AN1354: Using the RS9116 Feature Selection Worksheet

Version 1.0

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1 Introduction

This Application Note provides a comprehensive description of the RS9116 TCP/IP Feature Selection worksheet included in RS9116 WiseConnect software releases. This document explain worksheet's usage to determine the memory footprint in an RS116-based system family of modules to establish TCP/IP based applications using either Wi-Fi only or Wi-Fi plus Bluetooth capabilities and determine whether the desired Wi-Fi, Bluetooth Classic, Bluetooth LE, and TCP/IP capabilities for a customer application can be fit within the memory available in the RS9116 system of choice.

2 Prerequisites

To follow the guidance provided by this document you will need the following:

- A current RS9116 WiseConnect software release including the following excel workbook:

  RS9116_TCP_IP_Feature_Selection_vX.Y

  Where: vX.Y is the version of the above Excel worksheet included in the WiseConnect software release of interest.

3 Description of the RS9116_TCP_IP_Feature_Selection worksheet

3.1 RS9116 WiseConnect Capabilities and their Representation in the RS9116_TCP_IP_Feature_Selection Worksheet

As stated before, the RS9116 SoC family provides the following capabilities:

- Wi-Fi capabilities
- Bluetooth LE capabilities
- Bluetooth Classic capabilities
- A complete TCP/IP stack

To expand a little bit on the above, the following is a more complete description of the subsets of capabilities withing each of the above capability classes:

Wi-Fi Capabilities:

- The RS9116 SoCs can act as a Wi-Fi Station (Client)
- The RS9116 SoCs can act as a Wi-Fi Access Point (AP)

Bluetooth LE Capabilities:

- The RS9116 SoCs can act as a Bluetooth LE main
- The RS9116 SoCs can act as a Bluetooth LE secondary

Bluetooth Classic Capabilities:

- The RS9116 SoCs can act as a Bluetooth Classic main
- The RS9116 SoCs can act as a Bluetooth Classic secondary

TCP/IP Stack:

The following capabilities are available within the TCP/IP stack implementation of the RS9116 SoC family:

- ICMP capabilities
- DNS client and server capabilities
- FTP client and server capabilities
- SSL capabilities
- HTTP and HTTPS client capabilities
- HTTP and HTTPS server capabilities
- IPv4 and IPv6 support
- IPv4 DHCP client and server capabilities
- SNTP client support
- SMTP client support
- POP3 support
- OTAFU (Over the air firmware update) client support
- MQTT support

The following subsection will provide a description of the fields in the RS9116_TCP_IP_Feature_Selection worksheet that are to be used to determine the memory footprint that a set of features will have in an RS9116 system. The main purpose of the spreadsheet is to determine whether a given set of features can be included within the memory available in an RS9116 system. RS9116 systems can have the following amounts of memory at their disposal and the spreadsheet allows the user to specify which of those possible memory configurations their RS9116 system has and if the list of desired features can be accommodated within that given memory footprint:

- 192 kilobytes
- 256 kilobytes
- 320 kilobytes
- 384 kilobytes

3.2 Fields in the RS9116_TCP_IP_Feature_Selection Worksheet

This section presents the fields included in the RS9116_TCP_IP_Feature_Selection worksheet and describes how they should be used to determine the memory footprint that will be added to an MCU application to support the capabilities available in the RS9116 SoC family.

As stated before, the main purpose of the spreadsheet is to determine whether the desired feature list can be accommodated within the available memory footprint of the user's RS9116 system. For this purpose, the user should, before anything, enter the amount of memory available in its RS9116 system. This should be done in the field of the spreadsheet named as:

Memory Configuration for NWP

As shown in the image below, the available options for this parameter are the following:

- 192 kilobytes
- 256 kilobytes
- 320 kilobytes
- 384 kilobytes
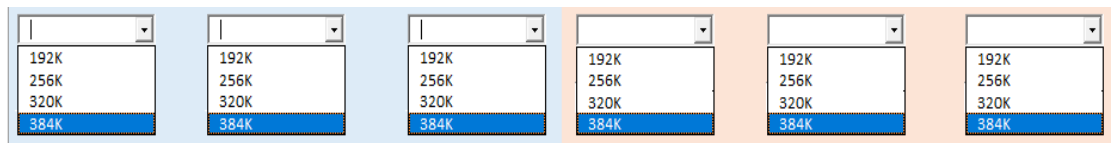
As illustrated above, there is an input field for this spreadsheet parameter in multiple rows of the spreadsheet. The spreadsheet allows the user to select the configuration of its system as a Wi-Fi only system or a Wi-Fi + Bluetooth system with several different configuration options for either. We will now discuss this. For now, simply be aware that you should set the memory configuration for your system under the "Memory Configuration for NWP" field row for the column that corresponds to the system configuration you desire.

After having selected the memory that will be present in your system, you will need to specify what is the operating mode that you will have your system working under. The available options are presented as rows in the spreadsheet as shown in the image below:

As illustrated above, there are two operating mode main categories for the system to operate under, they are the following:

1. Wi-Fi Alone Mode

   These categories are the ones shown in blue in the spreadsheet. These operating modes have the RS9116 system operating as a Wi-Fi only device with no Bluetooth support. The available operating mode options under this category are as follows:

   - WPA/WPA2-PSK

     This operating mode has the RS9116 system act as a Wi-Fi client (Station) operating with home security (either open, WPA or WPA2 home security).

- WPA/WPA2-Enterprise

This operating mode has the RS9116 system act as a Wi-Fi client (Station) operating with enterprise security (either WPA or WPA2 enterprise security).

- Access Point

This operating mode has the RS9116 system act as a Wi-Fi access point.

The above categories are the ones shown under the following columns in the spreadsheet:

Wi-Fi Alone Mode
WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point

2. CoEx Modes – BT/BLE

These categories are the ones shown in pink in the spreadsheet. These operating modes have the RS9116 system operating in a coexistence mode, supporting both Wi-Fi as well as either Bluetooth classic (BT) or Bluetooth Low Energy (BLE). The available operating mode options under this category are as follows:

- WPA/WPA2-PSK

This operating mode has the RS9116 system act as both a Wi-Fi client (Station) operating with home security (either open, WPA or WPA2 home security) and as Bluetooth or Bluetooth LE device (main or secondary) simultaneously (coexistence mode).

- WPA/WPA2-Enterprise

This operating mode has the RS9116 system act as a Wi-Fi client (Station) operating with enterprise security (either WPA or WPA2 enterprise security) and as Bluetooth or Bluetooth LE device (main or secondary) simultaneously (coexistence mode).

- Access Point

This operating mode has the RS9116 system act as a Wi-Fi access point and as Bluetooth or Bluetooth LE device (main or secondary) simultaneously (coexistence mode).

The above categories are the ones shown under the following columns in the spreadsheet:

Coex Modes- BT/ BLE
WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point

Once you have selected the operating mode that you desire for your system from the above 6 options (3 Wi-Fi only and 3 Wi-Fi plus BT/BLE options) you should configure the features that you desire your system to support to find out if the system's memory footprint is able to support them. The following subsections provide descriptions of each of the features in the spreadsheet.

3.2.1 Host Interface

The Host interface field allows the user to specify what type of interface will be used by the RS9116 to communicate to the host MCU. The possible interfaces are the following as shown in the image below:

- SDIO
- SPI
- UART
- USB
- USB-CDC
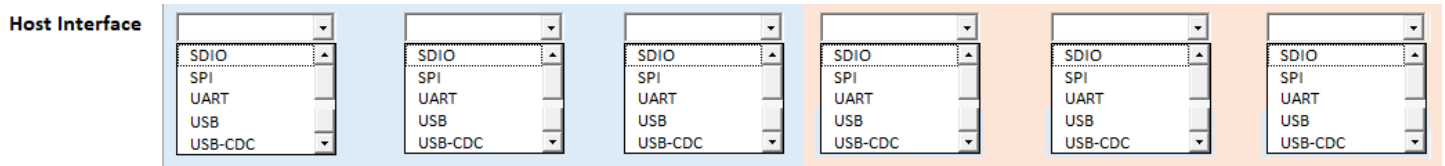
3.2.2 WLAN Features

This section of the spreadsheet allows the user to specify the support for the different available Wi-Fi capabilities. This section is as shown in the image below:
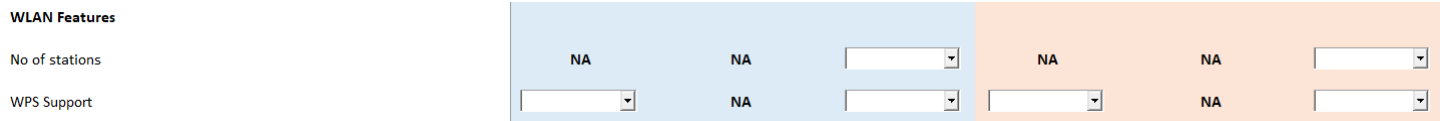
As illustrated above, not all features are supported in all operating modes. Such features are listed as "NA" in the spreadsheet. The following provides a description of the features of this section of the spreadsheet:

- No. of stations

  This field states the maximum number of 802.11 clients / stations that the RS9116 will need to support when acting as an AP. As shown below, that number can be configured from 1 to 16:
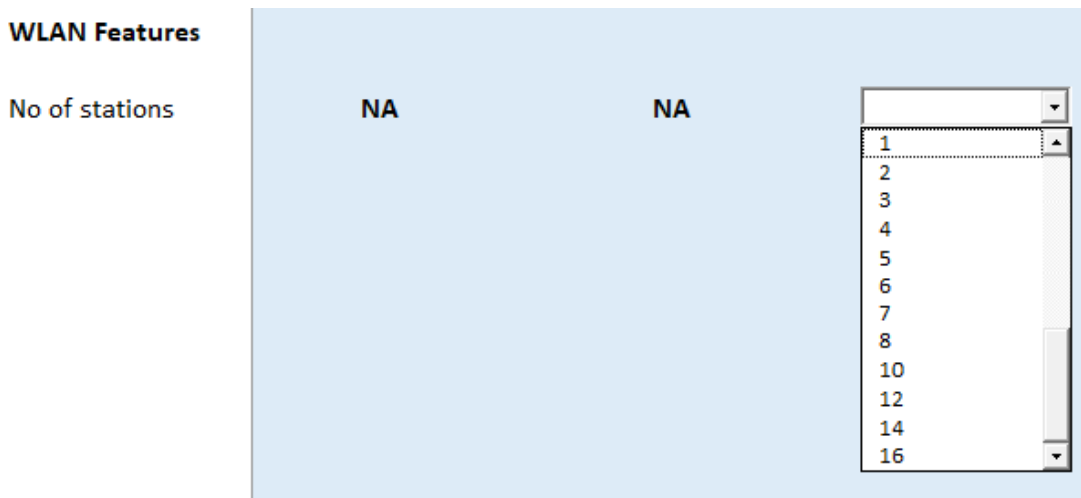
- WPS Support

This field specifies whether the system will support WPS (Wi-Fi protected setup) when operating as a Wi-Fi client or as an AP. As can be seen below, WPS is only supported when using open or home WPA or WPA2 security, but not when using enterprise security. The columns in the spreadsheet for WPA/WPA2-Enterprise, thus state "NA" under the row for this feature:

WPS Support		NA			NA	

3.2.3 CoEx Mode

This section of the spreadsheet allows the user to specify the support for the different available Bluetooth LE capabilities. This section is as shown in the image below:

Coex Mode	NA	NA	NA			
No of BLE slaves	NA	NA	NA			
No of the Packets in a Connection Interval Bluetooth LE is Mandatory	NA	NA	NA			
No of the Attributes Records Bluetooth LE is Mandatory	NA	NA	NA			
No of the Attributes Services Bluetooth LE is Mandatory	NA	NA	NA			
No of BT slaves	NA	NA	NA			

As illustrated above, the Bluetooth LE features (CoEx Mode section) are only supported in CoEx modes and not in Wi-Fi only mode, thus they are stated as "NA" under the Wi-Fi only columns in the spreadsheet. The following provides a description of the features of this section of the spreadsheet:

- No of BLE secondary

  This field states the maximum number of BLE secondary that the system will be required to support when acting as a BLE main. The available range is from 1 to 8 secondary as shown below:

No of BLE slaves	NA	NA	NA			
				1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8

- No of the Packets in a Connection Interval Bluetooth LE is Mandatory

  This field specifies the number of buffers to be allocated for packet transmission in Bluetooth LE mode within a connection interval. By default, each role (main or secondary) will be allocated 1 buffer for the notify/write command. The number of buffers specified by this parameter determine the throughput available for the system. To do so, the following equation is used.

  Minimum number of buffers required = No. of packets in connection interval >= Number of main connections + Number of Secondary connections.

  This allows achieving a throughput of up to 700 kbps with a connection interval of 45 mSec.

  The valid value range for this field is 0 to 20 as shown below:

No of the Packets in a Connection Interval Bluetooth LE is Mandatory	NA	NA	NA			

- No of the Attributes Records Bluetooth LE is Mandatory

This field indicates the maximum number of BLE attribute records that the firmware will be asked to maintain. Attribute records are records holding the attribute / characteristic information such as Type, UUID, handle, properties, and values. The possible values for this field are 10 to 80 as shown below:

No of the Attributes Records Bluetooth LE is Mandatory	NA	NA	NA		

- No of the Attributes Services Bluetooth LE is Mandatory

This field states the maximum number of attribute services that the firmware will be asked to maintain. A minimum of 2 needs to be specified as GAP and GATT are added by default, The possible value range for this field is 4 to 10 as shown below:

No of the Attributes Services Bluetooth LE is Mandatory	NA	NA	NA			

3.2.4 Bluetooth Classic Features

- No of BT secondary

This field specifies what is the maximum number of Bluetooth classic secondary that the system will be required to support when acting as a Bluetooth classic main. The available range is from 1 to 2 secondary as shown below:

No of BT slaves	NA	NA	NA			

- IAP Profile

This field specifies whether the system will support the Bluetooth IAP profile or not.

IAP Profile	Bluetooth Classic Mode is Mandatory	NA	NA	NA			

3.2.5   TCP/IP Features

This section of the spreadsheet lets the user specify which of the TCP/IP stack features are desired to be used within an RS9116 system to verify if enabling such features along with the desired Wi-Fi and BT/BLE features is possible within the memory footprint of the RS9116 system under consideration. The following shows an image of this section:

The features available for consideration in this section of the spreadsheet are the following:

- Basic TCP/IP Stack (IPv4)

   This field selects whether the TCP/IP stack will be enabled in your system or whether TCP/IP bypass will be selected in it to have the TCP/IP stack of your host MCU be used instead. The options for it, accordingly, are Yes for use of the RS9116 TCP/IP stack and No for bypassing it.

   Please note that to use the remainder of the features of the TCP/IP stack (all the following fields in this section) this feature MUST BE SELECTED.

- ICMP

This field selects whether ICMP (Internet Control Message Protocol) capabilities will be available in the RS9116 system. Please note that to have ping capabilities, this feature needs to be enabled. The possible options for this filed are Yes (ICMP enabled) and No (ICMP disabled) as shown below:
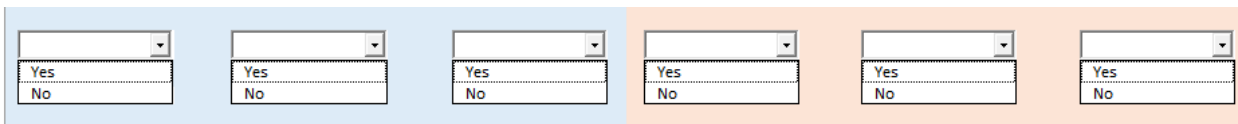

- DNS

This field selects whether DNS (Domain Name System) Client functionality will be available or not in the RS9116 system. Please note that this only allows DNS client and NOT DNS server functionality. The possible options for this filed are Yes (DNS client functionality enabled) and No (DNS client functionality disabled) as shown below:
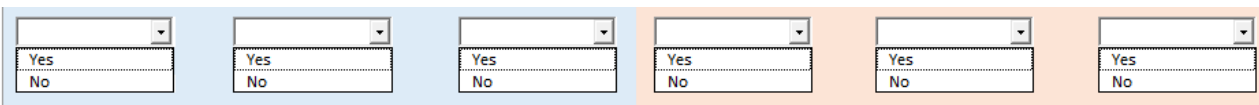

- FTP

This field selects whether File Transfer Protocol (File Transfer Protocol) Client and Server functionality will be available or not in the RS9116 system/ The possible options for this filed are Yes (FTP Client and Server functionality enabled) and No (FTP Client and Server functionality enabled disabled) as shown below:

- SSL

This field selects whether Secure Socket Layer (SSL) functionality will be available in the RS9116 system. In addition to that, it allows for the selection of the number of SSL sockets that will be available for use and whether such sockets will be used for local (local LAN) or cloud-based connections, as additional memory is needed to support SSL connections to the cloud. The possible options are:

No: This assumes that SSL functionality will be disabled entirely.
One Socket: This assumes that SSL functionality will be enabled and only a single local LAN SSL connection will be supported by it.
Two Sockets: This assumes that SSL functionality will be enabled, and two local LAN SSL connections will be supported by it.
Three Sockets: This assumes that SSL functionality will be enabled, and three local LAN SSL connections will be supported by it.
Two SSL CLOUD: This assumes that SSL functionality will be enabled and two SSL connections to cloud based devices will be supported by it.
Three SSL CLOUD: This assumes that SSL functionality will be enabled and three SSL connections to cloud based devices will be supported by it.

The available options are illustrated by the image shown below:

- SSL – Private and Public Certificates

An SSL session can be established with or without private and public certificates. This field specifies whether memory allocation will need to be made to support storage of private and public certificates (YES) or not (No) for SSL session establishment. This is shown in the following image:

- HTTP Client

This field selects whether HTTP (Hypertext Transfer Protocol) Client functionality will be available or not in the RS9116 system. The possible options for this filed are Yes (HTTP client functionality enabled) and No (HTTP client functionality disabled) as shown below:

- HTTP Server

This field selects whether HTTP (Hypertext Transfer Protocol) Server functionality will be available or not in the RS9116 system. The possible options for this filed are Yes (HTTP server functionality enabled) and No (HTTP server functionality disabled) as shown below:

- HTTPS Client

This field selects whether HTTPS (Hypertext Transfer Protocol Secure) Client functionality will be available or not in the RS9116 system. The possible options for this filed are Yes (HTTPS client functionality enabled) and No (HTTPS client functionality disabled) as shown below:

- HTTPS Server

This field selects whether HTTPS (Hypertext Transfer Protocol Secure) Server functionality will be available or not in the RS9116 system. The possible options for this filed are Yes (HTTPS server functionality enabled) and No (HTTPS server functionality disabled) as shown below:

- DHCP Client for IPv4

This field selects whether DHCP (Dynamic Host Configuration Protocol) client functionality will be available or not in the RS9116 system for IPv4. Please note that this functionality is ONLY available in operating modes where the RS9116 is acting as a Wi-Fi client and NOT in operating modes where it is acting as a Wi-Fi access point. The possible options for this filed are Yes (DHCP Client enabled) and No (DHCP Client functionality disabled) as shown below:

- DHCP Server for IPv4

This field selects whether DHCP (Dynamic Host Configuration Protocol) server functionality will be available or not in the RS9116 system for IPv4. Please note that this functionality is ONLY available in operating modes where the RS9116 is acting as a Wi-Fi Access Point and NOT in operating modes where it is acting as a Wi-Fi client. The possible options for this filed are Yes (DHCP Server enabled) and No (DHCP Server functionality disabled) as shown below:

- IPv6

This field selects whether IPv6 functionality will be available in the RS9116 system. Please note that to use the DHCP client for IPv6 and DHCP server for IPv6 functionalities, this field needs to be enabled. The possible options for this filed are Yes (IPv6 functionality enabled) and No (IPv6 functionality disabled) as shown below:

- DHCP Client for IPv6

This field selects whether DHCP (Dynamic Host Configuration Protocol) client functionality will be available or not in the RS9116 system for IPv6. Please note that this functionality is ONLY available in operating modes where the RS9116 is acting as a Wi-Fi client and NOT in operating modes where it is acting as a Wi-Fi access point. Also, note that to use DHCP client functionality for IPv6 the IPv6 option also needs to be enabled in the spreadsheet. The possible options for this filed are Yes (DHCP Client enabled) and No (DHCP Client functionality disabled) as shown below:

- DHCP Server for IPv6

This field selects whether DHCP (Dynamic Host Configuration Protocol) server functionality will be available or not in the RS9116 system for IPv6. Please note that this functionality is ONLY available in operating modes where the RS9116 is acting as a Wi-Fi access point and NOT in operating modes where it is acting as a Wi-Fi client. Also, note that to use DHCP server functionality for IPv6 the IPv6 option also needs to be enabled in the spreadsheet. The possible options for this filed are Yes (DHCP Server enabled) and No (DHCP Server functionality disabled) as shown below:

- JSON Objects

This field selects whether JSON (JavaScript Object Notation) objects will be available to allow the RS9116 system's webserver to serve dynamic webpages. Please note that enabling HTTP functionality (through the HTTP Server field in the spreadsheet) MSUT be enabled to use this option. The possible options for this filed are Yes (JSON objects enabled) and No (JSON objects disabled) as shown below:

- SNMP

This field selects whether SNMP (Simple Network Management Protocol) functionality will be available in the RS9116 system or not. The possible options for this filed are Yes (SNMP functionality enabled) and No (SNMP functionality disabled) as shown below:

- SNTP Client

This field selects whether SNTP (Simple Network Time Protocol) client functionality will be available in the RS9116 system or not. The possible options for this filed are Yes (STP client functionality enabled) and No (SNTP client functionality disabled) as shown below:

- mDNS Responder

This field selects whether mDNS (Multicast DNS) responder functionality will be available in the RS9116 system or not This functionality, if present, will allow the Rs9116 to discover mDNS services. The possible options for this filed are Yes (mDNS responder functionality enabled) and No (mDNS responder functionality disabled) as shown below:

- PUF

This field selects whether PUF (Physical Unclonable Function) functionality will be available in the RS9116 system or not This functionality, if present, will allow the Rs9116 to provide an extra layer of device security. Please note that PUF functionality is not currently present in WiseConnect firmware, and this field is only provided in the spreadsheet for future reference. The possible options for this filed are Yes (PUF functionality enabled) and No (PUF functionality disabled) as shown below:

- SMTP Client

This field selects whether SMTP (Simple Mail Transfer Protocol) client functionality will be available or not in the RS9116 system. The possible options for this filed are Yes (SMTP Client enabled) and No (SMTP Client functionality disabled) as shown below:

- POP3

This field selects whether POP3 (Post Office Protocol 3) client functionality will be available or not in the RS9116 system. Please note that POP3 functionality is not currently available in WiseConnect firmware, and this field is only placed in the spreadsheet for future reference. The possible options for this filed are Yes (POP3 Client functionality enabled) and No (POP3 Client functionality disabled) as shown below:

- OTAF Client

This field selects whether OTAF (Over the Air Firmware Upgrade) client functionality will be available or not in the RS9116 system. The possible options for this filed are Yes (OTAF client functionality enabled) and No (OTAF client functionality disabled) as shown below:

- MQTT

This field selects whether MQTT (Message Queuing Telemetry Transport Protocol) functionality will be available or not in the RS9116 system. The possible options for this filed are Yes (MQTT functionality enabled) and No (MQTT functionality disabled) as shown below:

3.2.6   Low Power Mode

The sole field in this section of the spreadsheet will let the user specify whether he wants his system to be capable to go into low power mode (deep sleep / standby) or if the user wants the system to remain solely in always on mode. This has memory usage implications, as sending the system into low power modes will require the system to store into memory configuration parameters such as association ID, SSID, password, IP address, status of TCP connections, etc. that will require memory allocation to be reserved for them. The possible options for this filed are Yes (The system will use low power states) and No (The system will be used ONLY in an always on configuration) as shown below:

3.3   Usage of the Spreadsheet

Follow the procedure provided by this section to use the spreadsheet to determine whether the desired configuration is possible with the memory available in your system.

1. The host interface to be used on your system (SDIO, SPI, UART, USB, or USB-CDC) will be selected.
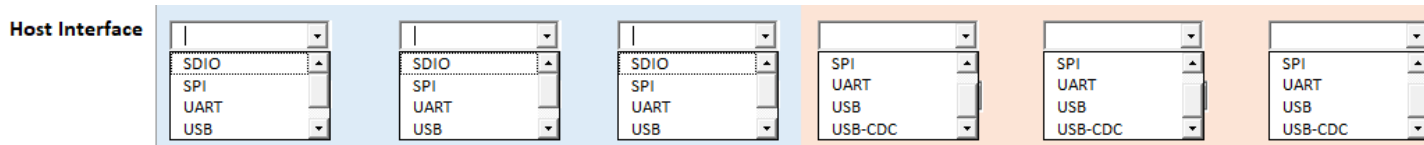
2. The amount of memory available in your RS9116 module should be entered in the Memory Configuration for NWP row in the spreadsheet, entering the option that is appropriate for your system among the following possibilities:

- 192 kilobytes
- 256 kilobytes
- 320 kilobytes
- 384 kilobytes

   As illustrated below:
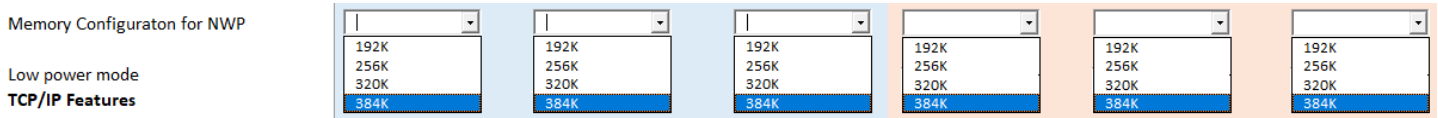
3. The proper operating mode should be selected, and the appropriate section of the spreadsheet should be selected for usage among the two following:
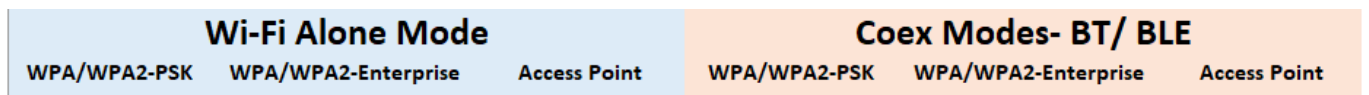
As described in the previous section, select first whether you want your RS9116 system to act as a Wi-Fi device only or as a Wi-Fi plus Bluetooth device.

If you desire your RS9116 system to act as a Wi-Fi device only, use the columns on the blue side (Wi-Fi Alone Mode) of the spreadsheet, if you want your system to act as a Wi-Fi plus Bluetooth device, use the columns on the pink side (CoEx Modes – BT/BLE) instead.

4. Once you have selected whether your system will do Wi-Fi only (blue) or Wi-Fi plus Bluetooth (Pink), select the proper column among the three columns available in that section to evaluate the memory usage of your system. For that purpose, select as follows:

   a. Select the column labeled "WPA/WPA2-PSK" if, on the Wi-Fi side, you desire your RS9116 system to act as a client and use either open security, home WPA or home WPA2 security.
   b. Select the column labeled "WPA/WPA2-Enterprise" if, on the Wi-Fi side, you desire your RS9116 system to act as a client and use enterprise WPA or WPA2 security.
   c. Select the column labeled "Access Point" if, on the Wi-Fi side, you desire your RS9116 system to act as an Access Point.

5. Configure the remaining fields on the column you selected on the previous point per your application needs following their descriptions on the previous section of the document.

6. Once you have completed the previous configuration steps, go back to the top of the spreadsheet, and see in the rows shown below whether the desired combination of features is feasible or not, and, if it is feasible, what is the number of sockets that can possibly be supported for it by the system:

	Basic TCP/IP Stack (IPv4) is mandatory						
Number of Possible Sockets		0	0	0	0	0	0
Combination Feasible or Not		Feasible	Not Feasible	Feasible	Not Feasible	Not Feasible	Not Feasible

3.4 Examples of RS9116_TCP_IP_Feature_Selection Worksheet Usage

The following section will provide you with several examples of using the RS9116_TCP_IP_Feature_Selection worksheet to determine the memory footprint to be expected for some typical real world IoT applications.

Example 1: Wi-Fi Station with HTTP Client Support

In the following example, the RS9116 system will be configured to act as a Wi-Fi client supporting WPA2 home security. The following will be the list of services to be supported:

- USB-CDC host interface
- IPv4 stack
- DNS (to provide DNS client functionality to allow resolution of online webserver IP addresses)
- ICMP support will be enabled in this system to allow for pings to be available in this system.
- HTTP client
- HTTPS client (In order to allow RS9116 to obtain webpages from HTTPS encrypted webservers online)
- DHCP client (In order to allow RS9116 system to obtain an IP address dynamically from the AP it associates to.
- Low power mode operation will be allowed on this system.

We will assume that an RS9116 system with 384 kilobytes of memory will be used for this configuration.

The configuration of the spreadsheet is as follows for this case (shown in the following page):

Features	Comments	Wi-Fi Alone Mode			Coex Modes- BT/ BLE		
		WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point	WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point
Number of Possible Sockets	Basic TCP/IP Stack (IPv4) is mandatory	10	0	0	0	0	0
Combination Feasible or Not		Feasible	Not Feasible	Feasible	Not Feasible	Not Feasible	Not Feasible
					Note : For Co-ex modes 384K should enable		
Host Interface		USB-CDC					
Memory Configuraton for NWP		384K					
No of stations		NA	NA		NA	NA	
WPS Support		No	NA			NA	
Coex Mode		NA	NA	NA			
No of BLE slaves		NA	NA	NA			
No of the Packets in a Connection Interval Bluetooth LE is Mandatory		NA	NA	NA			
No of the Attributes Records Bluetooth LE is Mandatory		NA	NA	NA			
No of the Attributes Services Bluetooth LE is Mandatory		NA	NA	NA			
No of BT slaves		NA	NA	NA			
Bluetooth Classic Features							
IAP Profile	Bluetooth Classic Mode is Mandatory	NA	NA	NA			
Low power mode		Yes					
TCP/IP Features							
Basic TCP/IP Stack (IPv4)	This is Mandatory for all features below	Yes					
ICMP		Yes					
DNS		Yes					
FTP		No					
SSL		No					
SSL - Private and Public Certificates		No					
HTTP Client		Yes					
HTTP Server		No					
HTTPS Client	HTTP Client and SSL are Mandatory	Yes					
HTTPS Server	HTTP Server and SSL are Mandatory	No					
DHCP Client for IPv4		Yes		NA			NA
DHCP Server for IPv4		NA	NA		NA	NA	
IPv6		No					
DHCP Client for IPv6	IPv6 is Mandatory	No		NA			NA
DHCP Server for IPv6	IPv6 is Mandatory	NA	NA		NA	NA	
JSON Objects (for Dynamic Pag HTTP Server is Mandatory		No					
SNTP Client		No					
mDNS Responder		No					
PUF		No					
OTAF CLIENT		No					
MQTT		No					

Note : Zigbee will be added later

Note the top of the spreadsheet, as shown below:

Features	Comments	Wi-Fi Alone Mode			Coex Modes- BT/ BLE		
		WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point	WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point
Number of Possible Sockets	Basic TCP/IP Stack (IPv4) is mandatory	10	0	0	0	0	0
Combination Feasible or Not		Feasible	Not Feasible	Feasible	Not Feasible	Not Feasible	Not Feasible

As circled in red, this combination of features is possible with an RS9116 system with 384 kilobytes of memory (Stated with the text "Feasible" in the "Combination Feasible or Not" row in the spreadsheet) and up to 10 sockets can be supported in this configuration (as stated with the text "10" in the Number of Possible Sockets" row in the column).

Example 2: Wi-Fi Access Point + Bluetooth LE Main with 2 Secondary and FTP Client Support

In the following example, the RS9116 system will be configured to act as a Wi-Fi AP supporting WPA2 home security in coexistence mode acting as well as a Bluetooth LE main supporting 2 secondary. The following will be the list of services to be supported:

- UART host interface
- IPv4 stack
- Wi-Fi access point with support for 8 stations
- WPA2 security
- Bluetooth LE Main with support for 2 secondary
- ICMP support will be enabled in this system to allow for pings to be available in this system.
- DHCP server support to allow AP to provide dynamic IP addresses to clients.
- OTAF client capabilities to support firmware upgrading.

We will assume that an RS9116 system with 384 kilobytes of memory will be used for this configuration.

The configuration of the spreadsheet is as follows for this case (shown in the following page):

Features	Comments	Wi-Fi Alone Mode			Coex Modes- BT/ BLE		
		WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point	WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point
Number of Possible Sockets	Basic TCP/IP Stack (IPv4) is mandatory	0	0	0	0	0	10
Combination Feasible or Not		Feasible	Not Feasible	Feasible	Not Feasible	Not Feasible	Feasible
				Note : For Co-ex modes 384K should enable			
Host Interface							UART
Memory Configuraton for NWP							384K
No of stations		NA	NA		NA	NA	2
WPS Support			NA			NA	No
Coex Mode		NA	NA	NA			BTLE
No of BLE slaves		NA	NA	NA			2
No of the Packets in a Connection Interval Bluetooth LE is Mandatory		NA	NA	NA			4
No of the Attributes Records Bluetooth LE is Mandatory		NA	NA	NA			
No of the Attributes Services Bluetooth LE is Mandatory		NA	NA	NA			4
No of BT slaves		NA	NA	NA			
Bluetooth Classic Features							
IAP Profile	Bluetooth Classic Mode is Mandatory	NA	NA	NA			
Low power mode							No
TCP/IP Features							
Basic TCP/IP Stack (IPv4)	This is Mandatory for all features below						Yes
ICMP							Yes
DNS							No
FTP							Yes
SSL							No
SSL - Private and Public Certificates							No
HTTP Client							No
HTTP Server							No
HTTPS Client	HTTP Client and SSL are Mandatory						No
HTTPS Server	HTTP Server and SSL are Mandatory						No
DHCP Client for IPv4				NA			NA
DHCP Server for IPv4		NA	NA		NA	NA	Yes
IPv6							No
DHCP Client for IPv6	IPv6 is Mandatory			NA			NA
DHCP Server for IPv6	IPv6 is Mandatory	NA	NA		NA	NA	No
JSON Objects (for Dynamic Pag HTTP Server is Mandatory							No
SNTP Client							No
mDNS Responder							No
PUF							No
OTAF CLIENT							Yes
MQTT							No

Note : Zigbee will be added later

Note the top of the spreadsheet, as shown below:

Features	Comments	Wi-Fi Alone Mode			Coex Modes- BT/ BLE		
		WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point	WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point
Number of Possible Sockets	Basic TCP/IP Stack (IPv4) is mandatory	0	0	0	0	0	10
Combination Feasible or Not		Feasible	Not Feasible	Feasible	Not Feasible	Not Feasible	Feasible

As circled in red, this combination of features is possible with an RS9116 system with 384 kilobytes of memory (Stated with the text "Feasible" in the "Combination Feasible or Not" row in the spreadsheet) and up to 10 sockets can be supported in this configuration (as stated with the text "10" in the Number of Possible Sockets" row in the column).

Example 3: Wi-Fi Client with Enterprise Security + Dual Mode (Bluetooth Classic + Bluetooth LE) Main with 2 Bluetooth LE and 2 Bluetooth Classic Secondary, SSL Client with Certificate, MQTT Support, and SNTP Client Support

In the following example, the RS9116 system will be configured to act as a Wi-Fi client supporting WPA2 enterprise security in coexistence mode acting as well as a Bluetooth classic main supporting 2 secondary. The following will be the list of services to be supported:

- SPI host interface
- IPv4 stack
- Wi-Fi client with enterprise security support
- Dual Mode Bluetooth Classic and Bluetooth LE main configuration
- Bluetooth Classic Main with support for 2 stations
- Bluetooth LE Main with support for 2 stations
- Bluetooth classic IAP profile support
- ICMP support will be enabled in this system to allow for pings to be available in this system.
- DHCP client support to allow client to obtain IP address dynamically from AP it associates to.
- DNS client support to allow for domain name resolution.
- Two cloud socket SSL support with certificate support to allow connection to two separate cloud-based SSL servers.
- SNTP client support to obtain timing reference from online source.
- MQTT support to allow client to connect to online MQTT servers (Amazon AWS cloud for example).
- Low power mode support

We will assume that an RS9116 system with 384 kilobytes of memory will be used for this configuration.

The configuration of the spreadsheet is as follows for this case (shown in the following page):

Features	Comments	Wi-Fi Alone Mode			Coex Modes- BT/ BLE		
		WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point	WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point
Number of Possible Sockets	Basic TCP/IP Stack (IPv4) is mandatory	0	0	0	0	10	0
Combination Feasible or Not		Feasible	Not Feasible	Feasible	Not Feasible	Feasible	Not Feasible
						Note : For Co-ex modes 384K should enable	
Host Interface						SPI	
Memory Configuraton for NWP						384K	
No of stations		NA	NA		NA	NA	
WPS Support			NA			NA	
Coex Mode		NA	NA	NA		BT Dual Mode	
No of BLE slaves		NA	NA	NA		2	
No of the Packets in a Connection Interval Bluetooth LE is Mandatory		NA	NA	NA		4	
No of the Attributes Records Bluetooth LE is Mandatory		NA	NA	NA		10	
No of the Attributes Services Bluetooth LE is Mandatory		NA	NA	NA		4	
No of BT slaves		NA	NA	NA		2	
Bluetooth Classic Features							
IAP Profile	Bluetooth Classic Mode is Mandatory	NA	NA	NA		Yes	
Low power mode						Yes	
TCP/IP Features							
Basic TCP/IP Stack (IPv4)	This is Mandatory for all features below					Yes	
ICMP						Yes	
DNS						Yes	
FTP						No	
SSL						TWO SSL CLOUD	
SSL - Private and Public Certificates						Yes	
HTTP Client						No	
HTTP Server						No	
HTTPS Client	HTTP Client and SSL are Mandatory					No	
HTTPS Server	HTTP Server and SSL are Mandatory					No	
DHCP Client for IPv4				NA		Yes	NA
DHCP Server for IPv4		NA	NA		NA	NA	
IPv6						No	
DHCP Client for IPv6	IPv6 is Mandatory			NA		No	NA
DHCP Server for IPv6	IPv6 is Mandatory	NA	NA		NA	NA	
JSON Objects (for Dynamic Pag HTTP Server is Mandatory						No	
SNTP Client						Yes	
mDNS Responder						No	
PUF						No	
OTAF CLIENT						Yes	
MQTT						Yes	

Note : Zigbee will be added later

Note the top of the spreadsheet, as shown below:

Features	Comments	Wi-Fi Alone Mode			Coex Modes- BT/ BLE		
		WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point	WPA/WPA2-PSK	WPA/WPA2-Enterprise	Access Point
Number of Possible Sockets	Basic TCP/IP Stack (IPv4) is mandatory	0	0	0	0	10	0
Combination Feasible or Not		Feasible	Not Feasible	Feasible	Not Feasible	Feasible	Not Feasible

As circled in red, this combination of features is possible with an RS9116 system with 384 kilobytes of memory (Stated with the text "Feasible" in the "Combination Feasible or Not" row in the spreadsheet) and up to 10 sockets can be supported in this configuration (as stated with the text "10" in the Number of Possible Sockets" row in the column).

As you can see from the configuration examples from the previous pages, the RS9116 is a rather flexible system that allows its users to configure it for several different possible applications. Using the TCP-IP feature selection worksheet will allow you to determine quickly whether your system's needs can be fit in the RS9116 system of choice.

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