Major Components of the Internet of Things Systems

1. **Sensors and Control Units**

Sensors

- Analog Sensors: thermistor, photoconductor, pressure gauge and Hall sensor
- Digital Sensors: touch sensor, proximity sensor, metal sensor, traffic
- presence sensor, rotator encoder for measuring angles, linear encoders for measuring position

Control Unit

- Most commonly used control unit in IoT consists of a microcontroller unit (MCU) or
- A custom chip or core in a VLSI or an SoC
- Popular microcontrollers: ATmega 328, ATMega 32u4, ARM Cortex and ARM LPC.

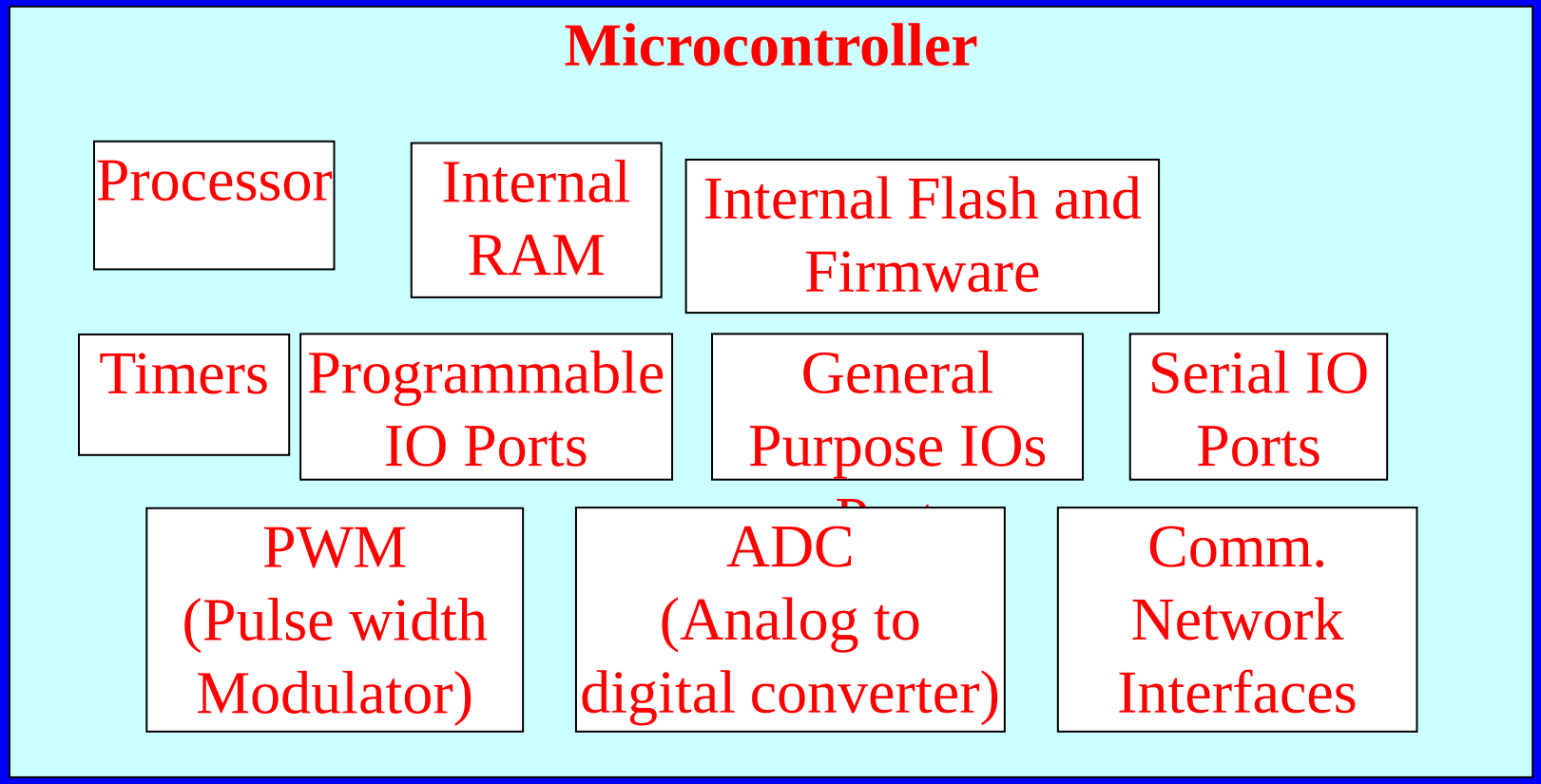

Fig. 1.6 Various functional units in a microcontroller embedded in IoT device

Arduino Boards

- E.g. **Arduino Yún**
- Using Microcontroller ATmega32u4
- Includes Wi-Fi, Ethernet, USB port, micro-SD card slot and three reset buttons
- Runs Linux

Intel Galileo

- Intel Galileo board
- A line of Arduino-certified development boards.
- Intel x86, Intel SOC X1000 Quark based System-On-Chip
- Power over Ethernet (PoE) and 6 Analog Inputs

BeagleBoard

- Very low power requirement
- Card like computer
- Can run Android and Linux
- Open source Hardware designs and the software for the IoT devices are

Raspberry Pi

- Wi-Fi-connected device
- Included code open source RasWIK

2. RFIDs

RFID (Radio Frequency ID)

- An identification system
- Tagging and labelling
- Tiny chips: passive, active and battery powered when reader nearby Wireless

RFID (Radio Frequency ID)

- Communication range 10 cm to 200 m
- Standard frequency ranges: 120-150 kHz, 13.56 MHz, 433 MHz and higher in UHF and Microwave regions

RFID Applications

- Tracking and inventory control
- Identification in supply chain systems
- Access to buildings and road tolls
- Secured store center entries
- Devices such as RFID based temperature sensors

RFID Applications

- Applications in factory design, 3PL-management, brand protection, and anti-counterfeiting
- Business processes for payment, leasing, insurance, and quality management

3. WSNs

WSN network

- Defined as a network in which each sensor node connect wirelessly
- Capabilities of computations
- Data compaction, aggregation and analysis
- Each with communication as well as networking capabilities.

Node Characteristics

- Autonomous: Independent computing power and capability to send requests and receive responses, and data forward and routing capabilities.

4: Communication Modules and Software Development Tools

Communication Module

- Device message-queue
- A device message-cache stores the received messages
- Protocol handlers:

  CoAP, HTTP, MQTT, TLS, DTLS

  LWM2M, CoAP-SMS, CoAP-MQ,

  ……

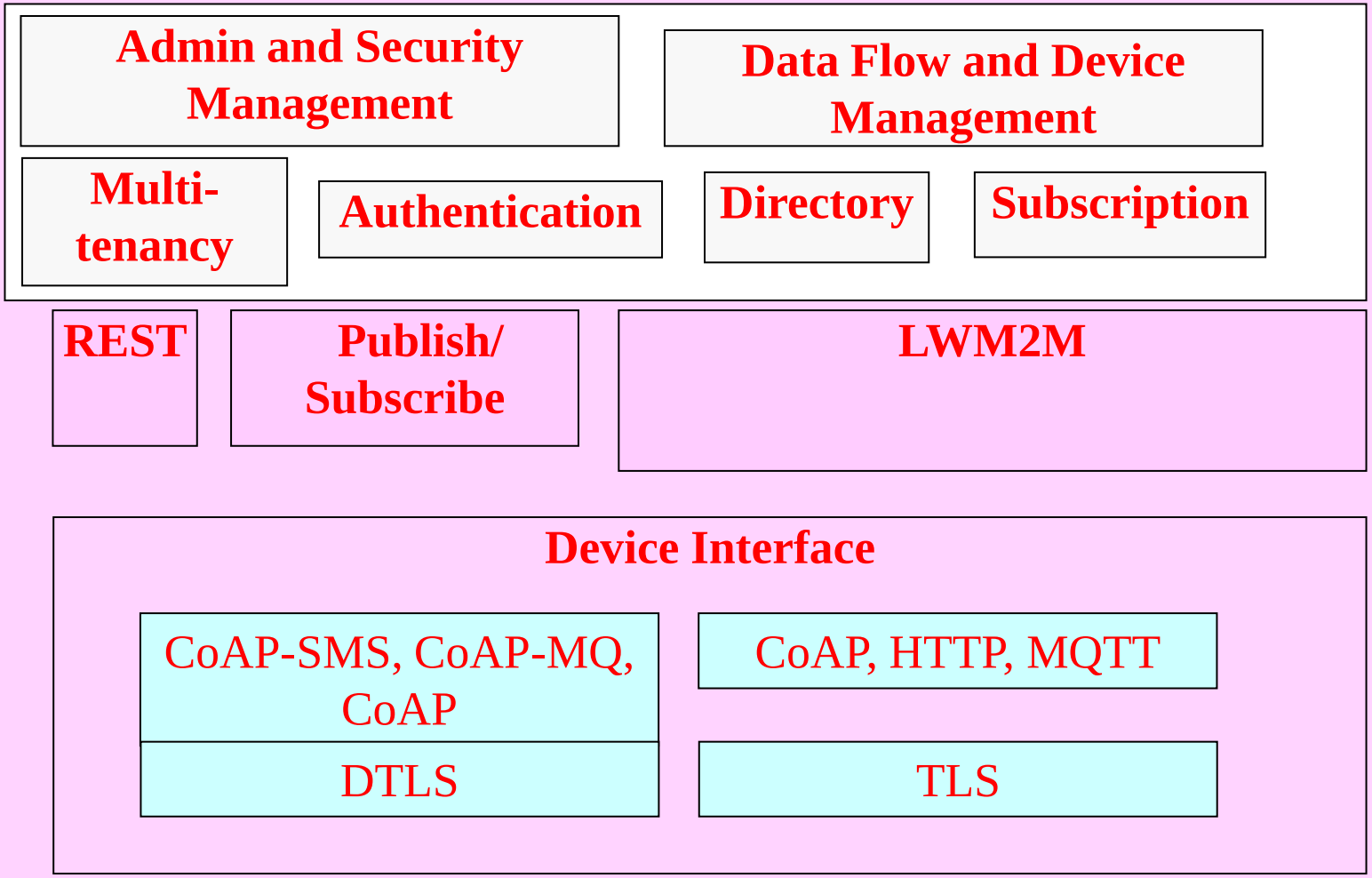

Fig. 1.7 mbed™ API and device interfacing components

Representational state transfer (REST) architectural style

- Used for HTTP access
- GET, POST, PUT and DELETE methods for the resources
- Building web services

Middleware

- OpenIoT (open source middleware)
- Communication with sensor clouds and Cloud-based ‘sensing as a service
- IoTSyS middleware provisioning of communication stack for smart devices using IPv6, oBIX, 6LoWPAN

Middleware

- CoAP and multiple standards and protocols. The oBIX is standard XML and web services
- protocol oBIX (Open Building Information Xchange).

OS

- RIOT: an operating system for IoT devices. supports developer and multiple architectures
- Including ARM7, Cortex-M0, Cortex-M3, Cortex-M4, standard x86 PCs and TI MSP430 architectures.

OS

- Raspbian: a popular Raspberry Pi operating system Based on the Debian distribution of Linux.
- AllJoyn, open source OS created by Qualcomm Cross-platform OS with APIs available for Android, iOS, OS X, Linux

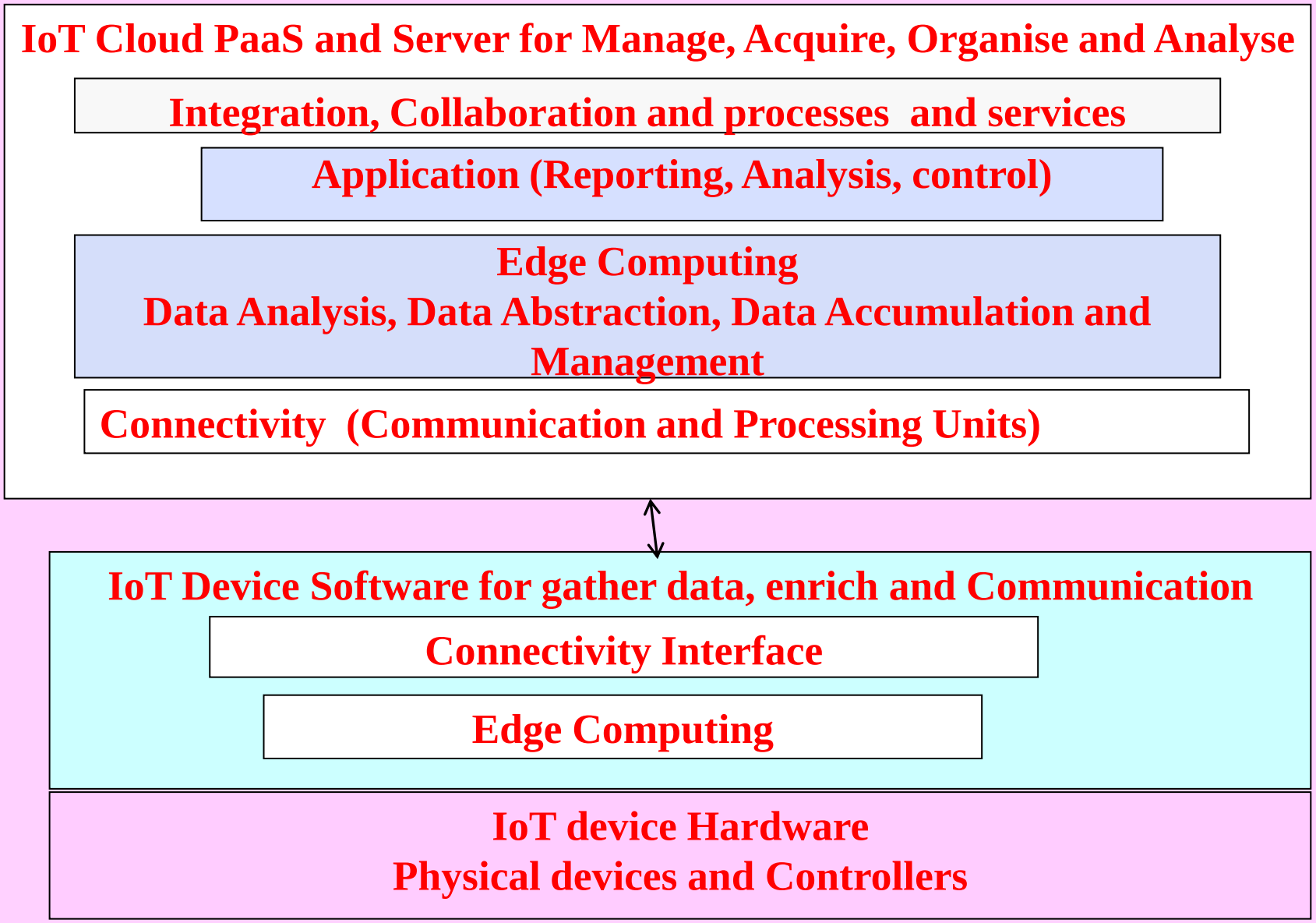

Fig. 1.8 The IOT software architecture

Cloud Platforms as a Service

- Sense, ThingWorx, Nimbits, Xively,
- openHAB, AWS IoT, IBM BlueMix, CISCO IoT, IOx and Fog, EvryThng, Azure, TCS CUP

Summary

We learnt

(i) Sensors, Control units, Microcontrollers

(ii) Sources for the IoTs: Arduino, Intel Galileo, Raspberry Pi, BeagleBone, (iii) RFIDs, (iv) WSNs

……Summary

We learnt

(iv) Communication module and software development tools

End of Lesson 3 on Major Components of the Internet of Things Systems