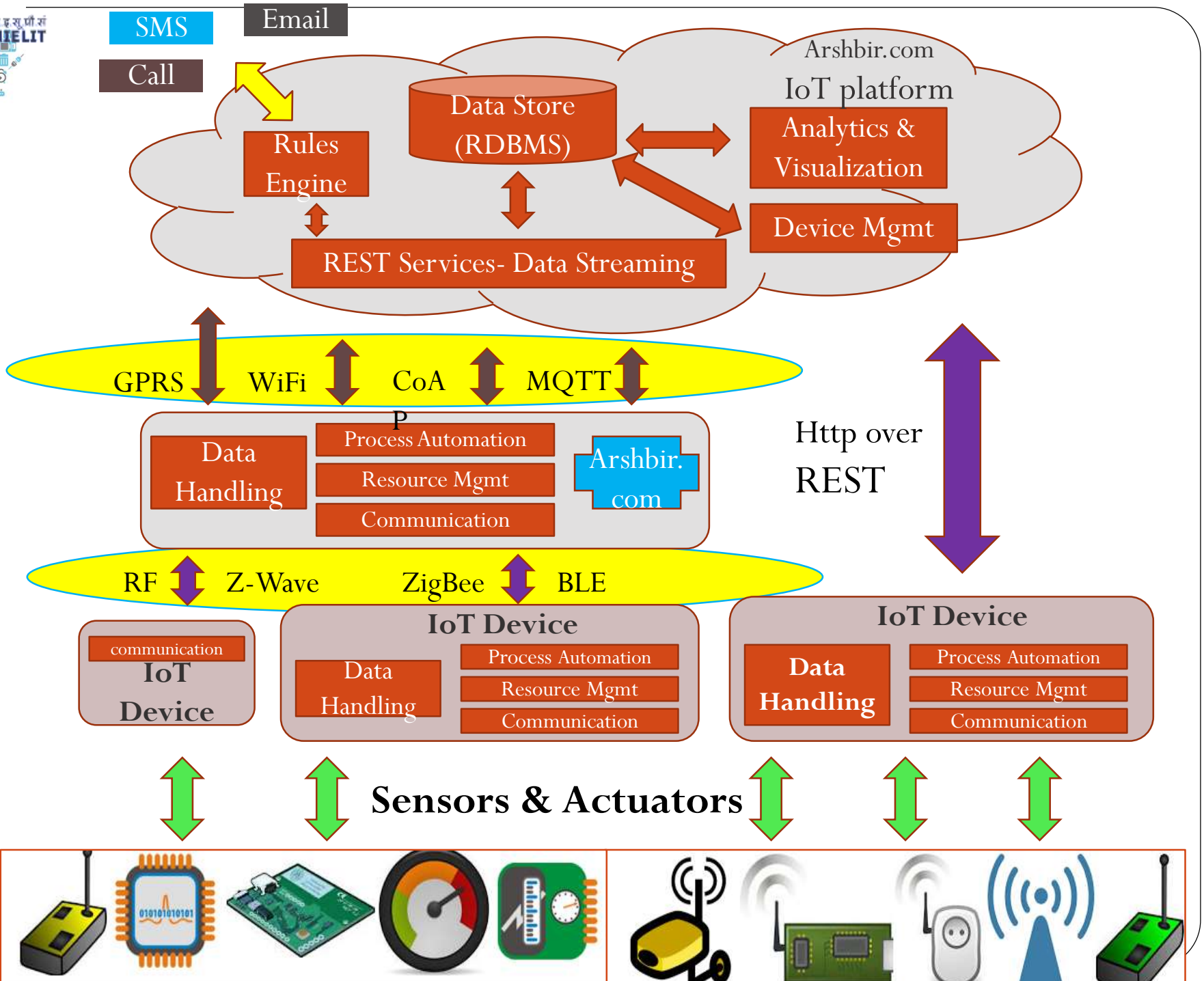


Raspberry Pi , Beaglebone

Node vs Gateway

Parameter	Node	Gateway
Cost	$10	$80
Power	Battery	Continuous
Communication	Short Range Wireless	Cloud
Computing Power	Low	Meduim
Size	1”	6”
Unique IP	Not necessary	Most likely

Communication



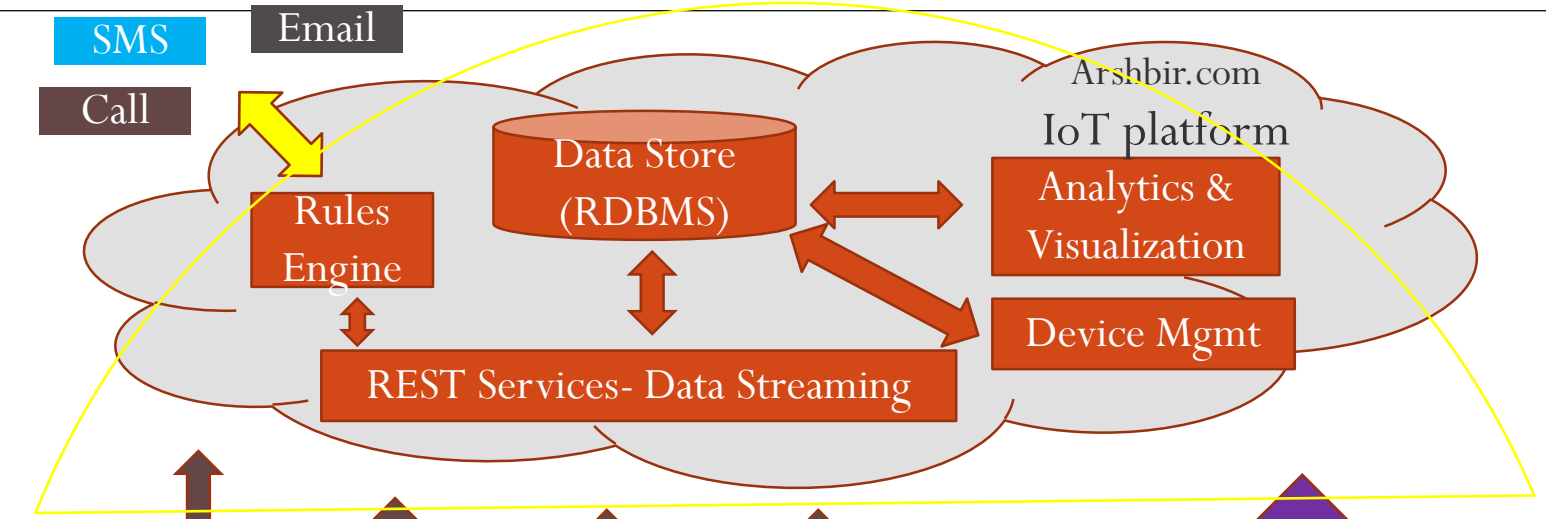
Radio frequency

Components	Typical Bands	Examples/Protocols
• transmitter • Receiver • Transceivers • System on Chip	• 433MHz • 868 MHz recommended for India • 2.4 GHz	• ZigBee • Z-wave • Bluetooth • BLE • Wi-Fi • Proprietary

Communication

Cloud Communication

Components	Channels	Examples/Protocols
• Gateway • Server	• Wifi • Ethernet • GSM/GPRS • LTE • 3G • PLC	• Http/Https • TCP/IP • UDP • MQTT • CoAP • XMPP


SMS
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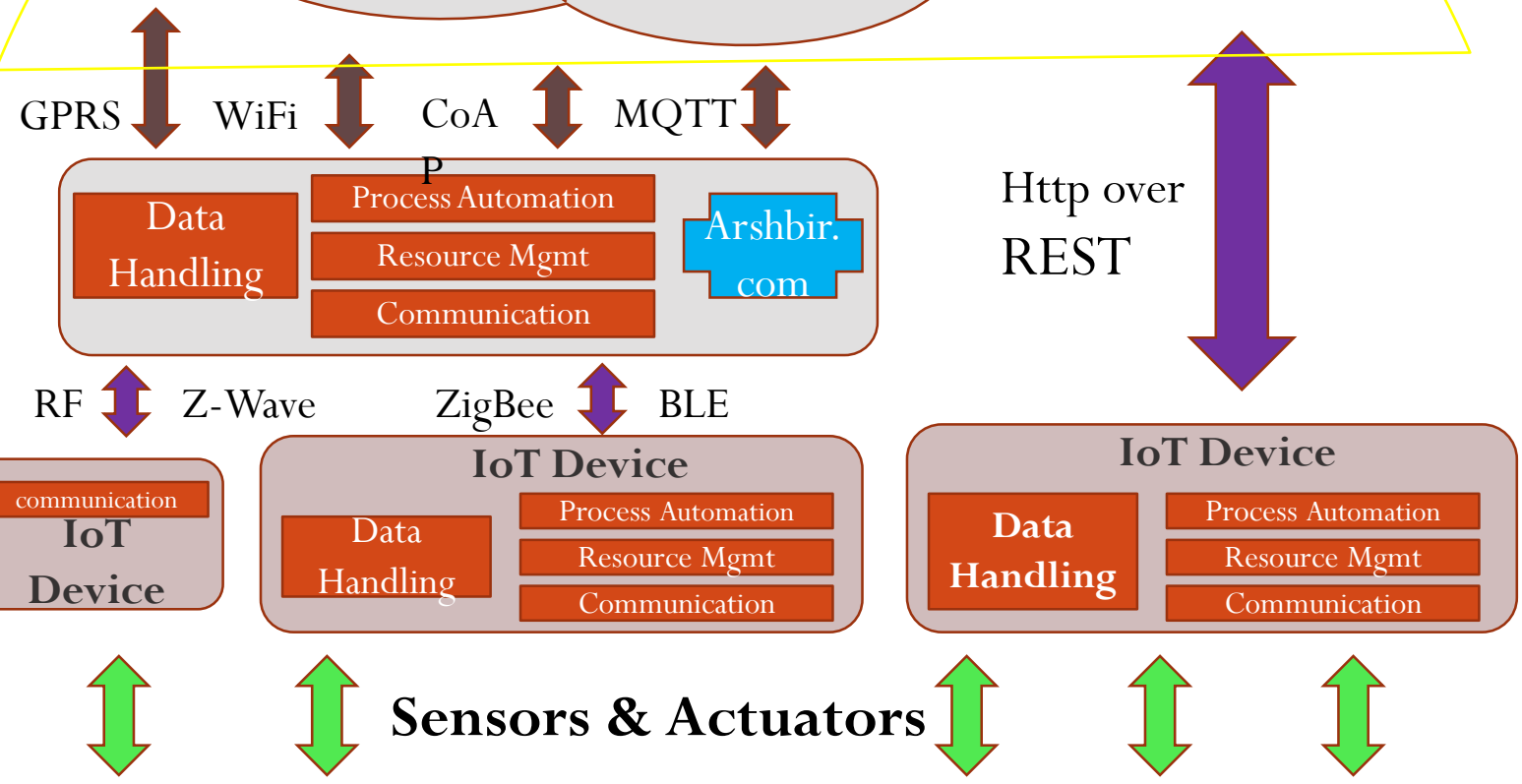
Arshbir.com
IoT platform
Data Store (RDBMS)
Rules Engine
Analytics & Visualization
Device Mgmt
REST Services- Data Streaming


GPRS
WiFi
CoAP
MQTT
Data Handling
Process Automation
Resource Mgmt
Communication
Arshbir.com
Http over REST
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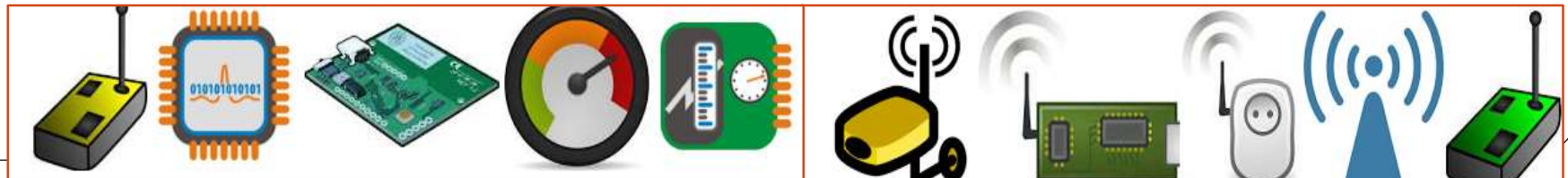
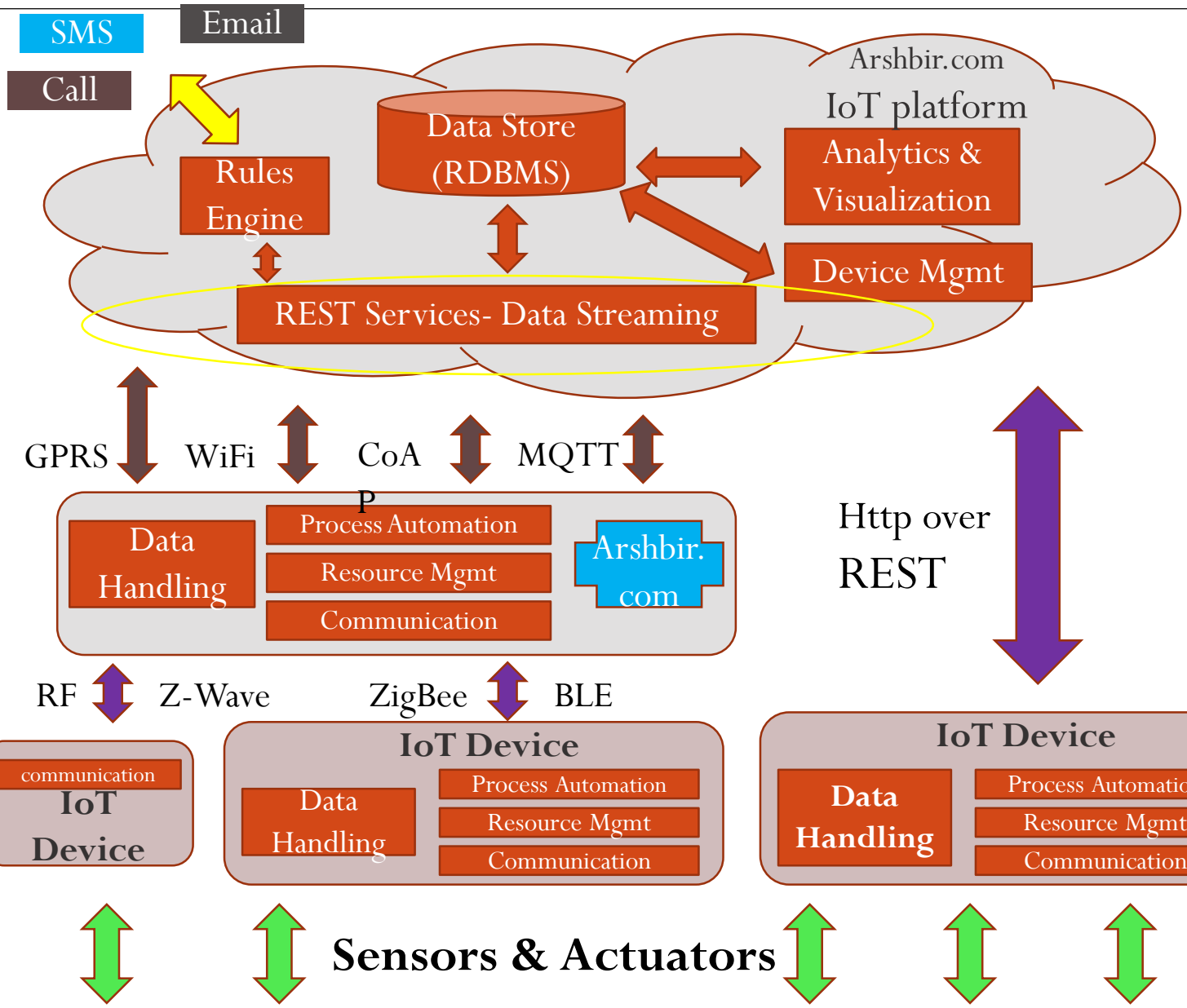
Communication
Sensors & Actuators



Cloud

Components	Examples
• Streaming • Data stores • Rules Processing & Notification • Device Management Systems • Analytics and Reporting Engines	• AWS • IBM • CISCO • Microsoft

Data Stream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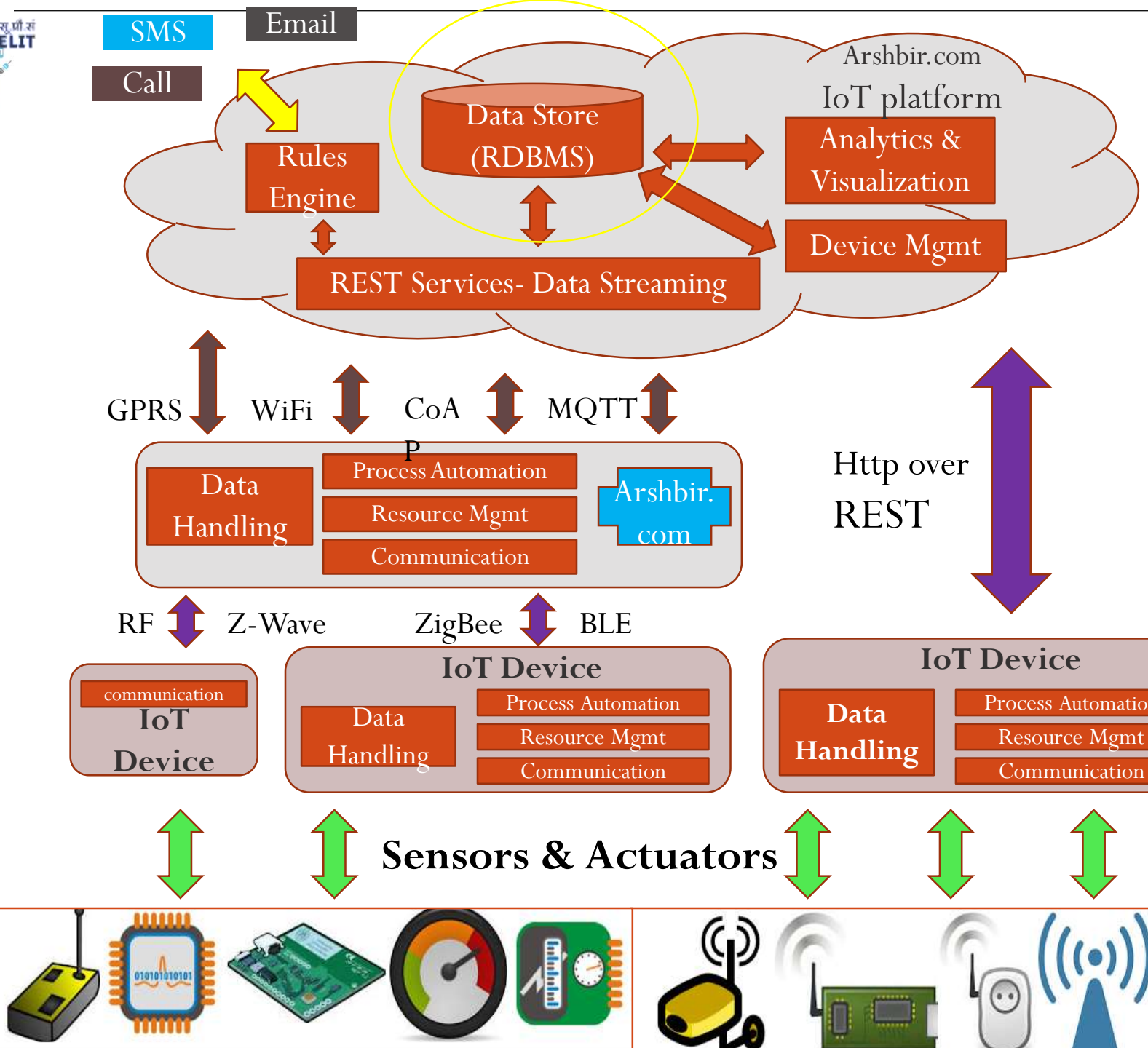
Data Streaming

Components	Examples	Approach
• streaming Server • Actuation • Over the Air Updates	• Tomcat • Jboss • Websphere • Mosquitto • Node.js –TCP/IP	• REST over Http/Https • Jersey reference implementation • Entire functionality over REST services • REST over CoAP under development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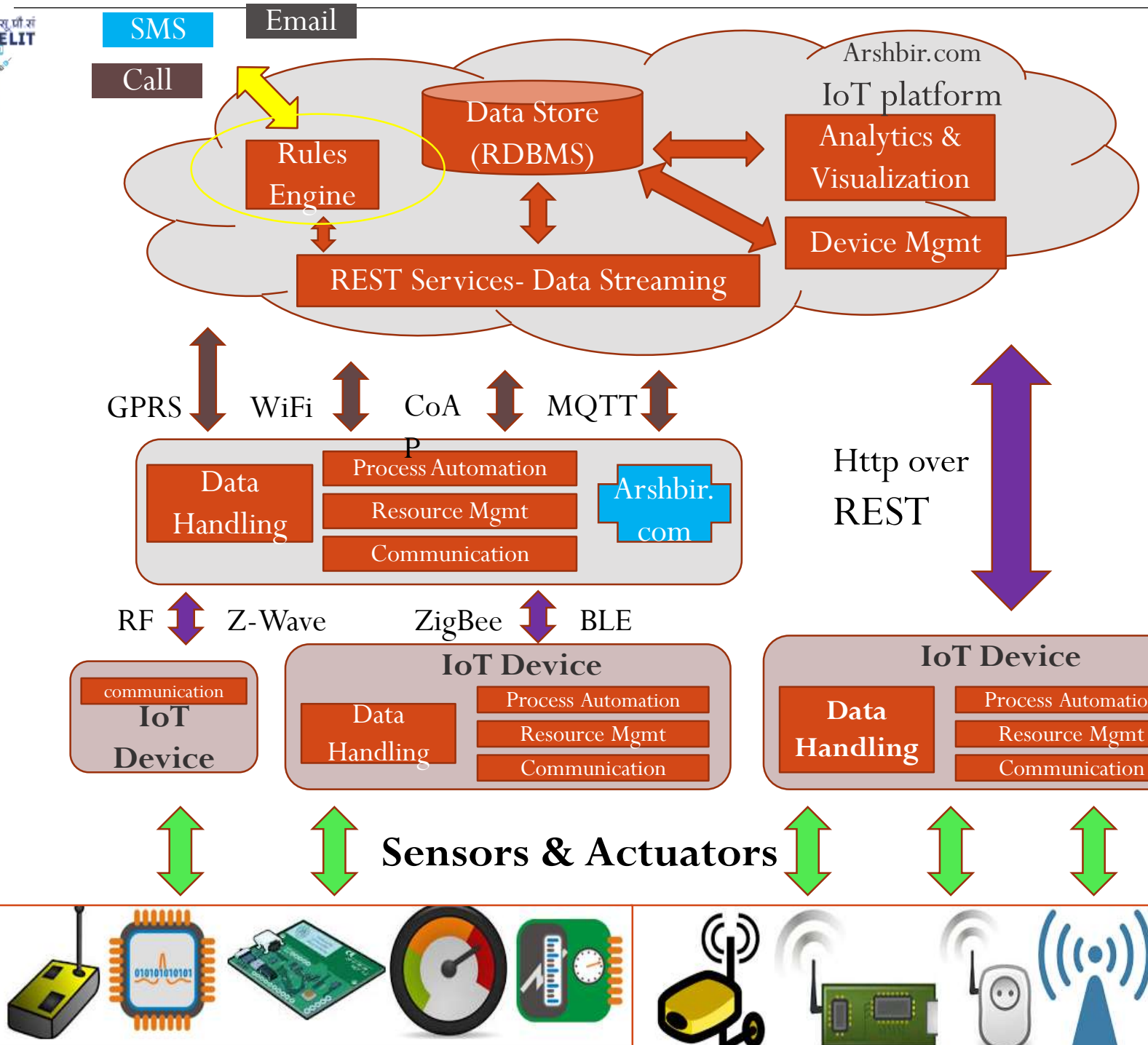
Data Store

Sql	NoSql	Approach
• Oracle • **MySQL**	• Key value – Redis, Amazon Simple DB • Column – Cassandra Hbase • Document – CouchDB, MangoDB • Graph - Neo4J	• Hybrid • Hibernate • Modularization

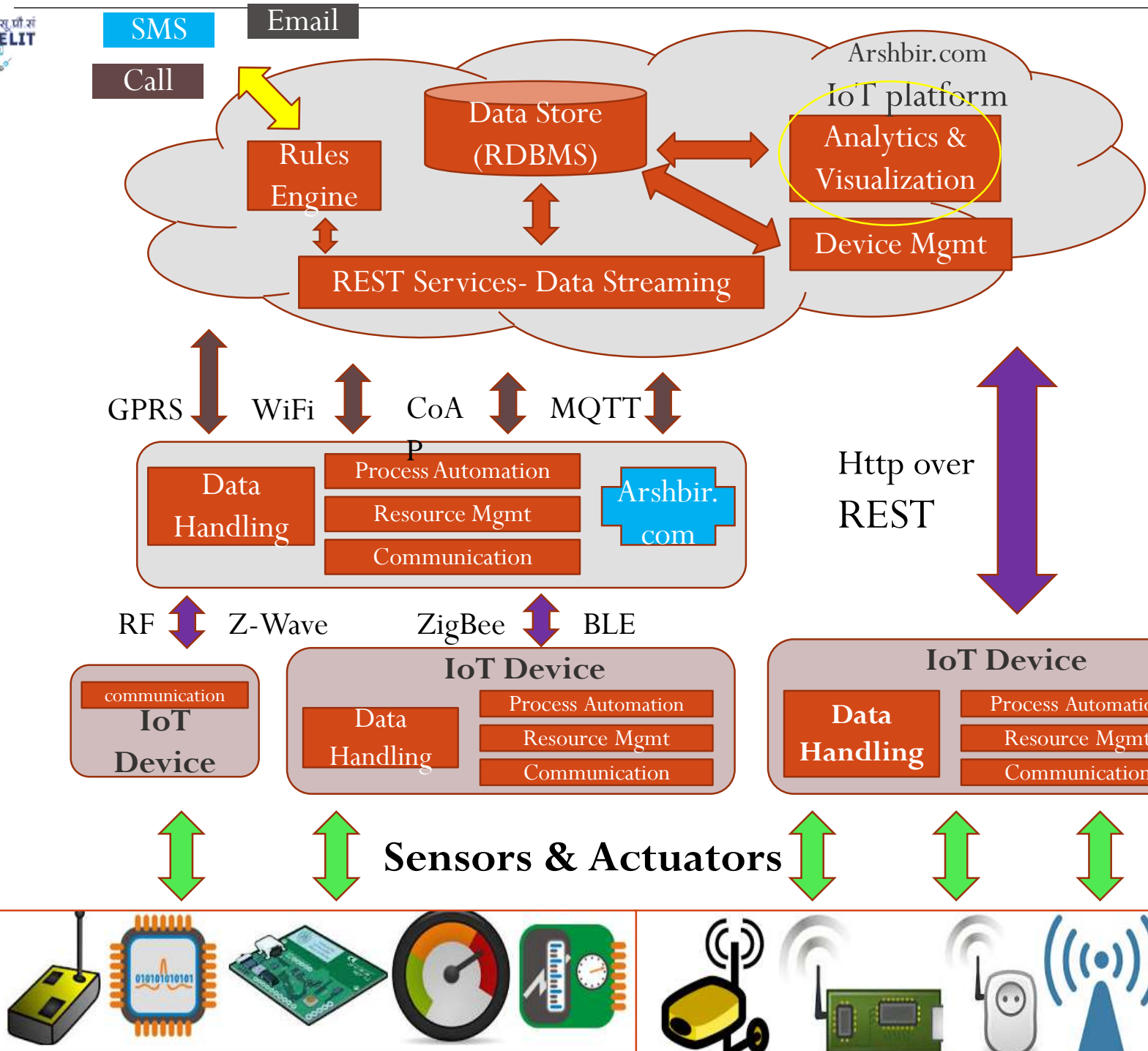
Event Processing



Event Processing

Components	Examples	Approach

• Real time analytics
• Quick processing
• Processing based on
  • Stream info
  • Patterns
  • Combination of rules
	• Oracle CEP
	• Sidhi
	• Altibase
	• Microsoft StreamInsight
		• Custom Rules Engine
		• Simple Rules based on UI Scripting
		• Plugin mechanism for more complex rules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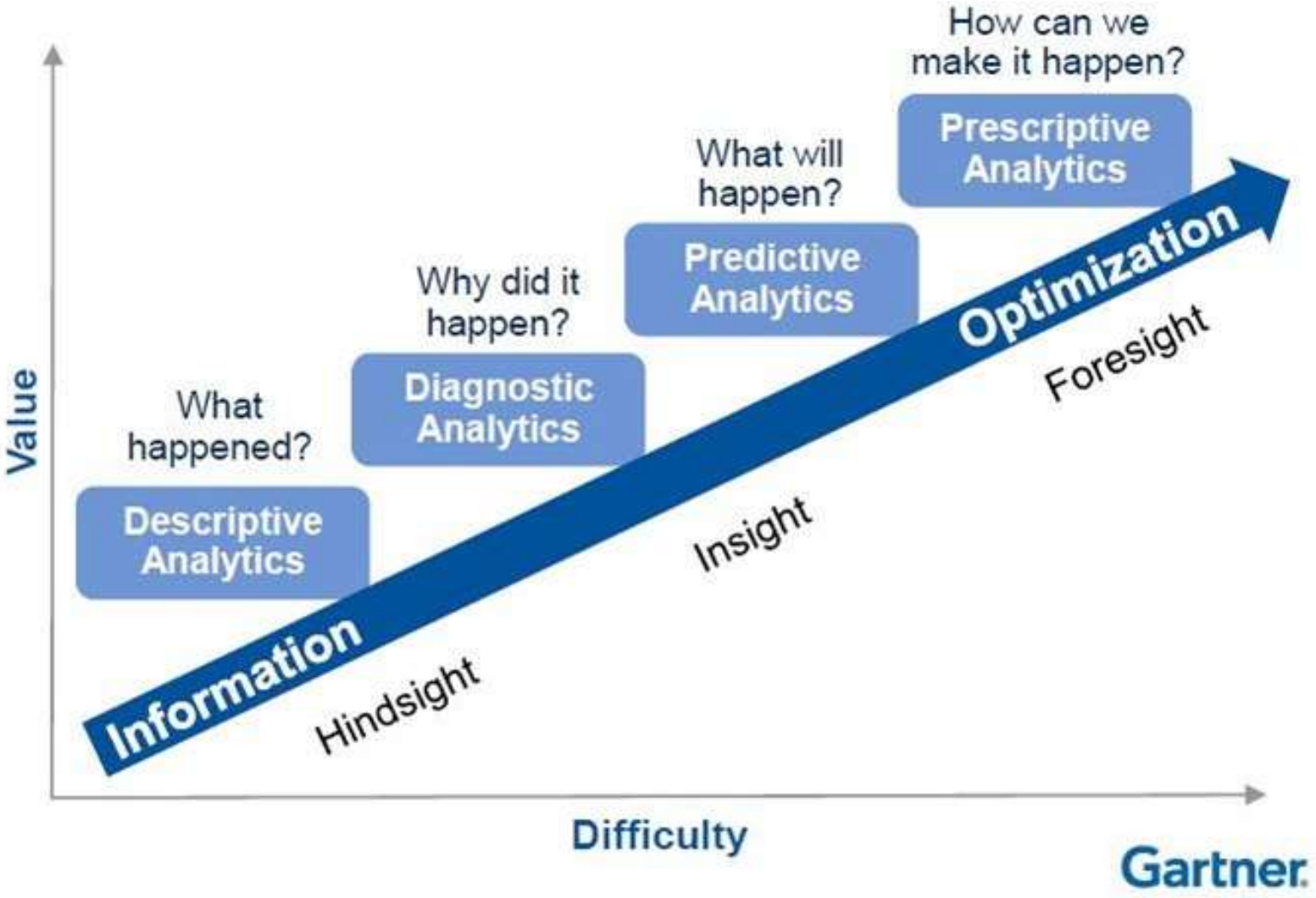
Analytics

Components	Examples	Approach
• Real time • Offline • Visualization	• Hadoop Ecosystem • Spark • MangoDB • D3 • Tableau	• MangoDB – Map Reduce • NVD3 – Visualization • Real time Dashboards • Domain ontologies

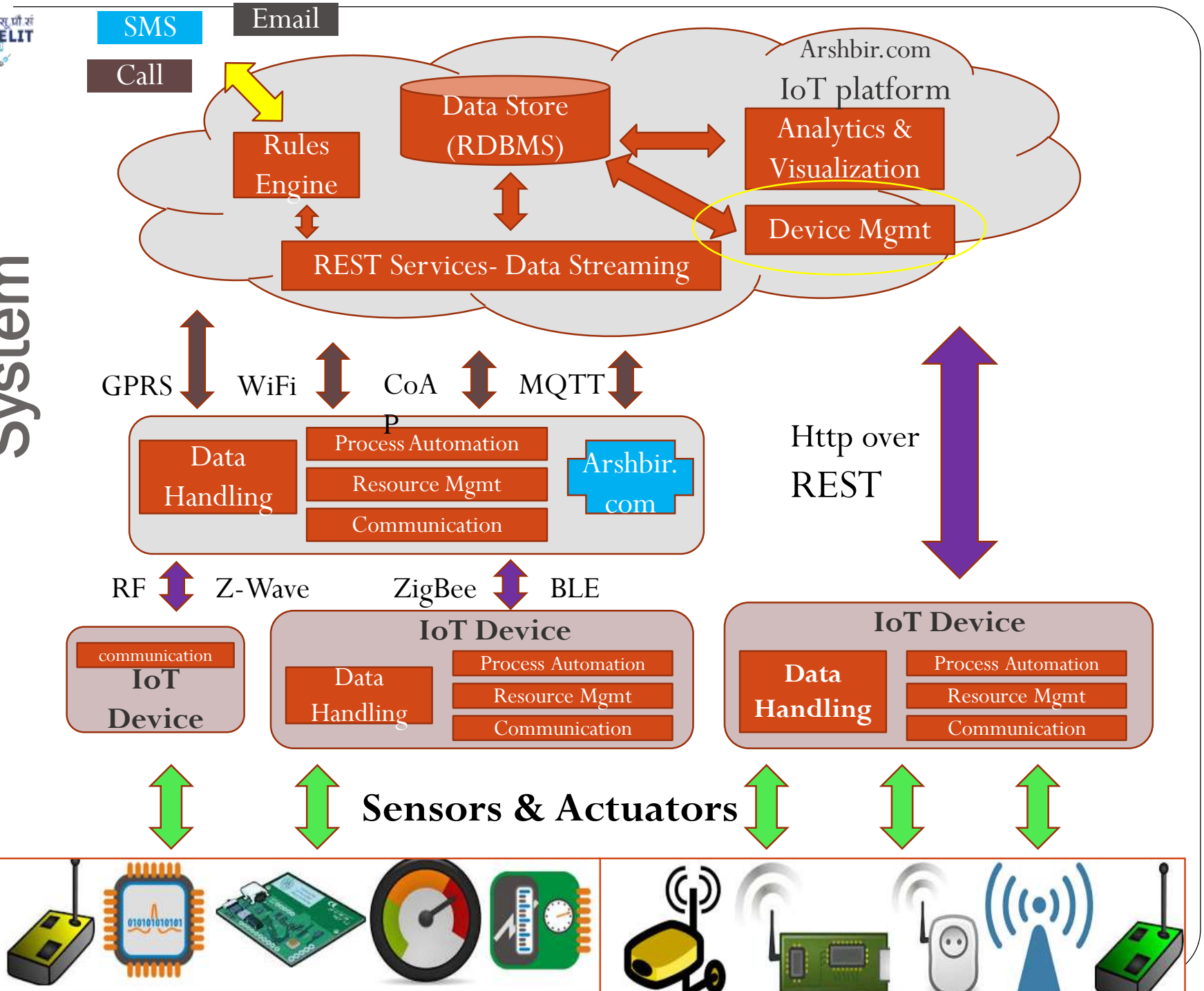
Analytics Maturity



What is Visual Analytics

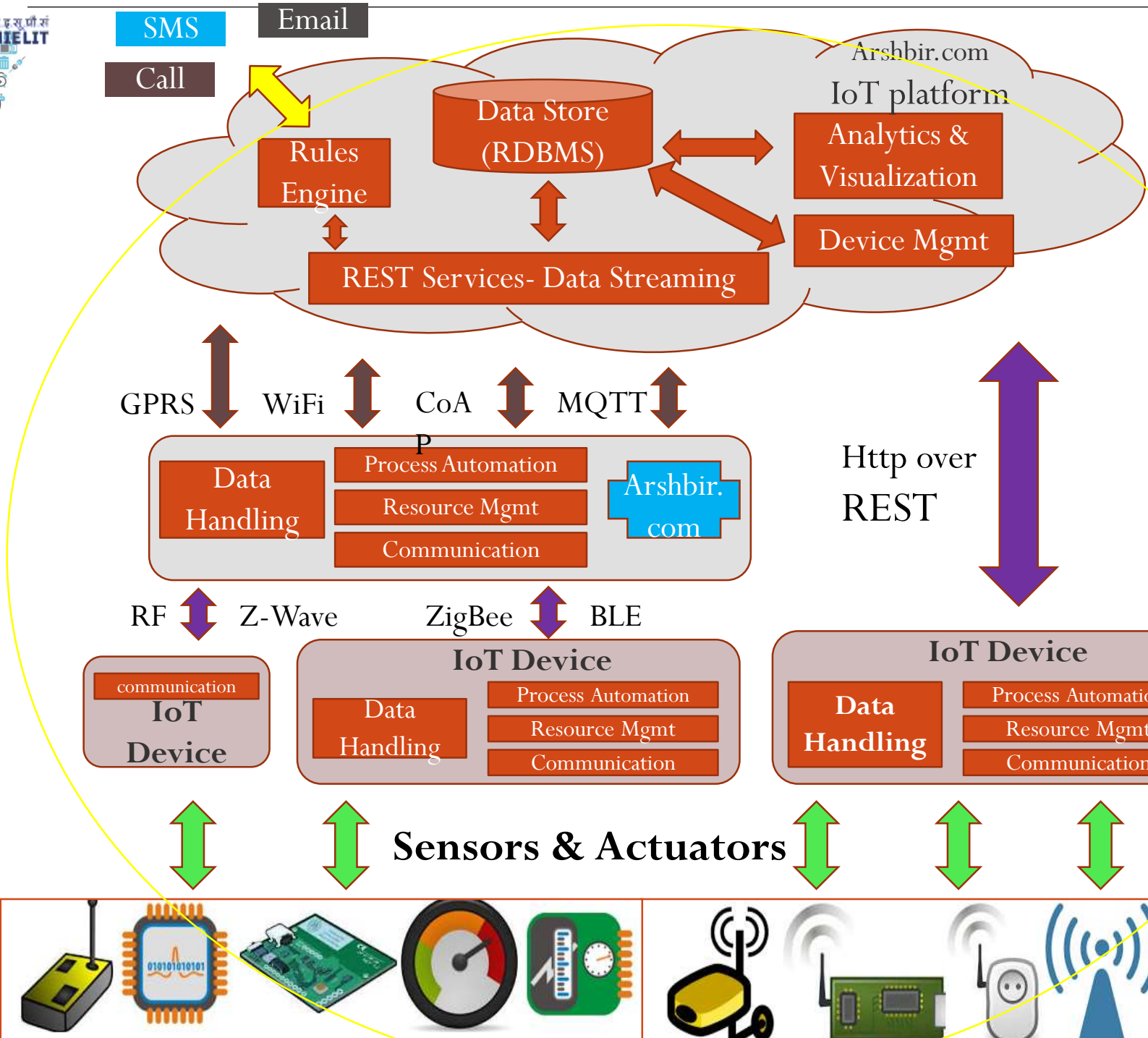
- Science of analytical reasoning facilitated by visual interactive interfaces
- Integrates new computational and theory-based tools with innovative interactive techniques and visual representations to enable human-information discourse
- Design is based on human cognitive and perceptual principles

Device Management System



UI Technologies

Components	Examples	Approach
• Business logic • Data Store • Visualization • Integration and Services	• Angular JS • Google Toolkit • Spring MVC / rails • Ruby on Rails	• Spring MVC • Bootstrap and JQuery • Hibernate • mySQL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Security

Components	Examples	Approach
• Wireless communication • Communication with server • Security of Data in Cloud	• DTLS • Https • BLE	• HTTPS • Pseudo Random Numbers • Proprietary Encoding / Decoding • Fused code on Chip • AWS security infrastructure

Why IoT security difficult ? .... because

- Wireless communication
- Physical insecurity
- Constrained devices
- Potentially sensitive data
- Lack of standards
- Heterogeneity : weakest link problem
- A systems, not software problem
- Classic web/internet threats
- Identity management & dynamism
- Inconvenience and cost

Threats to IoT systems

- The physical devices
  - Can be stolen
  - Can be modified
  - Can be replaced
  - Can be cloned

- The software
  - Can be modified (firmware/OS/middleware)
  - Can be decompiled to extract credentials
  - Can be exhausted (denial of service)

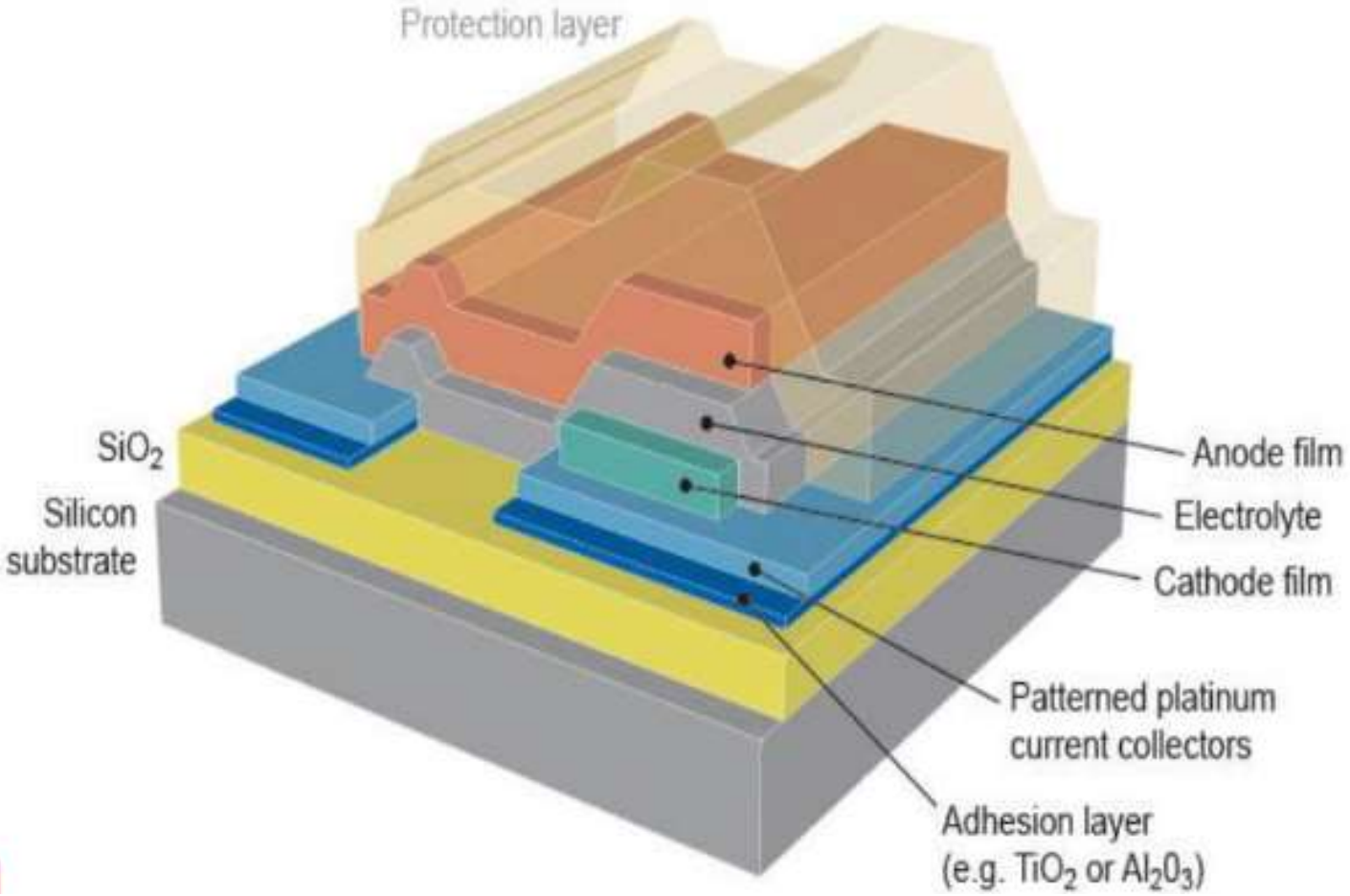
- The network
  - Eavesdropping
  - Man-in-the-middle attacks
  - Rerouting traffic
  - Theft of bandwidth

Challenges and technology trends

Power

Chip	ULP Bench Score	Active Mode	Sleep Mode
Atmel L21	185	35uA	200nA
TI MSP 432	167	90uA	800nA

Solid State Battery



Bio Batteries