IOT: Internet of Things
and
Single Board PC Computers Under $100

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Agenda

- What is IoT
- What are the challenges
- What is the status
- Single Board computers under $100
- Role of Sensors and RFID in IoT
- Conclusion

What's the Internet of Things

- **Definition**

  (1) The Internet of Things, also called The Internet of Objects, refers to a wireless network between objects, usually the network will be wireless and self-configuring, such as household appliances.

  ------Wikipedia

  (2) By embedding short-range mobile transceivers into a wide array of additional gadgets and everyday items, enabling new forms of communication between people and things, and between things themselves.

  ------WSIS 2005

What's the Internet of Things

- **Definition**

(3) **T**he term "Internet of Things" has come to describe a number of technologies and research disciplines that enable the Internet to reach out into the real world of physical objects.

------IoT 2008

(4) "Things having identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts".

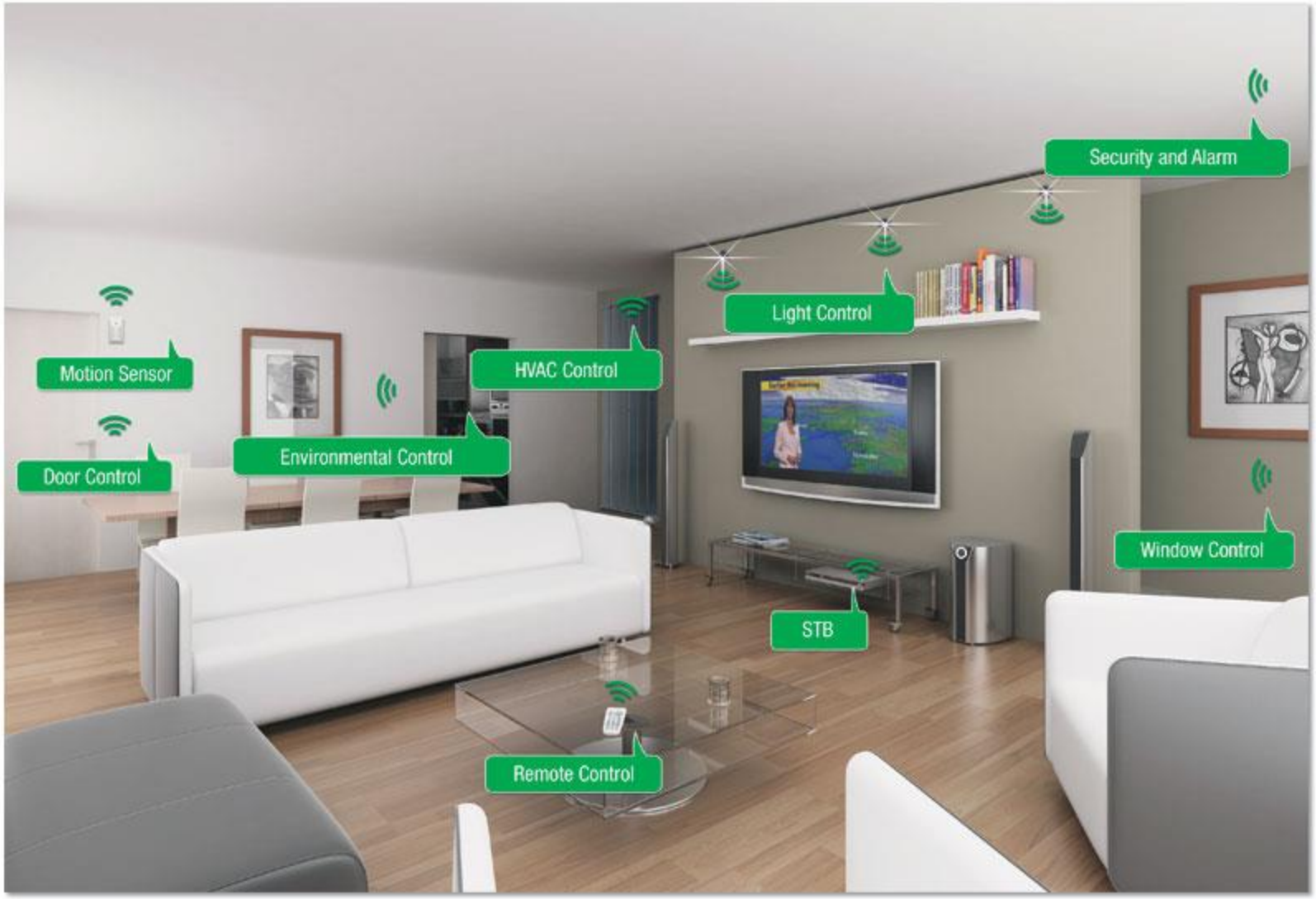
-------IoT in 2020

The Internet of Things Starts at the Smart Home

The smart and energy-efficient home, monitored and controlled by one central application on your smartphone, will finally become a reality and introduce a connected ecosystem for everyday living.

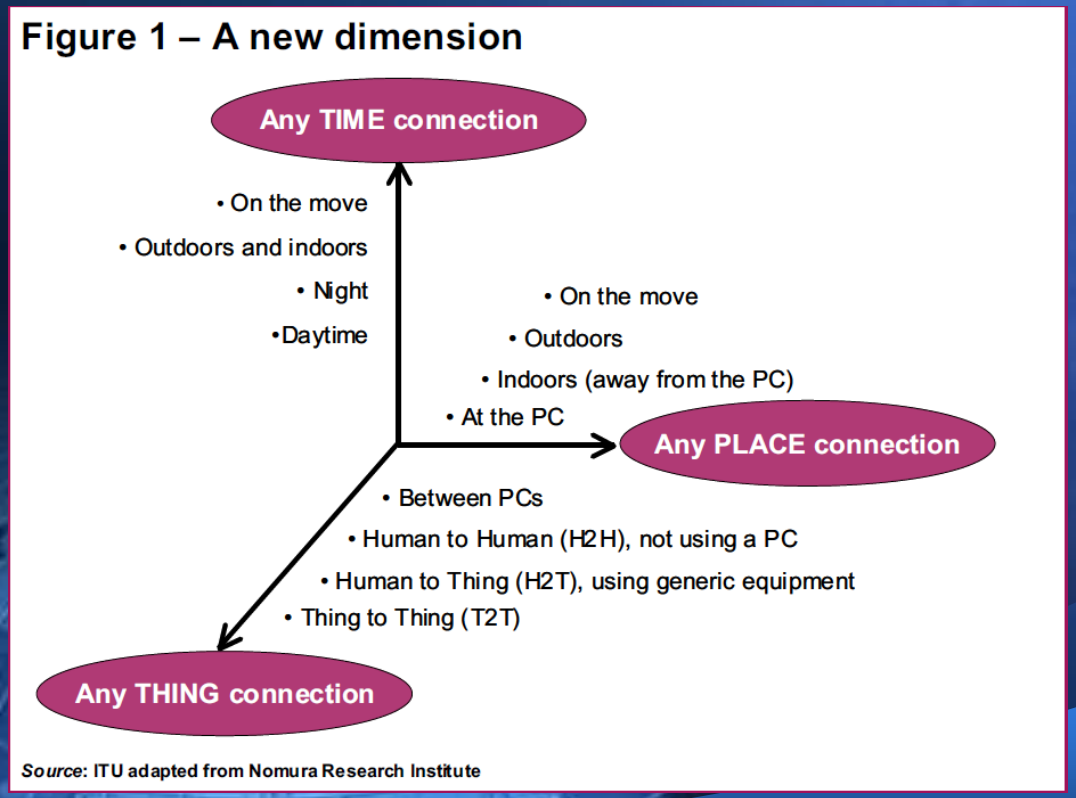
- The term Internet of Things was first used by Kevin Ashton in 1999.
- Refers to uniquely identifiable objects (things) and their **virtual representations** in an Internet-like structure

IoT in a home


Security and Alarm
Light Control
Motion Sensor
HVAC Control
Door Control
Environmental Control
Window Control
STB
Remote Control

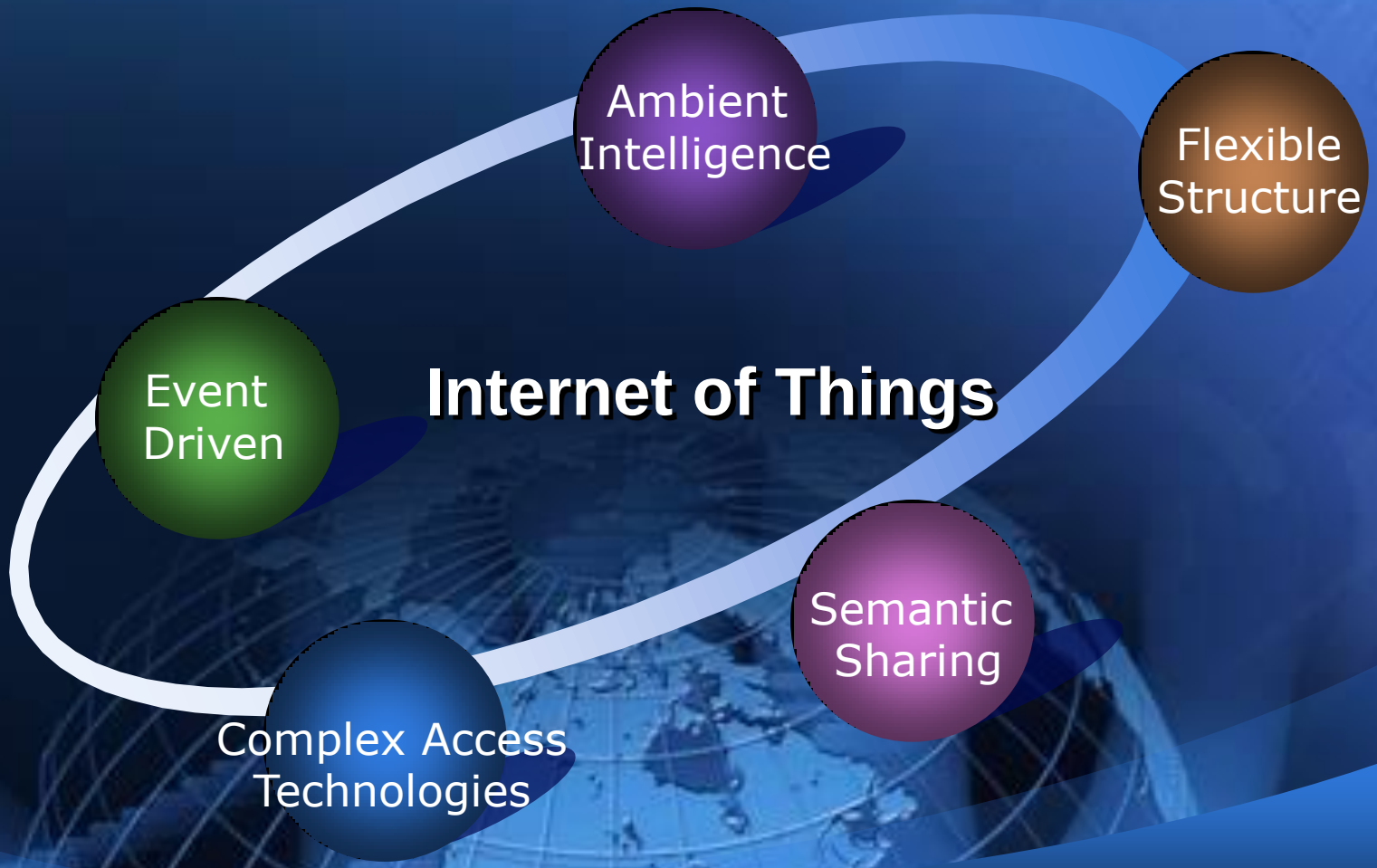
What's the Internet of Things

From any time ,any place connectivity for anyone, we will now have connectivity for anything!

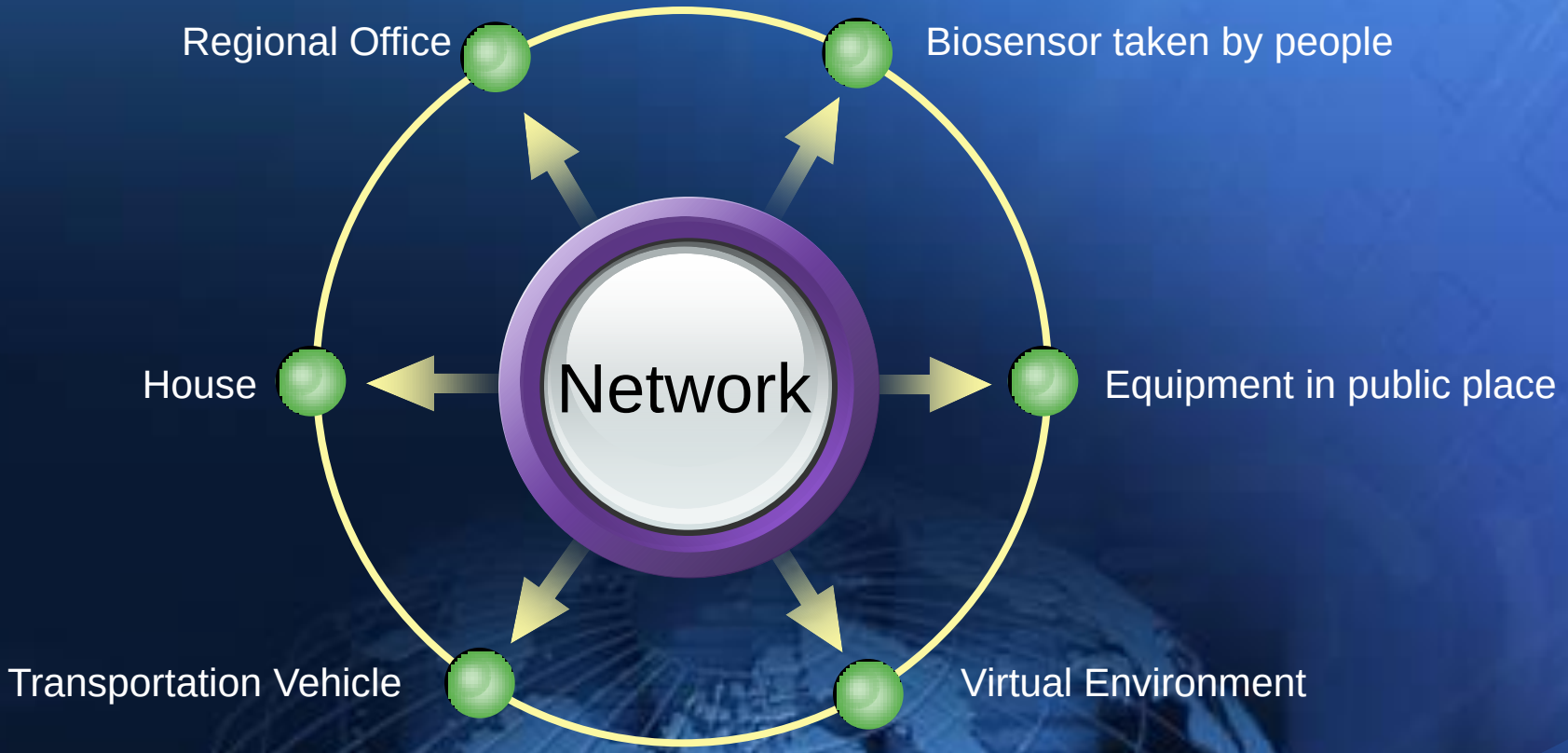


What's the Internet of Things

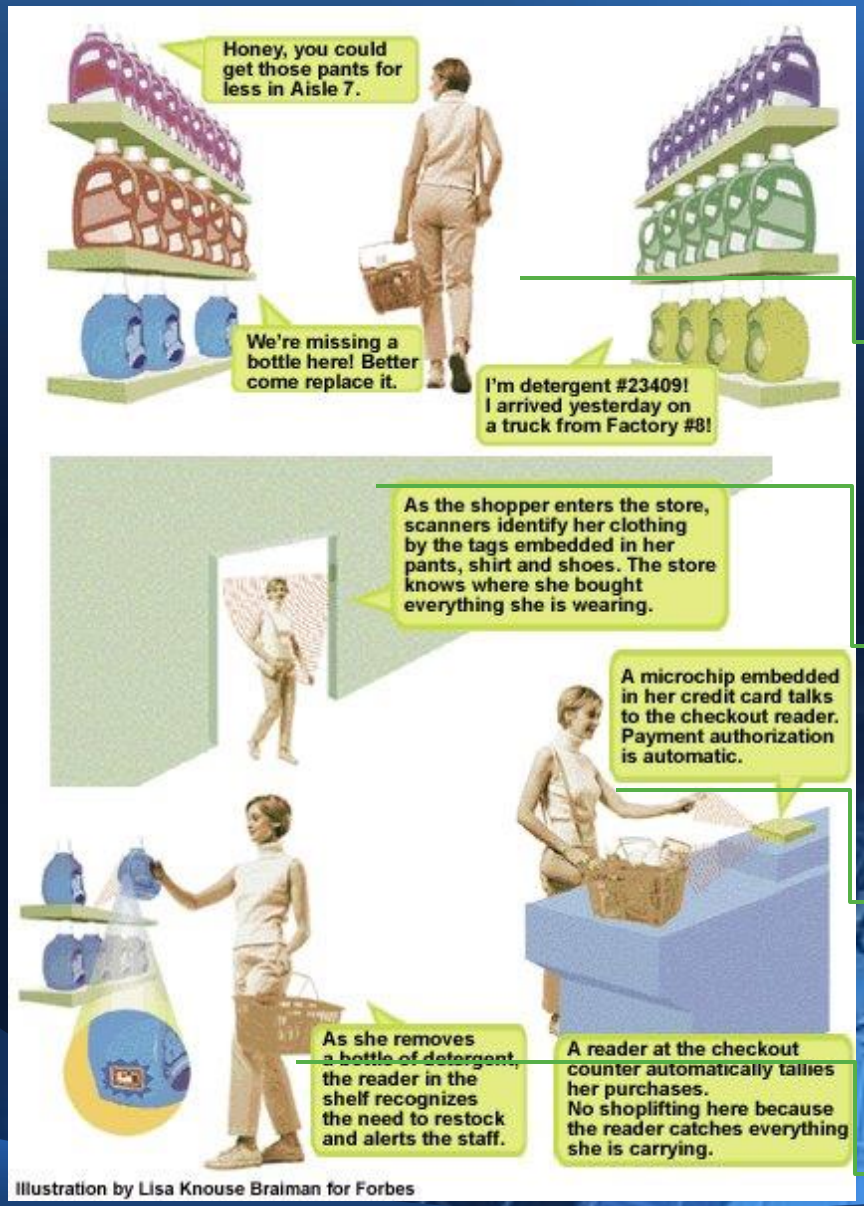
Characteristics



The application of IoT(1)



The application of IoT(2)



Scenario: shopping

(2) When shopping in the market, the goods will introduce themselves.

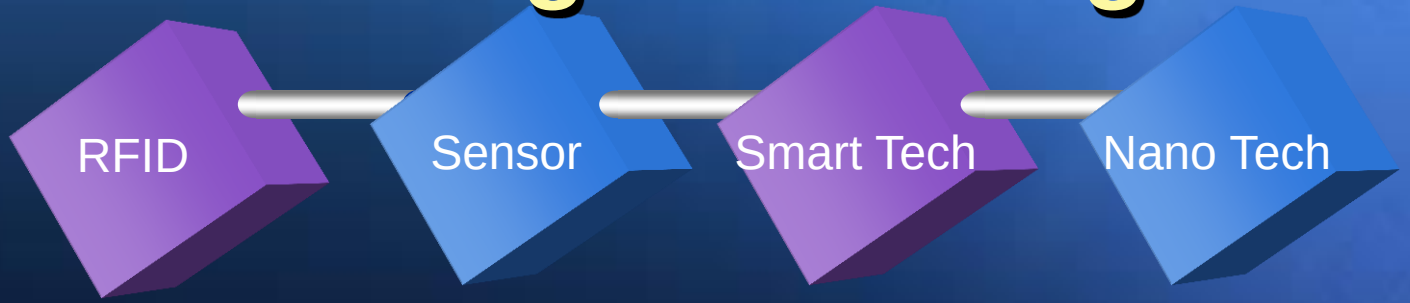
(1) When entering the doors, scanners will identify the tags on her clothing.

(4) When paying for the goods, the microchip of the credit card will communicate with checkout reader.

(3) When moving the goods, the reader will tell the staff to put a new one.

State of the Art of IoT

Enabling Technologies



RFID	Sensor	Smart Tech	Nano Tech
To identify and track the data of things	To collect and process the data to detect the changes in the physical status of things	To enhance the power of the network by devolving processing capabilities to different part of the network.	To make the smaller and smaller things have the ability to connect and interact.

Sensor technology

The ability to detect changes in the physical status of things is essential for recording changes in the environment.

Wireless sensor technology play a pivotal role in bridging the gap between the physical and virtual worlds, and enabling things to respond to changes in their physical environment. Sensors collect data from their environment, generating information and raising awareness about context.

Example: sensors in an electronic jacket can collect information about changes in external temperature and the parameters of the jacket can be adjusted accordingly

State of the Art of IoT

Research groups

1

MIT Auto-ID Lab & EPC Global.

Stanford University

Georgia Institute of Technology

Cambridge Univ

2

EPFL & ETH Zurich Information and Communication Systems Research Group

Chemnitz University of Technology VSR Group

3

Nokia
SAP
IBM
GOOGLE
AMBIENT
Metro Group
Siemens
Sun
Cisco
GE

The challenge of IoT

Total challenge of IOT

1.Technological Standardization in most areas are still remain fragmented.
2.managing and fostering rapid innovation is a challenge for governments
3. privacy and security
4.Absence of governance

The challenge of IoT

How to convince users that the IoT technology will protect their data and privacy when tracking

Cisco Router for IoT

Cisco unveiled on Sept 24, 2013 its Internet of Everything router, a device intended to address the growth in **Internet traffic brought about by cloud, mobile, video and machine-to-machine communications.**

NCS (network convergence system) includes a new network processor Cisco introduced two weeks ago: the nPower X1.

Single Board Computer to aid IoT

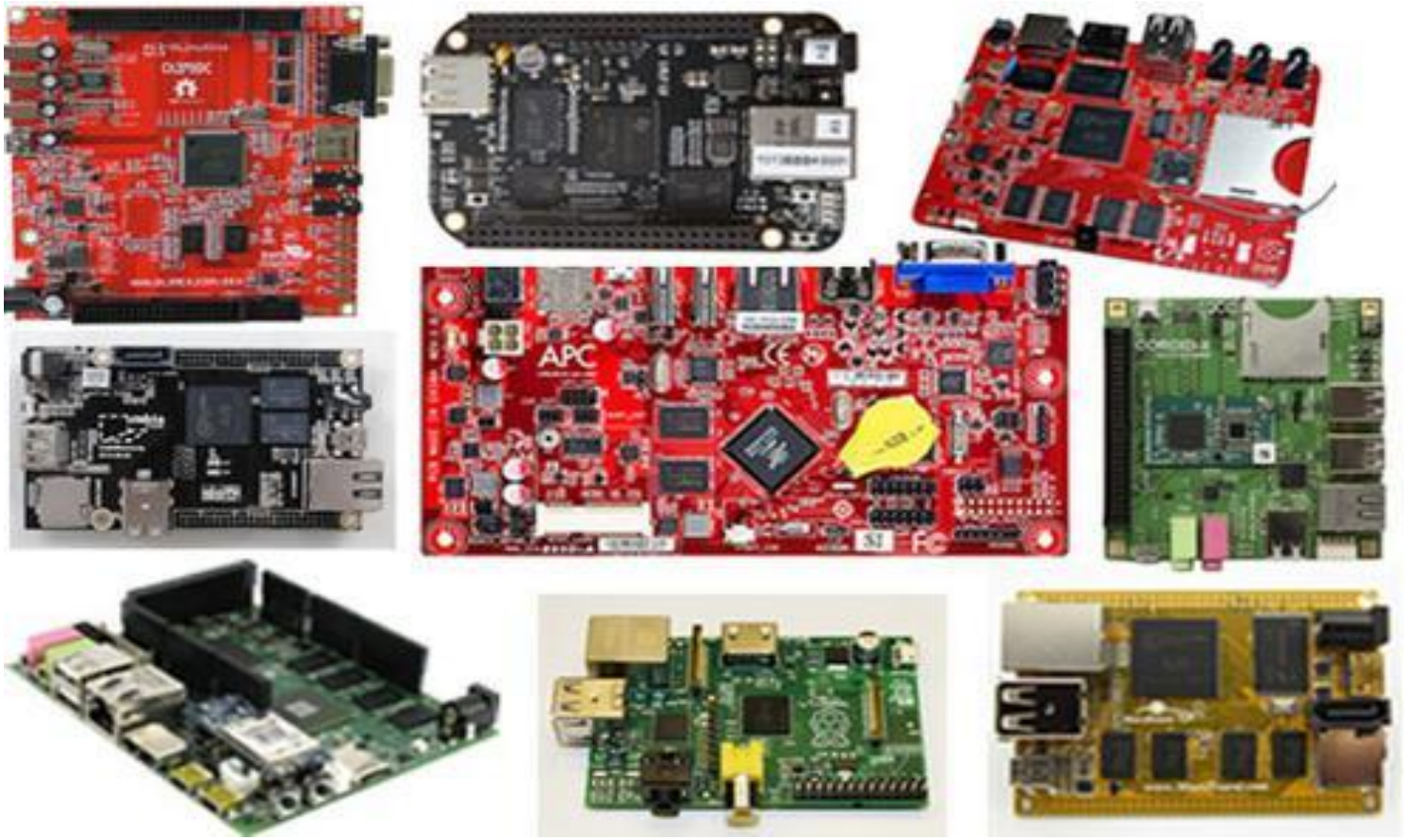
- SBC are Cheap
- Easy to integrate with any device or sensors- using USB port
- Has Wireless interface
- Has internet interface
- Algorithm development are easy using PC

Cheap PC boards

Since the coming of the Raspberry Pi Model B, single-board computers (SBCs) have become a prevalent force in the development world. These pocket-sized devices have taken the online maker community in particular by storm, providing PC functionality to a plethora of open-source projects in amazingly compact, cost-effective, and low-power platforms.

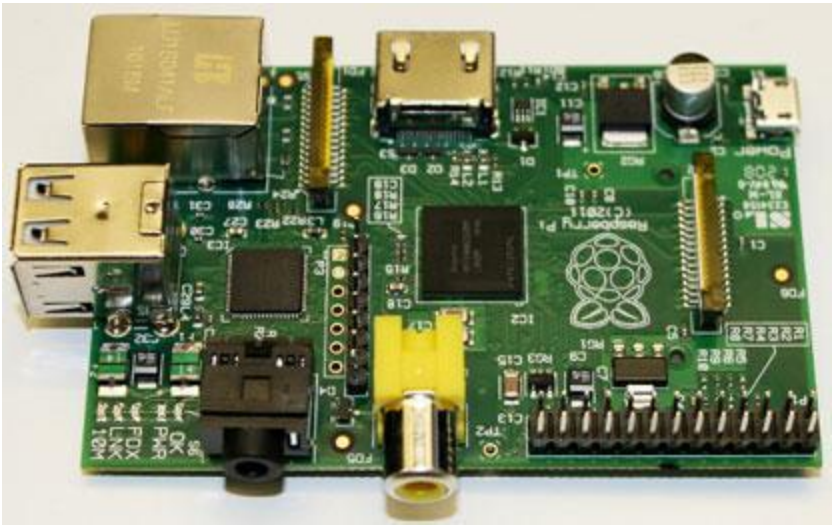
http://www.**eetimes**.com/document.asp?doc_id=1319262&itc=eetimes_sitedefault&cid=NL_EET_Daily_20130821&elq=9dea33a652464fea8c40a538cb1f3f6e&elqCampaignId=841

Pushing the limits of technological creativity achievable in the palm of one's hand



SBCs are poised to change how we approach embedded systems development.

Raspberry Pi Model B



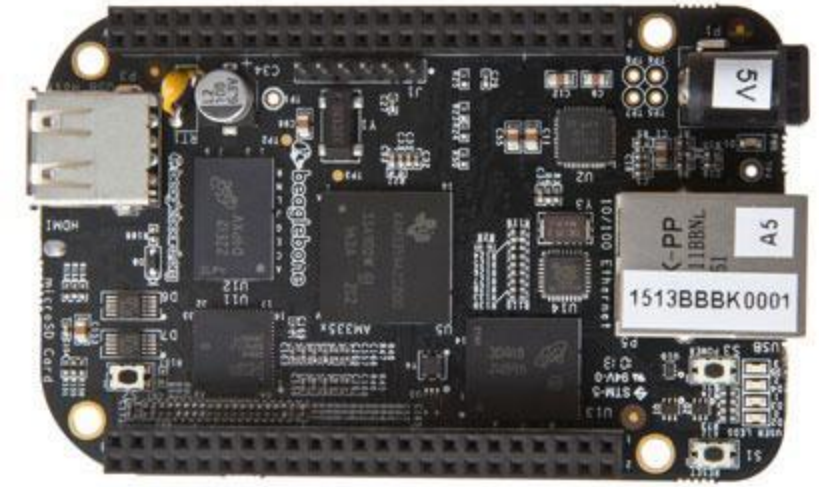
Linux-based Pi has become the foundation of several DIY project builds for mobile PC applications. These include projects such as pocket-sized media streaming, LED display boards, environmental sensing devices, Pi-powered cat feeders, and many more.

Raspberry Pi Model B

This RP is based on the Broadcom BCM2835 SoC, equipped with an ARM11767JZF-S 700 MHz processor. As an upgrade to the original design, the Model B has 512 MB RAM with two USB ports and an Ethernet port. The VideoCore IV GPU enables high-definition video playback; I^2C interface allows for device expansion; and an SD card slot is provided for booting and long-term memory storage.

Debian Linux and its derivative Raspbian OS being the most popular. The rest of the supported OS platforms being Android (2.3 & 4.0), Haiku, Firefox OS, Gentoo Linux, Google Chromium OS, Open web OS, Arch Linux ARM, Fedora, Plan 9, Slackware Linux, FreeBSD, NetBSD, and the RISC OS.

BeagleBone Black



The BeagleBone Black, a Texas Instruments-powered SBC, is a member of the BeagleBoard family of development boards. By featuring TI's low-cost Sitara AM335x ARM Cortex-A8 microprocessor, the BeagleBone Black intends to offer developers a cost-effective solution for builds requiring a plethora of expansion options such as add-on boards. As most development boards of its kind, the BBB supports most Linux distributions and comes with the Angstrom distribution pre-installed.

- The BeagleBone Black is equipped with 256 MB x 16 DDR3L SDRAM (4 GB), 32 kB EEPROM, and 2 GB eMMC flash as the primary boot source. An onboard microSD slot can also be used for booting and memory storage in addition to the provided serial and USB booting modes. Other onboard interfaces include HDMI, 10/100 Ethernet, serial (for debugging), PC USB, USB 2.0 host port, EtherCAT, and Profibus. Some key applications of the BBB have included motor drives, data backup, data acquisition, robotics, and Twitter printers.
- It's a step up from the Raspberry Pi, with quite robust OS support and expansion options.
- **$45 Source:** element14

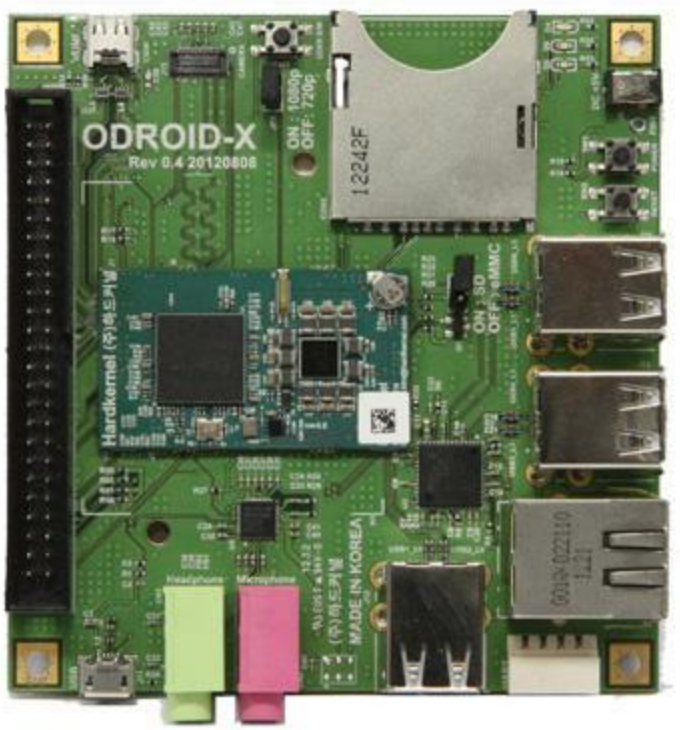
Parallella

Epiphany-powered Parallella board. This single-board supercomputer, is built around Adapteva's line of Epiphany multicore chips. These scalable RISC processors, fully programmable in C/C++, intend to provide developers open and affordable access to parallel computing on a credit-card-sized device. The final product will consist of a multicore Parallella computer delivering 90 Gflops while consuming only 5 watts under heavy workloads.

Equipped with a Zynq-7000 Series Dual Core ARM A9 CPU and either a 16- or 64-core Epiphany Multicore Accelerator to handle supercomputing operations. Additional features include 1 GB RAM, MicroSD slot, 2x USB 2.0 slots, HDMI interface, 10/100/1000 Ethernet port, and four general-purpose expansion ports. Linux distributions are supported. **$99**

Source: Adapteva

Odroid-X2

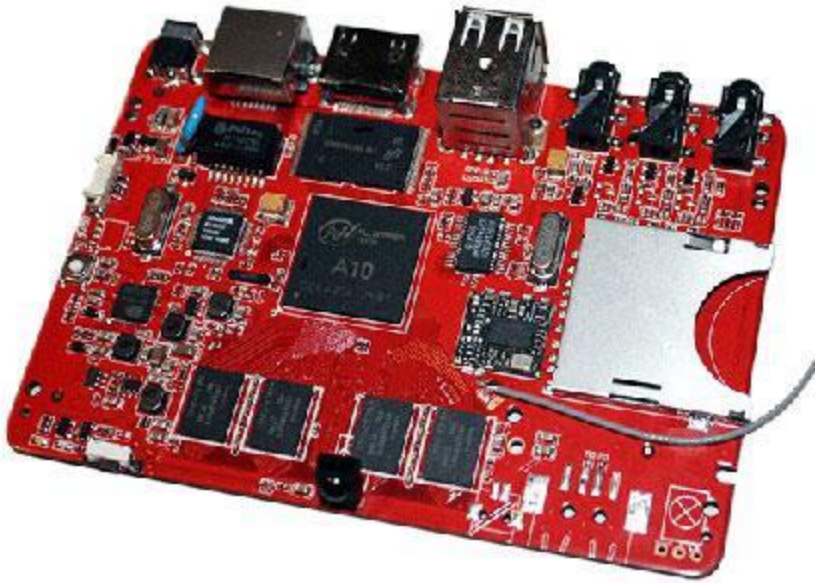


Hardkernel Co, the open-source hardware company from Korea

Ordroid X2

This device sports a 1.7 GHz quadcore platform (Samsung Exynos 4412 Prime ARM Cortex-A9) with 2 GB of LPDDR2 RAM to offer developers an ultra-compact solution with PC-like performance. An integrated Mali-400 quadcore GPU running at 440 MHz is included in the package with just enough headroom available for overclocking. A stacked hub design provides six high-speed USB 2.0 ports and a 10/100 Mbit/s Ethernet connection. A micro HDMI connector outputs video at full 1080p, with a 3.5 mm headphone jack for audio, and power is supplied via 5V2A DC jack. Memory storage and system booting is performed through the onboard Micro SD slot or the eMMC module. Several modules are available for purchase that will upgrade its on-board features via USB, UART, eMMC, and PWM interfaces such as cooling fans, a USB to IO expansion board for GPIO/PWM/SPI/UART/12/ADC interfaces, micro HDMI to HDMI cables, Bluetooth modules, eMMC memory modules, and WiFi kits. The fully open Odroid-X2 supports Android and Linux Ubuntu with boot-ready micro SDs available for purchase. **$89**

Hackberry



Linux PC utilizing a 1 GHz ARM Allwinner A10 SoC. By complementing an ARM A8 CPU with a Mali400 GPU, the Hackberry is capable of HD video playback, making it an excellent choice for an Android 3D gaming platform. Android 4.0 ICS and Linux distributions are supported by Hackberry. Booting is done via internal 4 GB NAND flash or via SD card. $65. **:** Miniand

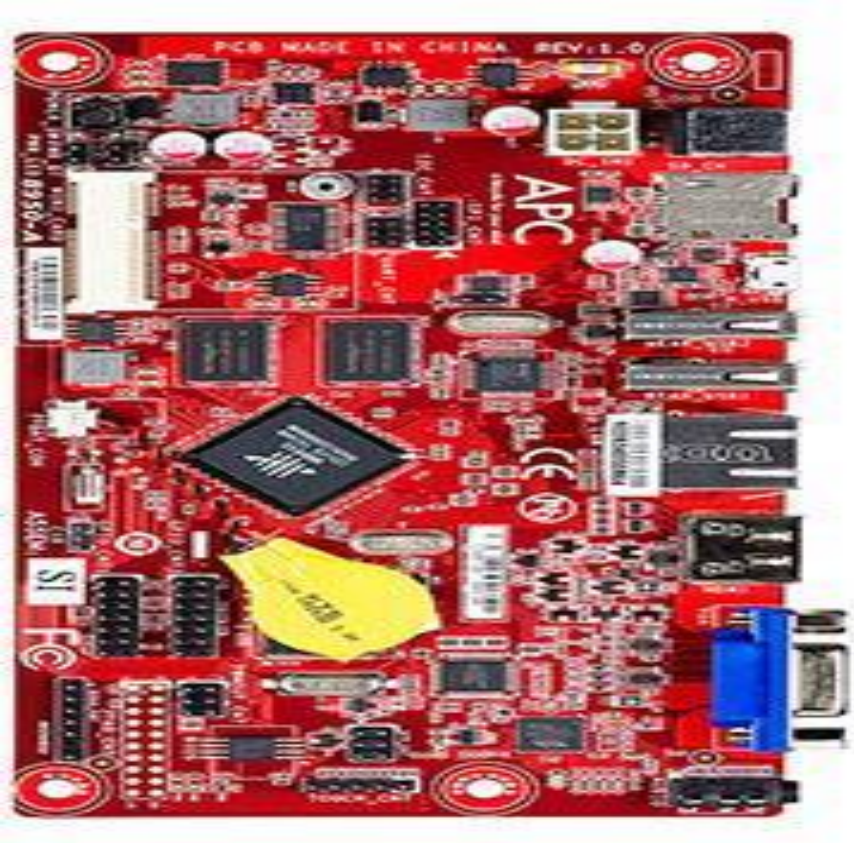
UDOO

UDoo

The UDOO comes equipped with either a dual- or quad-core 1 GHz ARM i.MX6 Freescale CPU in addition to the integrated Atmel SAM3X8E ARM Cortex-MR CPU. Integrated graphics are provided by three distinct accelerators for 2D, OpenGL ES2.0 3D, and OpenVG, and include 1 GB of DDR3 RAM. With a total of 54 digital I/Os, an Arduino-compatible analog input, HDMI and LVDS video output (with touch capability), optional Ethernet and WiFi modules, a mini USB and a mini USB OTG port, two Type A USB ports and a USB connector, analog audio and mic (line-in) support, and a camera connection -- the UDOO truly offers developers a feature-filled canvas to work with. Power is supplied via a 5-12V adapter @ 2A, and a Micro SD slot is used for booting the device. providing full compatibility for all Arduino DUE shields available for any designer's peripheral stacking needs.

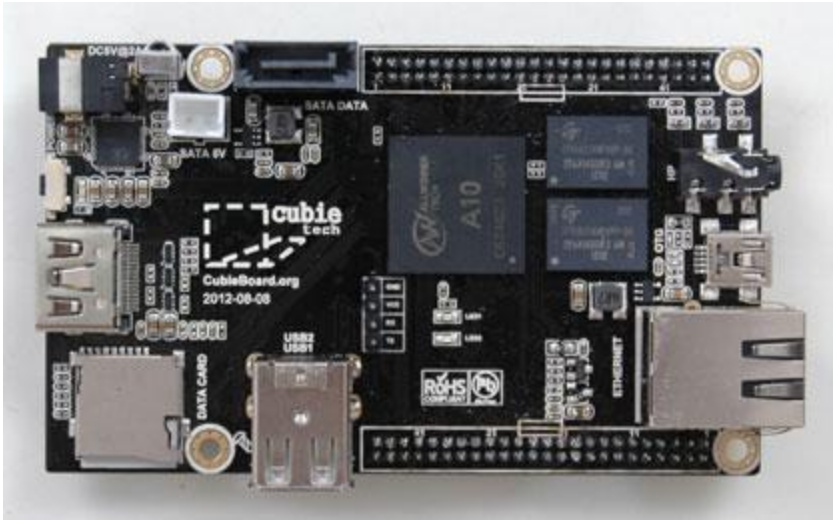
$ 99 and up. Udoo.org

APC Rock



Running a custom Android OS built for mouse and keyboard input (The "PC version"), the Rock features a VIA ARM Cortex-A9 processor running at 800 MHz. Memory is provided via 512 MB DDR2 RAM and 4 GB internal NAND storage. Other features include: 2x USB 2.0 ports, audio-out/mic-in, HDMI and VGA out, 10/100 Ethernet port, microUSB (OTG), and a microSD slot. Expansion is available via extra GPIO, SPI, and I^2C buses on a header.
$79

CubieBoard



Cubieboard contains a Cortex-A8 ARM processor operating at 1 Ghz speed with a Mali400 OpenGL ES GPU. The Cubieboard comes with 1080P HDMI output support, 10/100M Ethernet capability, two USB hosts, one microSD slot (with SDHC support), one SATA connection, an IR interface, and a 2x48 extend pin for external headers.

Project suggestions include: an Android TV multimedia powerhouse, a home network file server, a lightweight Linux desktop, and a network accessible home automation device.

$49 **Sources:** Miniand, Indiegogo, and Cubieboard

Marsboard

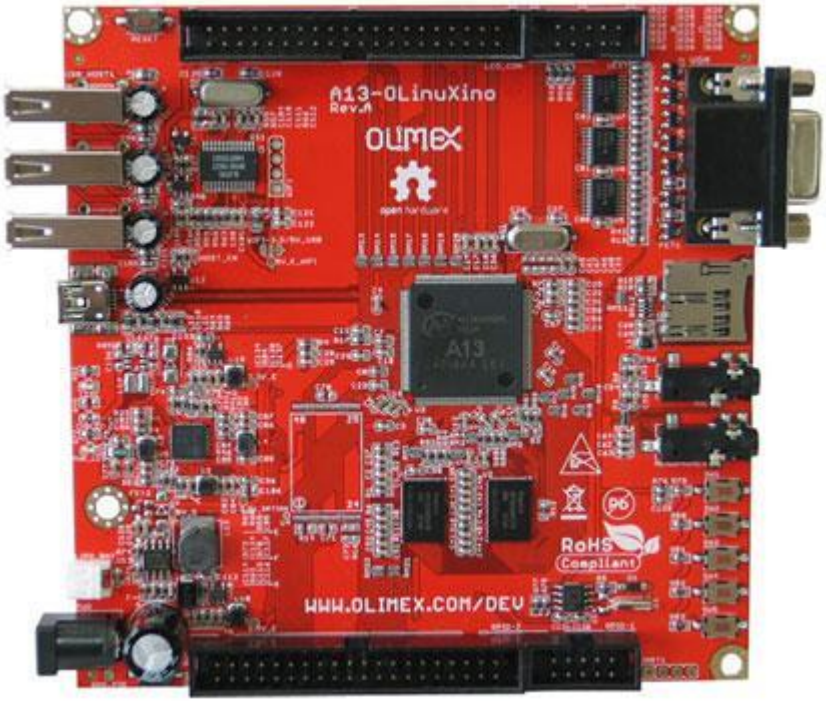
ARM Cortex A8 processor operates at 1.2 GHz and is further complemented by a 3D capable Mali400 GPU. 1 GB of DDR3 RAM i

$49.90

Sources: Marsboard, HAOYU Electronics, and CNXSoft

A13-OLinuXino

the use of an A13 Cortex A8 processor operating at 1 GHz. In addition to featuring a 3DMali400 GPU and 512 MB of RAM, the board includes: 3+1 USB ports -- three for users, one for WiFi; an SD card connector for booting Linux images; a VGA output; audio out; microphone input; battery option with connector; RTC PCF8536 for real-time clock and alarms; five on-board keys for android navigation; a UEXT connector for Zigbee, Bluetooth, and relay modules; and a 68/74 pin GPIO connector. To round up its long list of features, the OLinuXino can also output video to an optional on-board 7" LCD with touchscreen by disabling the VGA/HDMI. $59 / $72 with Wifi



BeagleBoard XM

The $149 MSRP BeagleBoard-xM delivers with the help of its AM37x 1GHz ARM processor, enabling hobbyists, students and innovators to bring a project to development fast. Designed with community inputs in mind, this open hardware design brings the previous generations' laptop-like performance and expandability to the next level, while adhering to hand-held power levels. Direct connectivity is supported by the on-board four-port hub with 10/100 Ethernet, while maintaining a tiny credit-card-sized footprint.

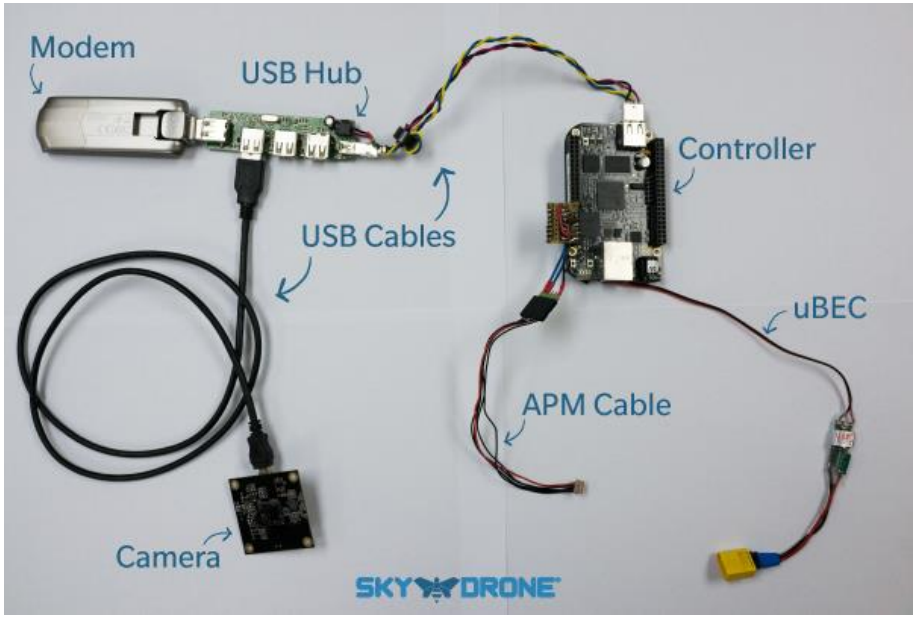
BeagleBoard XM

- **Processor: AM37x 1GHz ARM Cortex-A8 compatible**
  - More than 2,000 Dhrystone MIPS
  - Up to 20 million polygons/second graphics
  - HD video capable C64+TMDSP core
  - 512 MB LPDDR RAM
- **Connectivity**
  - 2D/3D graphics accelerator
  - 4 USB 2.0 ports
  - MMC/SD connector
  - DVI-D port
  - S-Video port
  - USB mini AB connector
  - Ethernet
- **Software Compatibility**
  - Angstrom Linux
  - Android
  - Ubuntu
  - XBMC

SkyDroneFPV

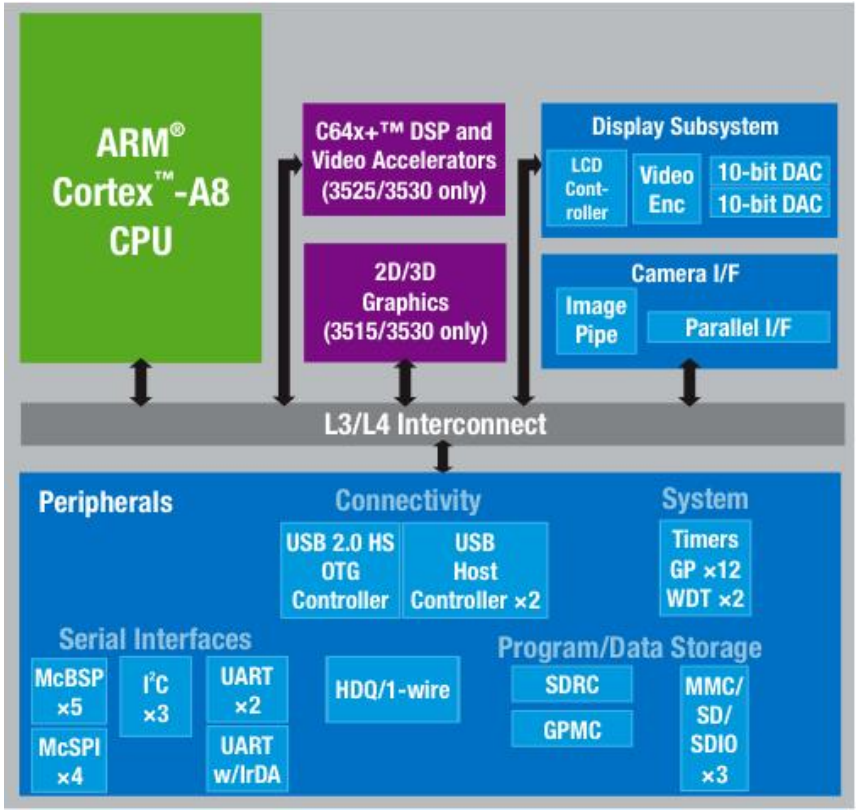
http://www.indiegogo.com/projects/sky-drone-fpv

Uses BeagleBoard



TI-OMAP3530 Processor

- **Application Processor**
  - **600 MHz ARM Cortex™ A8 Core**
  - **ARMv7 Architecture**
  - **16KB I-Cache; 16KB D-Cache; 256KB L2**
  - **NEON™ SIMD Coprocessor**
- **DSP Core**
  - **TMS320C64x DSP**
  - **L1 32KB Program Cache + 80KB Data Cache**
  - **L2 64K Program/Data Cache + 32KB SRAM**
  - **Video Hardware Accelerators**
- **Graphics Core**
  - **PowerVR SGX Graphics Accelerator**
  - **Tile Based Architecture: 10 MPoly/Sec**
- **On Chip Memory: 64KB SRAM**



BeagleBoard Support from Simulink

Low-cost, single-board computer designed for audio, video, and digital signal processing

You can design and run Simulink® models as standalone applications on the BeagleBoard, a low-cost, single-board computer designed for digital signal processing. The BeagleBoard-xM features TI's 1 GHz ARM Cortex-A8 processor, provides stereo audio and digital video connectivity, and supports USB, RS-232, and Ethernet.

The BeagleBoard helps students understand the workflow for designing an embedded system without using manual programming. Students can use Simulink to create algorithms for audio processing and computer vision applications. They can apply industry-proven techniques for Model-Based Design to verify that their algorithms work during simulation. They can then implement the algorithms as standalone applications on the BeagleBoard using the ARM Cortex-A8 processor.

Conclusion

IoT is gaining importance for the near future.

Trillions of devices will be connected in a few years.

IoT promises big business and useful for common man too.

RFID, other sensors, Cheap PC boards, wireless/internet connectivity, new routers, are fueling the growth of IoT