Application Brief

Optimizing WLAN and WiFi Access Point Systems With Logic and Voltage Translation

Emrys Maier

Functional Block Diagram

For the purpose of this report, a simplified WLAN and Wi-Fi AP block diagram is used to illustrate the logic and translation use cases, see Simplified Block Diagram for WLAN and Wi-Fi access points. Each red block has an associated use-case document. Links are provided in Table 1 and Table 2. For a more complete block diagram, see the interactive online end equipment reference diagram for WLAN/Wi-Fi access point.

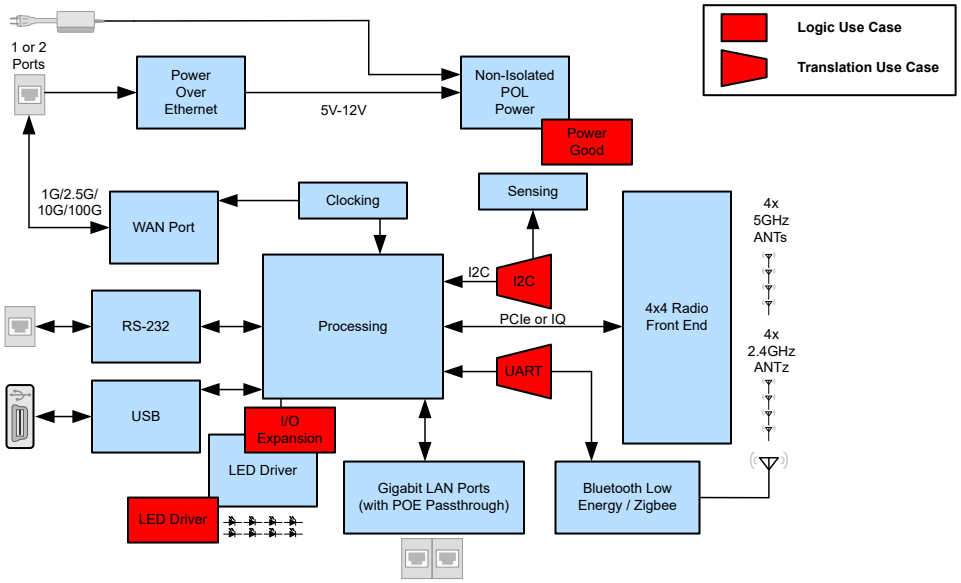

Figure 1. Simplified Block Diagram for WLAN and Wi-Fi Access Points

Logic and Translation Use Cases

Each use case is linked to a separate short document that provides additional details including a block diagram, design tips, and part recommendations. The nearest block and use-case identifiers are listed to match up exactly to the use cases shown in the provided *simplified block diagram*.

Table 1. Logic Use Cases

Nearest Block	Use-Case Identifier	Use Case
LED Driver	I/O Expansion	*Driving Indicator LEDs with Shift Registers*
	LED Driver	*Drive Indicator LEDs*
Non-Isolated POL Power	Power Good	*Combine Power Good Signals*

Table 2. Translation Use Cases

Nearest Block	Use-Case Identifier	Use Case
Processing	I2C	*Translate Voltages for I2C*
	UART	*Translate Voltages for UART*

Driving Indicator LEDs with Shift Registers

Most, if not all, WLAN and Wi-Fi access points have multiple LED indicators on the front panel to help users see the current status of the device. These usually include power, internet connectivity, and physical ethernet port usage among other indicators.

Using shift registers with output registers like the SN74HCS595 it is easy to control any number of indicator LEDs while only using three outputs from the system controller. Two of the pins can even be shared with an existing SPI mode 0 bus if it is available in the system.

If using SPI bus, replace GPIO1 with SCLK and GPIO2 with SDO. The shift registers will always be loading data from the SPI clock to their internal registers, however the outputs will only change when GPIO 3 transition from low to high, so it is easy to control the 595 devices even with other devices on the SPI bus. Just sent 1 byte (8 bits) of data per shift register on the SPI bus to configure them, then pulse RCLK to save those values to the output registers and drive the indicator LEDs. This process can be done very quickly with the SN74HCS595, supporting clock speeds up to 110 MHz (typical) with a 5-V supply and 74 MHz (typical) with a 3.3-V supply. At 10 MHz (0.1 µs period), it only takes 1.6 µs to load 16 bits to the shift registers shown in Figure 2, and another 0.1 µs to pulse RCLK to move those values to the output registers.

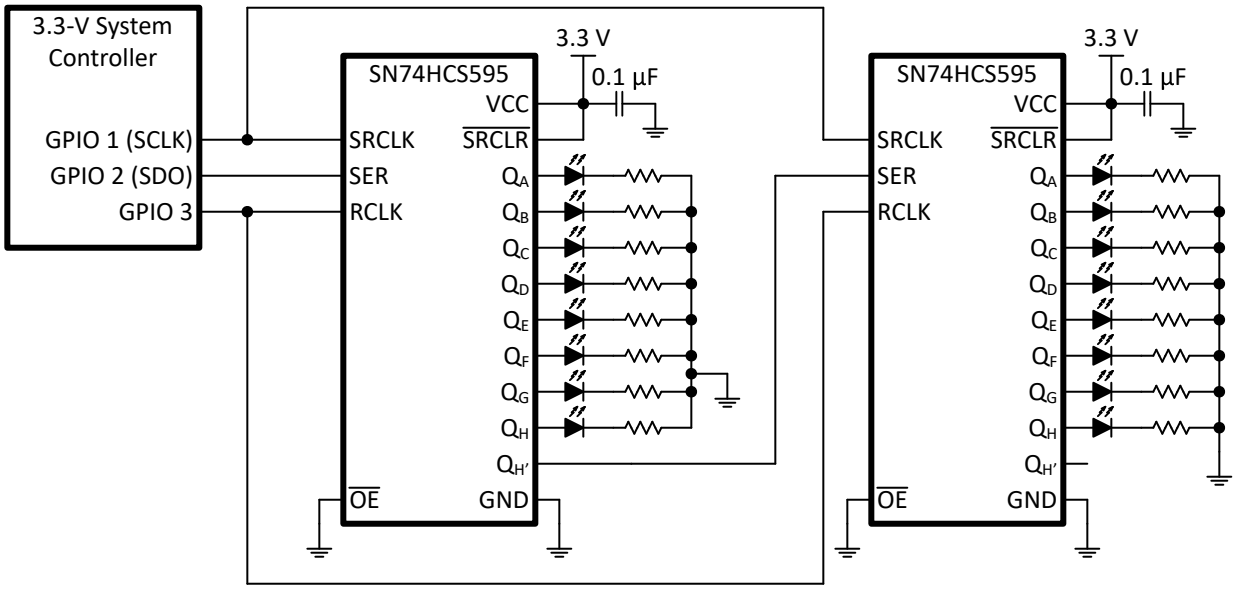

Figure 2. Example Schematic of Driving 16 Indicator LEDs with Shift Registers Using Only 3 Control Pins

For more details, please see the application report .

See more about similar use cases in the application report *Designing with Shift Registers* and the *Logic Minute* video *Increase the Number of Outputs on a Microcontroller*.

- Shift registers can be daisy chained to provide any number of additional outputs
- The supply voltage must be larger than the required forward voltage on the selected LEDs
- Choose resistor values based on the supply (V_{CC}), forward voltage (V_F) and operating current (I_D) of the LEDs per the following equation: $R = \frac{V_{CC} - V_F}{I_D}$
- Limit total current consumption to the data sheet specification for maximum current through V_{CC} or GND
- For additional current drive capability, external buffers can be added
- Need additional assistance? Ask our engineers a question on the *TI E2E™ Logic Support Forum*

Table 3. Recommended Parts

Part Number	Automotive Qualified	Operating Voltage Range	Features
SN74HCS595-Q1	✓	2 V to 6 V	8-Bit shift register with output registers HCS family logic has integrated Schmitt-trigger inputs allowing for slow input signals Up to eight LEDs per device Up to 70 mA total (35 mA max per channel)
SN74HCS595			
SN74HCT595-Q1	✓	4.5 V to 5.5 V	8-Bit shift register with output registers HCT family logic includes TTL-compatible inputs to support 2.5-V or 3.3-V input signals Up to eight LEDs per device Up to 70 mA total (35 mA max per channel)
SN74HCT595			
SN74LVC244A-Q1	✓	1.65 V to 3.6 V	Octal buffer/driver with 3-state outputs Up to eight LEDs per device Up to 100 mA total (50 mA max per channel)
SN74LVC244A			
SN74AC244		2 V to 6 V	Octal buffer/driver with 3-state outputs Up to eight LEDs per device Up to 200 mA total (50 mA max per channel)

For more devices, browse through the *online parametric tool* where you can sort by desired voltage, output current, and other features.

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265