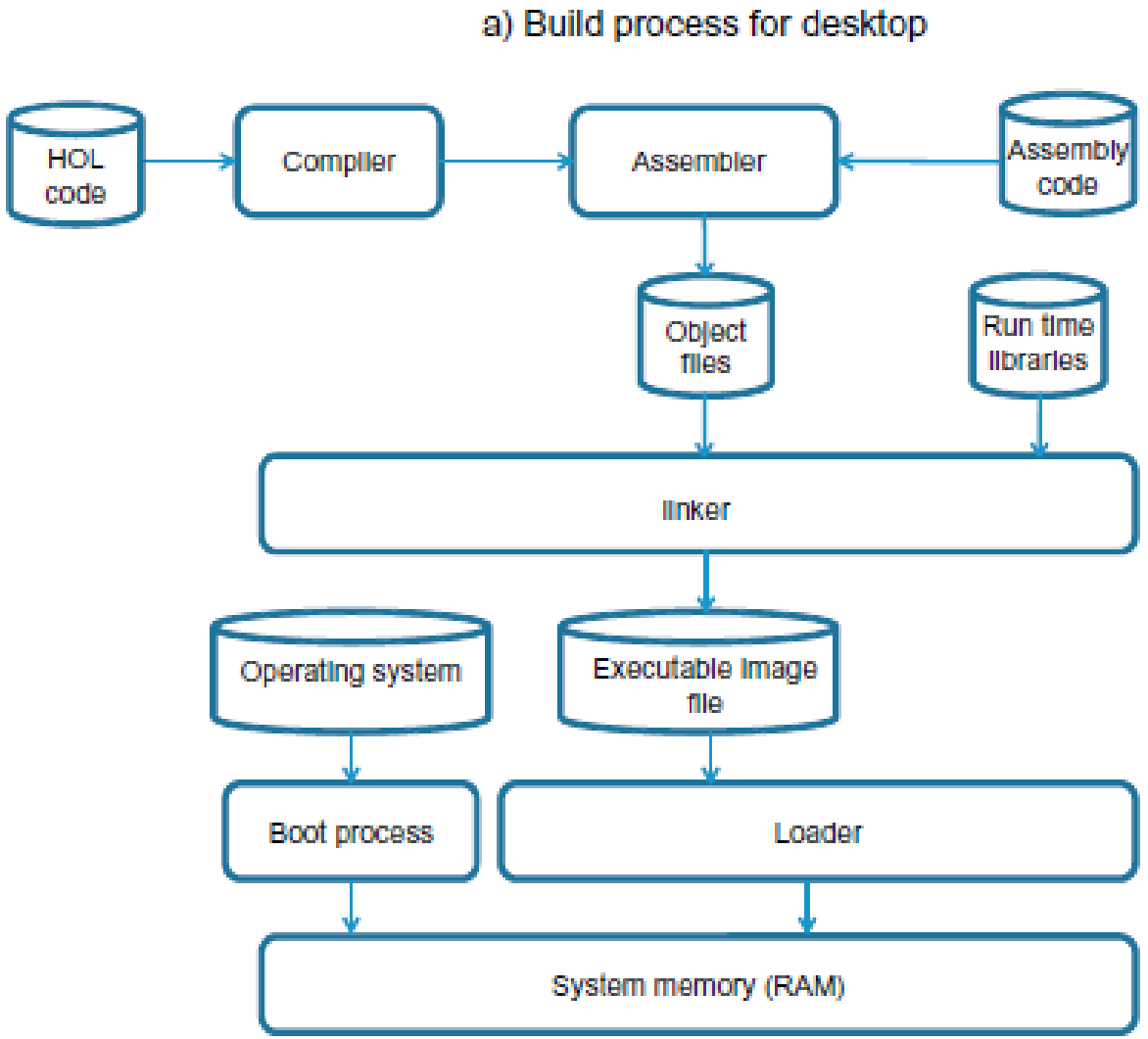
# Software Development for Embedded and Realtime Systems

## SE for Embedded Systems

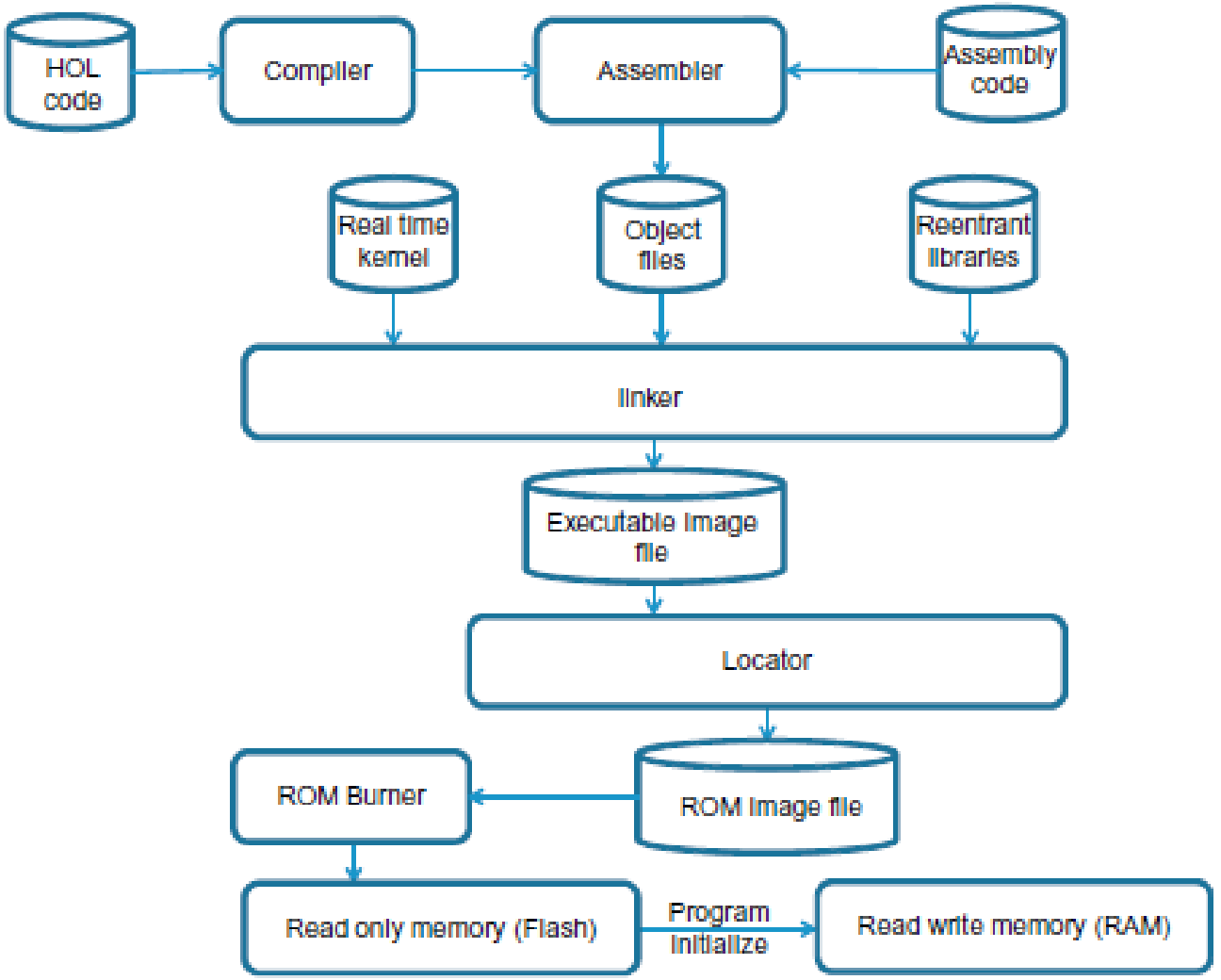
# SE for Embedded Systems

- The embedded system software build process
- Super loop architecture
- Power-save super loop architecture
- HAL for embedded systems
- Embedded system software development flow
- Layers of HW/SW in an embedded system
- Typical embedded system design flow

# Desktop System Build Process



# Embedded System Build Process



# Super Loop Architecture

```
Function Main_Function()
{
        Initialization();
        Do_Forever
        {
                Check_Status_of_Task();
                Perform_Calculations();
                Output_Result();
        }
}
```

# Example Gaming Loop

```
Function Main_Game_Function()
{
    Initialization();
    Do_Forever
    {
        Game_AI();
        Move_Objects();
        Scoring();
        Draw_Objects();
    }
    Cleanup();
}
```

# Multiple tasks execute simultaneously in an embedded system

```
/*  Monitor Room_Temperature */
do forever {
        measure temperature;
        if (temperature < temperature_setting)
                start furnace_heater;
        else if (temperature > temperature_setting + delta)
                stop furnace_heater;

}
```

```
/* Monitor Time of Day */
do forever {
        measure time_of_day;
                if (7:00am)
                        setting = 72_degrees_F;
                else if (10:00pm)
                        setting = 60_degrees_F;
}
```

```
/* Monitor Thermostat Keypad */
do forever {
        check thermostat_keypad;
        if (raise temperature)
                setting++;
        else if (lower temperature)
                setting--;
}
```

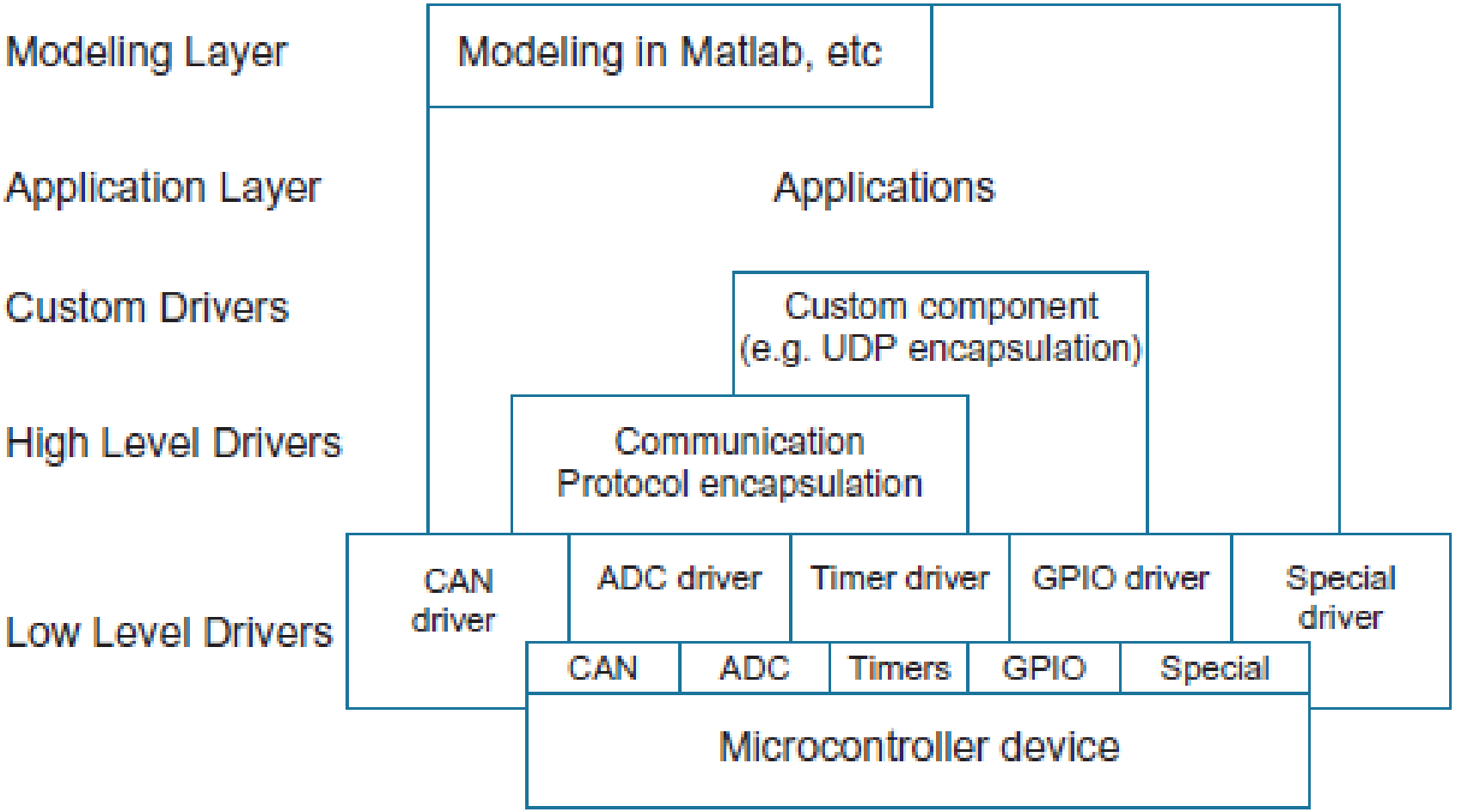
# Power-Saving Super Loop Architecture

```
Function Main_Function()
{
    Initialization();
    Do_Forever
    {
        Check_Status_of_Task();
        Perform_Calculations();
        Output_Result();
        Delay_Before_Starting_Next_Loop();
    }
}
```

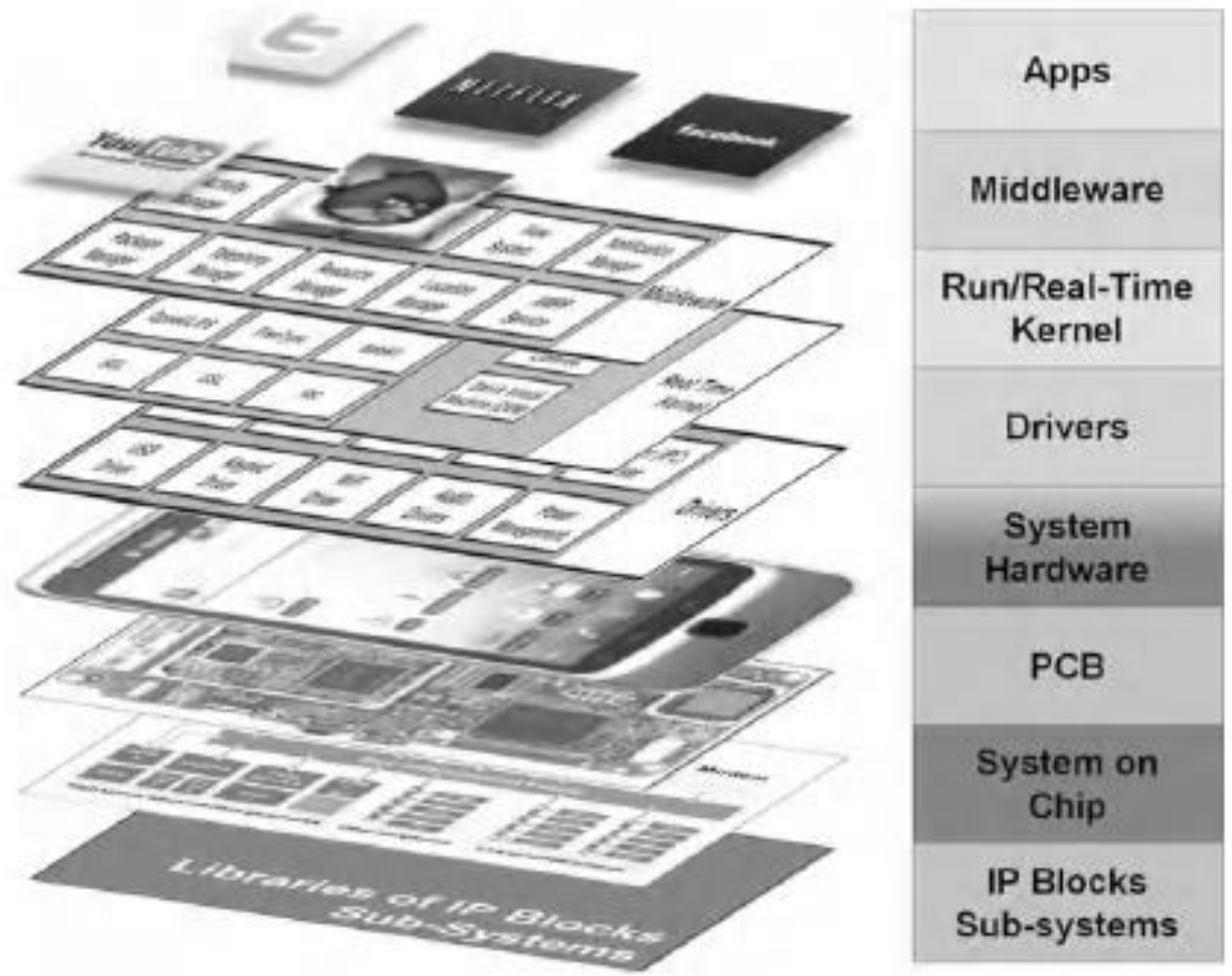
# HAL for embedded systems

- Embedded system development is about programming at the hardware level
- Hardware abstraction layers provide an interface between hardware and software so applications can be device independent
- HAL encapsulates peripherals of a microcontroller and several API implementations can be provided at different levels of abstraction

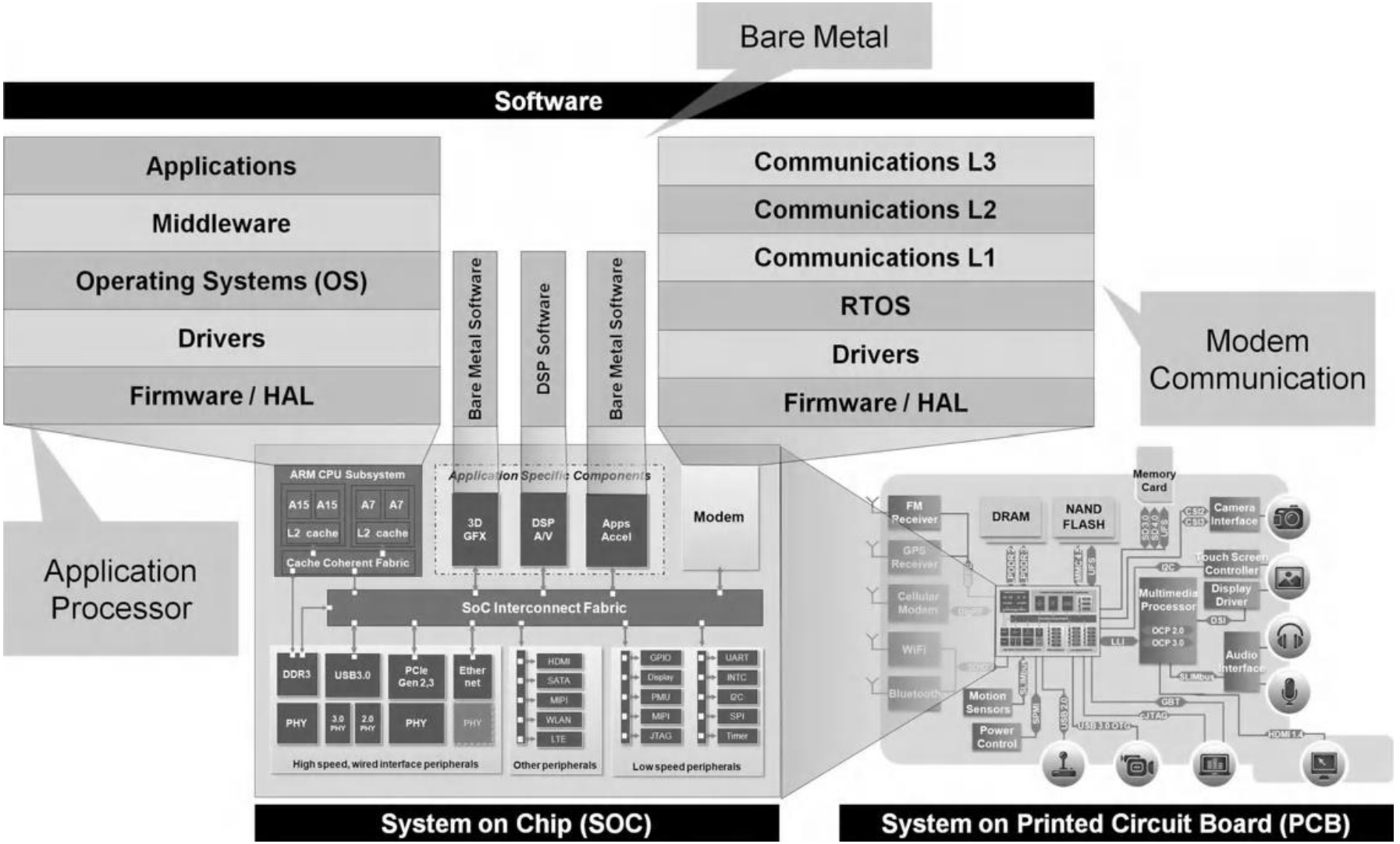
# • HAL for embedded systems



# Layers of HW/SW in embedded systems



# Layers of HW/SW in embedded systems



# References


- **Chapter 1,2**: Oshana, Robert, ed. **Software Engineering for Embedded Systems: Methods, Practical Techniques, and Applications.** Newnes, 2013.

Thank you for
your attention.