Session -35

BeagleBone Black (BBB) Board and System on Chip (SoC)

🔷 1. What is the BeagleBone Black (BBB)?

The **BeagleBone Black** is a low-cost, open-source **single-board computer (SBC)** used for:

- Embedded Linux development
- IoT projects
- Robotics
- Real-time applications
- Learning ARM-based system design

📦 Key Features of BeagleBone Black

Feature	Specification
Processor (SoC)	**AM335x** ARM Cortex-A8 @ 1GHz
RAM	512 MB DDR3
Storage	4 GB eMMC + microSD slot
OS Support	Debian, Ubuntu, Android, and others
GPIO Pins	65+ (digital I/O, PWM, I2C, SPI, UART, etc.)

Feature	Specification
USB	Host and Device ports
Network	10/100 Ethernet
Display	HDMI
Power Supply	5V via micro-USB or barrel jack

🔷 2. What is a System on Chip (SoC)?

A **System on Chip (SoC)** is a complete computer system integrated into a single chip. It contains:

- CPU (Central Processing Unit)
- GPU (Graphics Processing Unit)
- RAM controller
- Storage interfaces (eMMC, SD)
- Peripherals: UART, I2C, SPI, PWM
- Timers, ADCs, and even power management

🔩 BBB's SoC: AM335x

The BeagleBone Black uses **Texas Instruments AM335x** SoC, which includes:

Component	Description
CPU	ARM Cortex-A8, 32-bit, 1GHz
GPU	PowerVR SGX530 (3D graphics)
PRU	Programmable Real-time Units for fast I/O

Component	Description
Memory Controller	Supports DDR3/DDR2
Ethernet MAC	Built-in 10/100 Ethernet
USB OTG	Host and device support
LCD Controller	Supports display output

🛠️ Development With BBB

You can use BBB for:

- Running embedded Linux (Debian, Ubuntu)
- GPIO programming (LEDs, motors)
- Real-time data collection via PRU
- Interfacing with sensors, displays, and other devices

📷 BBB Pin Diagram (Summary)

- **P8 and P9 headers**: 46 pins each
- Support for:
    - **Digital I/O**
    - **PWM**
    - **UART / SPI / I2C**
    - **ADC**

🧪 Example: Blink LED using GPIO (Linux)

```
echo 60 > /sys/class/gpio/export      # Enable GPIO 60 (P9_12)
echo out > /sys/class/gpio/gpio60/direction
echo 1 > /sys/class/gpio/gpio60/value  # Turn LED on
sleep 1
echo 0 > /sys/class/gpio/gpio60/value  # Turn LED off
```

📜 Summary

- ✅ **BBB** is a powerful SBC ideal for Linux-based embedded projects.
- ✅ It uses an **AM335x SoC** that combines CPU, GPU, and I/O on a single chip.
- ✅ It provides extensive I/O and supports many embedded OSes.
- ✅ Great for real-time, robotics, and IoT projects.