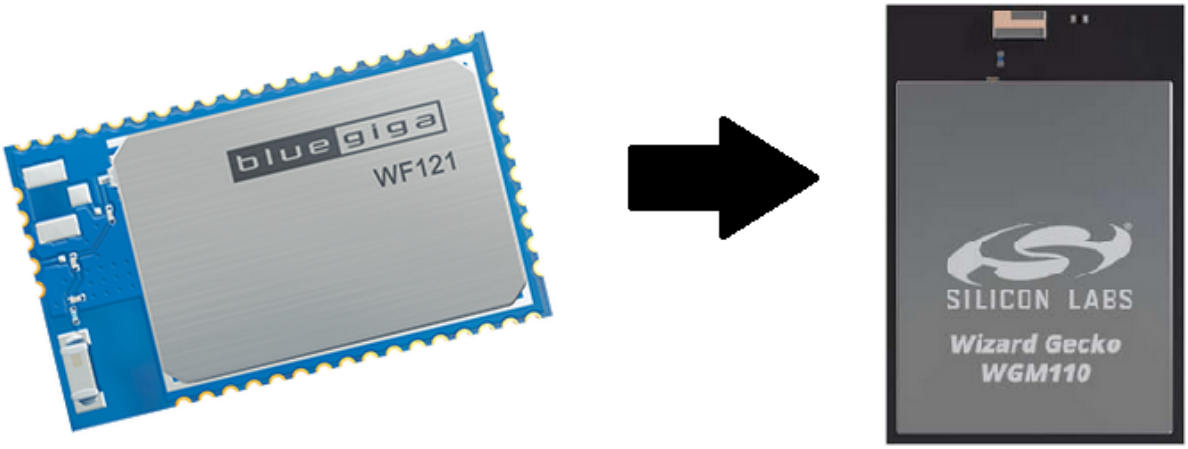
AN1001: WF121 to WGM110 Migration Guide

This document provides guidance on how to migrate from the WF121 Wi-Fi Module to the Wizard Gecko WGM110 Wi-Fi Module. It highlights the major differences in terms of high-level features, module configuration, hardware design requirements, and software APIs with the purpose of ensuring the easiest possible migration.

KEY POINTS

- SDK and Tools
- WF121 vs. WGM110 differences
  - Power supply
  - PCB layout
  - Configuration
  - API
- Simplifies migration



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1. Introduction

The Wizard Gecko WGM110 Wi-Fi Module from Silicon Labs provides the easiest path for native Internet of Things (IoT) connectivity. It comes in a smaller form factor than the WF121 to allow for more compact designs and introduces additional security features, such as WPA2-Enterprise and TLS/SSL. It also has lower energy consumption, making WGM110 more suitable for battery-powered or energy-constrained applications.

Similar to the WF121, the WGM110 can be programmed with BGScript for stand-alone applications, controlled by an external host via BGAPI (the so called NCP Mode), or used in mix-mode with both BGScript and host control.

This application note is intended for those customers who want to migrate from WF121 to WGM110. It summarizes the most important differences which need to be taken into account when designing WGM110 to replace WF121 in existing designs and it also helps determine the differences between the WF121 and WGM110 when considering either of these modules for new designs.

2. SDK and Tools

The Wizard Gecko WGM110 Wi-Fi Module requires a different SDK than the one used with WF121. This SDK is called the **Wizard Gecko Wi-Fi SDK** and it can be downloaded from the the Silicon Labs web page at Getting Started with Wi-Fi (www.silabs.com/start-wgm).

The SDK contains a development tool with a graphical user interface called **BGTool** which can be used to build the firmware and flash the module, as well as to control the module during evaluation and debugging. For more details on using **BGTool** please download the document UG160: Wizard Gecko BGTool™ User's Guide. In addition you can watch a Getting Started video which shows how to build the firmware and how to flash it into the module by using **BGTool** together with the Wireless Starter Kit SLWSTK6120A.

3. Features

The following table summarizes the main feature differences between the WF121 and WGM110 Modules.

For more detailed comparison see the latest data sheets of both modules.

Feature	WF121	WGM110
Ethernet	Yes	No
WPA2-Enterprise	No	Yes
TLS/SSL	No	Yes
Wi-Fi Direct	No	Yes
Max Wi-Fi Clients	5	10
Dimensions	15.4 x 26.2 x 2.0 mm	14.4 x 21.0 x 2.0 mm
Flash	512 KB	1 MB

4. Hardware Design

The WGM110 is not pin compatible with WF121, so designs incorporating WGM110 need to take this into account and re-assign the pins in a suitable way. More details on available pins and their functions can be found in the WGM110 datasheet.

4.1 Power Supply Requirements

Both modules have 2 separate internal power blocks mapped to different power pins. One pin is for supplying the radio part (VDD_PA) and another is for supplying the microcontroller (VDD_3.3V on WF121 and VDDCPU on WGM110). The table below shows the requirements for each supply input in terms of voltage and current.

Pin	Voltage (min – max)		Maximum current (mA)	
	WF121	WGM110	WF121	WGM110
VDDPA	2.7—4.8	2.7—4.8	350	350
VDD_3.3/VDDCPU	2.3—3.6[1]	1.98—3.8	100	30

Notes:

1. If flash writing is required the minimum voltage is 3.0 V. For more details, please refer to the WF121 Module Data Sheet.

4.2 PCB Design Guidelines

The WGM110 has a different antenna than the WF121, which affects the PCB design recommendations. The most important difference is the requirement for a portion of ground plane around the module with a width of 15 - 20 mm for optimal antenna performance. This can be realized using any of the PCB layers (including middle ones on a multi-layer PCB) while the remaining layer(s) can be used for regular component placing. In addition WGM110 has no minimum distance for a dielectric material, as long as it is not touching the antenna, whereas the WF121 needs a 5 mm clearance from the antenna to dielectric materials.

5. Module Configuration

The module configuration for WGM110 has some differences in both the project and the hardware configuration file. Just like the WF121, the hardware configuration can be embedded in the project file with the `<hardware>` attribute. Because the peripherals are different on the WGM110, some of the same attribute parameters might have different value ranges than the equivalent attribute parameter on the WF121. For example, the `<timer>` 'index' parameter has values "2" and "3" on WF121 and "0" and "1" on the WGM110. For more information, please read the module configuration guide for the respective module.

5.1 Project File

The table below highlights the differences in the project configuration file.

WF121		Change	WGM110		Comment
Attribute	Parameter		Attribute	Parameter	
<image>	'out'	Modified	<image>	'out'	File extension is **.bin*
<bootloader>	'WDTPS'	Deprecated	<bootloader>	—	—
—	—	New	<certificates>	—	Used for adding X.509 certificates to the flash image

5.2 Hardware File

The table below highlights the differences in the hardware configuration file.

WF121		Change	WGM110		Comment
Attribute	Parameter		Attribute	Parameter	
<adc>	‘enable_pins’	Deprecated	<adc>	—	ADC pins will be automatically configured by the command *hardware_adc_read*
<adc>	—	New	<adc>	‘reference’	Allows for ADC reference voltage selection
<i2c>	‘channel’	Modified	<i2c>	‘channel’	Values are **‘0’** and **‘1’** instead of **‘1’**, **‘3’** and **‘5’**
<i2c>	‘brg’	Modified	<i2c>	‘baud’	I^2C clock frequency is given in bits/s
<notify>	—	Deprecated	—	—	
<port>	—	Modified	<gpio>	—	GPIO initial configuration
<sleep>	—	Deprecated	—	—	
<spi>	‘channel’	Modified	<spi>	‘channel’	Values are **‘0’** and **‘1’** instead of **‘3’** and **‘4’**
<spi>	‘divisor’	Modified	<spi>	‘baud’	SPI clock frequency is given in bits/s
<spi>	—	New	<spi>	‘notify’	Enables/Disables notification pin support
<spi>	—	New	<spi>	‘notify_port’	Defines GPIO port for the notification pin
<spi>	—	New	<spi>	‘notify_pin’	Defines GPIO pin within the port
<spi>	—	New	<spi>	‘location’	Defines the location of the SPI pins
<timer>	‘index	Modified	<timer>	‘index’	Values are **‘0’** and **‘1’** instead of **‘2’** and **‘3’**
<timer>	—	New	<timer>	‘location’	Defines the location of the pins for the CC channels
<timer>	‘bits’	Deprecated	<timer>	—	
<timer>	‘period’	Renamed	<timer>	‘top_value’	Top value for the timer before wrapping back to 0
<uart>	—	New	<uart>	‘location’	Defines the location of the UART pins
<ethernet>	—	Deprecated	—	—	WGM110 doesn’t support Ethernet
<sdhc>	‘enable’	Modified	<sdhc>	‘enable’	Values are **‘true’** or **‘false’** instead of **‘0’** or **‘1’**
<sdhc>	‘spi_port’	Modified	<sdhc>	‘usart’	Determines the SPI channel to use
<sdhc>	—	New	<sdhc>	‘usart_loc’	Defines the location of the SPI pins
<sdhc>	‘cs_port’	Modified	<sdhc>	‘cs_port’	Values are **‘0’** to **‘5’** (Port A to Port F) instead of **‘1’** to **‘6’** (Port B to Port G)
—	—	New	<kit>	‘vcom’	Enables VCOM in the WSTK
—	—	New	<kit>	‘sensor’	Routes I2C1 LOC2 to the WSTK Si7021 sensor
—	—	New	<kit>	‘lcd’	Routes USART1 LOC1 to the WSTK LCD

6. Software APIs

The WGM110 provides the same application development options as the WF121:

- On-board BGScript application
- Control by an external via BGAPI over UART/SPI/USB (NCP Mode)
- Mixed mode with both BGScript and BGAPI

The APIs for the two modules are for the most part compatible. The API differences will be highlighted in the following sections. These differences impact both BGScript as well as hosted applications that are using BGLib. Hosted application should incorporate the ***bglib*** which comes with the WGM110 SDK.

In addition, it is important to emphasize that on the WGM110 the UART flow-control is software emulated and for this reason there may be up to 2 extra data bytes transmitted by the module after the host's RTS has been pulled high.

6.1 Enumerations

The following table lists all differences concerning enumerations. Note that the enumerations marked as **"New"** in the ***Change*** column are available only in WGM110 while those marked as **"Deprecated"** are only available in WF121. In some cases the original enumeration in WF121 has been modified for use with WGM110 and these are marked as **"Renamed"** in the ***Change*** column.

WF121 Enumeration	Change	WGM110 Enumeration	Comment
	New	system_power_saving_state_0	Power saving state enumerations
	New	system_power_saving_state_1	Power saving state enumerations
	New	system_power_saving_state_2	Power saving state enumerations
	New	system_power_saving_state_3	Power saving state enumerations
	New	system_power_saving_state_4	Power saving state enumerations
	New	sme_eap_type_none	EAP types
	New	sme_eap_type_tls	EAP types
	New	sme_eap_type_peap	EAP types
	New	sme_eap_type_mschapv2	EAP types
endpoint_free	Renamed	endpoint_type_free	
endpoint_uart	Renamed	endpoint_type_uart	
endpoint_usb	Renamed	endpoint_type_usb	
endpoint_tcp	Renamed	endpoint_type_tcp	
endpoint_tcp_server	Renamed	endpoint_type_tcp_server	
endpoint_udp	Renamed	endpoint_type_udp	
endpoint_udp_server	Renamed	endpoint_type_udp_server	
endpoint_script	Renamed	endpoint_type_script	
endpoint_wait_close	Renamed	endpoint_type_wait_close	
endpoint_spi	Renamed	endpoint_type_spi	
endpoint_i2c	Deprecated		I^2C data exchange is handled directly through the API
endpoint_drop	Renamed	endpoint_type_drop	
-	New	endpoint_type_ssl	
hardware_alarm_every_half_second	Deprecated		
hardware_alarm_every_second	Deprecated		

WF121 Enumeration	Change	WGM110 Enumeration	Comment
hardware_alarm_every_ten_seconds	Deprecated		
hardware_alarm_every_minute	Deprecated		
hardware_alarm_every_ten_minutes	Deprecated		
hardware_alarm_every_hour	Deprecated		
hardware_alarm_every_day	Deprecated		
hardware_alarm_every_week	Deprecated		
hardware_alarm_every_month	Deprecated		
hardware_alarm_every_year	Deprecated		
	New	hardware_gpio_porta	
	New	hardware_gpio_portb	
	New	hardware_gpio_portc	
	New	hardware_gpio_portd	
	New	hardware_gpio_porte	
	New	hardware_gpio_portf	
	New	hardware_gpio_mode_disabled	
	New	hardware_gpio_mode_input	
	New	hardware_gpio_mode_input_pull	
	New	hardware_gpio_mode_input_pull_filter	
	New	hardware_gpio_mode_push_pull	
	New	hardware_gpio_trigger_disabled	
	New	hardware_gpio_trigger_rising	
	New	hardware_gpio_trigger_falling	
	New	hardware_gpio_trigger_both	
	New	hardware_adc_input_ch0	
	New	hardware_adc_input_ch1	
	New	hardware_adc_input_ch2	
	New	hardware_adc_input_ch3	
	New	hardware_adc_input_ch4	
	New	hardware_adc_input_ch5	
	New	hardware_adc_input_ch6	
	New	hardware_adc_input_ch7	
	New	hardware_adc_input_vdddiv3	
	New	x509_store_flash	
	New	x509_store_ram	
	New	x509_type_ca	
	New	x509_type_user	

6.2 Defines

The following table lists all differences concerning defines. Note that the defines marked as **"New"** in the ***Change*** column are available only in WGM110 while those marked as **"Deprecated"** are only available in WF121. In some cases the original define in WF121 has been modified for use with WGM110 and these are marked as **"Renamed"** in the ***Change*** column.

WF121 Defines	Change	WGM110 Defines	Comment
FLASH_PS_KEY_APPL_NUM1	Deprecated		
FLASH_PS_KEY_APPL_NUM2	Deprecated		
FLASH_PS_KEY_APPL_NUM3	Deprecated		
FLASH_PS_KEY_APPL_NUM4	Deprecated		
FLASH_PS_KEY_APPL_STR1	Deprecated		
FLASH_PS_KEY_APPL_STR2	Deprecated		
FLASH_PS_KEY_APPL_STR3	Deprecated		
FLASH_PS_KEY_APPL_STR4	Deprecated		
FLASH_PS_KEY_APPL_TITLE	Deprecated		
FLASH_PS_KEY_HTTP_PW	Deprecated		
FLASH_PS_KEY_HTTP_LOGIN_LEVEL	Deprecated		
FLASH_PS_KEY_AP_SCANLIST_ITEM_1	Deprecated		
FLASH_PS_KEY_AP_SCANLIST_ITEM_2	Deprecated		
FLASH_PS_KEY_AP_SCANLIST_ITEM_3	Deprecated		
FLASH_PS_KEY_AP_SCANLIST_ITEM_4	Deprecated		
FLASH_PS_KEY_AP_SCANLIST_ITEM_5	Deprecated		
FLASH_PS_KEY_AP_SCANLIST_ITEM_6	Deprecated		
FLASH_PS_KEY_AP_SCANLIST_ITEM_7	Deprecated		
FLASH_PS_KEY_AP_SCANLIST_ITEM_8	Deprecated		
FLASH_PS_KEY_AP_SCANLIST_ITEM_9	Deprecated		
FLASH_PS_KEY_AP_SCANLIST_ITEM_10	Deprecated		
FLASH_PS_KEY_AP_LABEL1	Deprecated		
FLASH_PS_KEY_AP_LABEL2	Deprecated		
FLASH_PS_KEY_AP_LABEL3	Deprecated		
FLASH_PS_KEY_AP_LABEL4	Deprecated		
FLASH_PS_KEY_AP_LABEL5	Deprecated		
FLASH_PS_KEY_AP_LABEL6	Deprecated		
FLASH_PS_KEY_AP_LABEL7	Deprecated		
FLASH_PS_KEY_AP_LABEL8	Deprecated		
FLASH_PS_KEY_AP_LABEL9	Deprecated		
FLASH_PS_KEY_AP_LABEL10	Deprecated		
	New	FLASH_PS_KEY_EOF	Last PS key index

6.3 Predefined Endpoints

There are predefined endpoints for each of the hardware interfaces. If those interfaces are not configured, then the corresponding endpoint will be part of the pool to be dynamically assigned (TCP client/server, UDP client/server, TLS client).

Predefined endpoint	WF121	WGM110
0	UART1/SPI3/I2C3	USART0
1	UART2/SPI4/I2C5	USART1
2	BGScript	BGScript
3	USB	USB
4	I2C1	
5 - 30	Dynamically assigned	0-30
31	Drop	Drop

6.4 BGAPI Commands/Responses and Events

Some commands, responsess and events have been added to support new features, others relating to deprecated features have been removed (e.g. Ethernet), and some might have been modified to enable use with WGM110. The next sections will highlight the differences between the commands, responses and events in each class. The commands, responses and events will be listed as they are named for BGScript usage.

6.4.1 Wi-Fi Command Class

This command class has new commands related to the WPA2-Enterprise feature but no changes in responses or events.

WF121 Command	Change	WGM110 Command
	New	sme_set_eap_configuration
	New	sme_set_eap_type_ca_certificate
	New	sme_set_eap_type_password
	New	sme_set_eap_type_server_common_name
	New	sme_set_eap_type_username
	New	sme_set_type_user_certificate
	New	sme_ap_client_config
	New	sme_p2p_accept_client
	New	sme_start_p2p_group
	New	sme_stop_p2p_group

WF121 Event	Change	WGM110 Event
	New	sme_p2p_client_wants_to_join
	New	sme_p2p_group_failed
	New	sme_p2p_group_started
	New	sme_p2p_group_stopped

6.4.2 TCP Stack Command Class

This command class has new commands related to encrypted TLS/SSL connections, one new event but no changes in responses.

WF121 Command	Change	WGM110 Command
	New	tcpip_tls_connect
	New	tcpip_tls_set_authmode
	New	tcpip_tls_set_user_certificate
	New	tcpip_mdns_gethostbyname

WF121 Event	Change	WGWM110 Event
	New	tcpip_tls_verify_result
	New	tcpip_mdns_gethostbyname_result

6.4.3 HTTP Server Command Class

On WGM110 the HTTP Server has an additional event to indicate an error state

WF121 Event	Change	WGM110 Event
	New	https_error

6.4.4 Hardware Command Class

This command class has the most differences compared to WF121 with modified, deprecated, renamed and new commands and also some new events but no changes to responses.

WF121 Command	Change	WGM110 Command
hardware_external_interrupt_config	Modified	hardware_configure_gpio_interrupt
hardware_change_notification_config	Deprecated	
hardware_change_notification_pullup	Deprecated	
hardware_io_port_config_direction	Modified	hardware_configure_gpio
hardware_io_port_config_open_drain	Modified	hardware_configure_gpio
hardware_io_port_read	Renamed	hardware_read_gpio
hardware_io_port_write	Renamed	hardware_write_gpio
	New	hardware_timer_init
hardware_output_compare	Modified	hardware_timer_initcc
hardware_rtc_init	Modified	hardware_rtc_init
hardware_rtc_set_time	Modified	hardware_rtc_set_time
hardware_rtc_set_alarm	Modified	hardware_rtc_set_alarm

WF121 Event	Change	WGWM110 Event
hardware_external_interrupt	Renamed	hardware_interrupt
hardware_change_notification	Deprecated	

6.4.5 I²C Command Class

The I²C data exchange is done directly through the I²C APIs, and it does not require using the endpoint commands. Data write is sent as the payload of `i2c_start_write`, and data read is received through the `i2c_start_read` command response. This command class has modified commands and a modified response but no changes to events.

WF121 Comand	Change	WGM110 Command
i2c_start_read	Modified	i2c_start_read
i2c_start_write	Modified	i2c_start_write
i2c_start_write	Modified	i2c_start_write
i2c_stop	Modified	i2c_stop

WF121 Response	Change	WGWM110 Response
i2c_start_read	Modified	i2c_start_read

6.4.6 Wired Ethernet Command Class

This command class does not exist on the WGM110 as it doesn't support Ethernet so some commands and one event are deprecated, no changes to responses.

WF121 Command	Change	WGM110 Command
Ethernet_connected	Deprecated	
Ethernet_set_dataroute	Deprecated	
Ethernet_close	Deprecated	

WF121 Event	Change	WGWM110 Event
Ethernet_link_status	Deprecated	

6.4.7 Persistent Store Command Class

On the WGM110, the system key indexes are from 0 to 32767 and the user keys are from 32768 to 65534. The command `flash_ps_erase_all` does not remove the MAC address, and the flash can be written across the entire VDDCPU voltage supply range. No changes to commands or responses but one removed event.

WF121 Event	Change	WGWM110 Event
flash_low_voltage	Deprecated	

6.4.8 X.509 Command Class

This command class is used to manage the X.509 cryptography certificates and keys used in TLS/SSL and WPA2-Enterprise. New commands and events but no changes to responses.

WF121 Command	Change	WGM110 Command
	New	x509_add_certificate
	New	x509_add_certificate_data
	New	x509_add_certificate_finish
	New	x509_add_private_key
	New	x509_add_private_key_data
	New	x509_add_private_key_finish
	New	x509_delete_certificate
	New	x509_list_certificates
	New	x509_reset_store

WF121 Event	Change	WGWM110 Event
	New	x509_certificate
	New	x509_certificates_listed
	New	x509_certificate_subject

6.5 Error Codes

Ethernet related error codes (0x190 and 0x191) do not exist on WGM110.

WF121 Error code	Change	WGM110 Error code
0x0190	Deprecated	
0x0191	Deprecated	

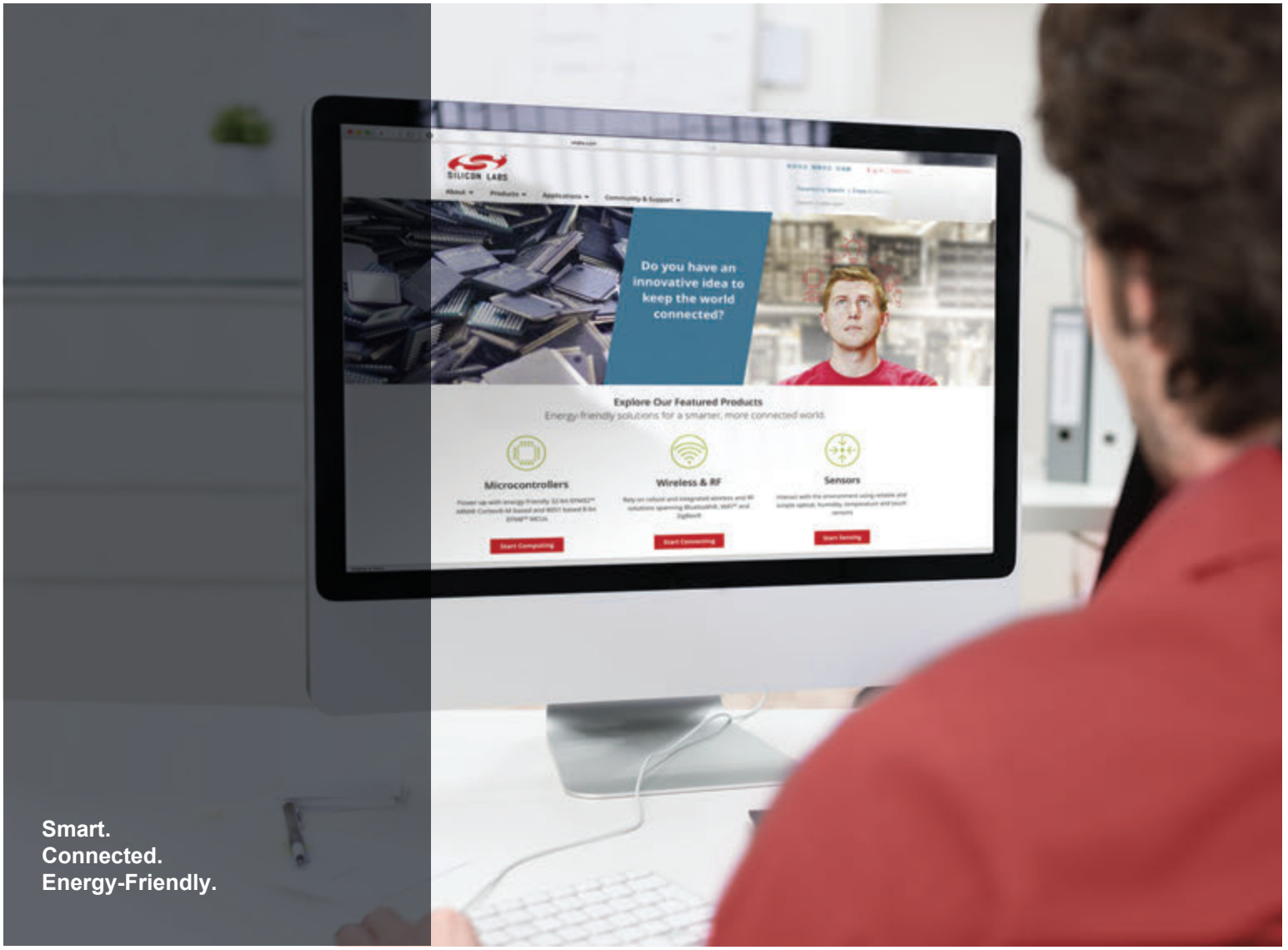
7. Revision history

7.1 Revision 1.1

Updated to align with latest SDKs for both WF121 and WGM110.

7.2 Revision 1.0

First version



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