AN1002: ZigBee® HA CICIE AT Command Set Usage Scenarios

The Combined Interface with Control Indicating Equipment (CICIE) firmware provides a series of AT commands which allow developers to build a ZigBee® HA compliant Combined Interface or Control Indicating Equipment without the need for any in-depth knowledge of the ZigBee PRO stack. To assist the user in working with the CICIE AT command set, this document provides step-by-step guidance for some typical usage scenarios. The user can follow the suggested sequence to input AT commands using a serial port communication tool (such as HyperTerminal, Telegesis™ Terminal etc) and run some tests.

This application note briefly introduces several basic and advanced usage scenarios. However, it is recommended that the user check AN1003: TG-PM-0523-CICIE R3xx CICIE AT Command Set for Combined Interface & Control Indicating Equipment for information on the full command set and command syntax.

KEY POINTS

- Discusses the following basic usage scenarios:
  - Forming a HA network and commissioning a HA device to join
  - Commissioning an on/off output device and how to work with it
  - Comissioning a level-controllable device and how to work with it
  - Commissioning an IAS zone device
- Discusses the following advanced usage scenarios:
  - Finding a target HA device in the network
  - Finding more information about a remote device in the network

Current Firmware CICIE R311, Hardware ETRX358USB

1. Introduction

The Combined Interface with Control Indicating Equipment (CICIE) firmware provides a series of AT commands which allow developers to build a ZigBee HA compliant Combined Interface or Control Indicating Equipment without the need for any in-depth knowledge of the ZigBee PRO stack. To assist the user in working with the CICIE AT command set, this document provides step-by-step guidance for some typical usage scenarios. The user can follow the suggested sequence to input AT commands using a serial port communication tool (such as HyperTerminal, Telegesis Terminal etc) and run some tests.

This application note briefly introduces several basic and advanced usage scenarios. However, it is recommended that the user check AN1003: TG-PM-0523-CICIE R3xx CICIE AT Command Set for Combined Interface & Control Indicating Equipment for information on the full command set and command syntax.

Note: Telegesis Terminal provides a pre-configured panel, as shown in the figure below. The user can edit the panel by adding buttons. Once added, clicking the buttons will trigger commands.
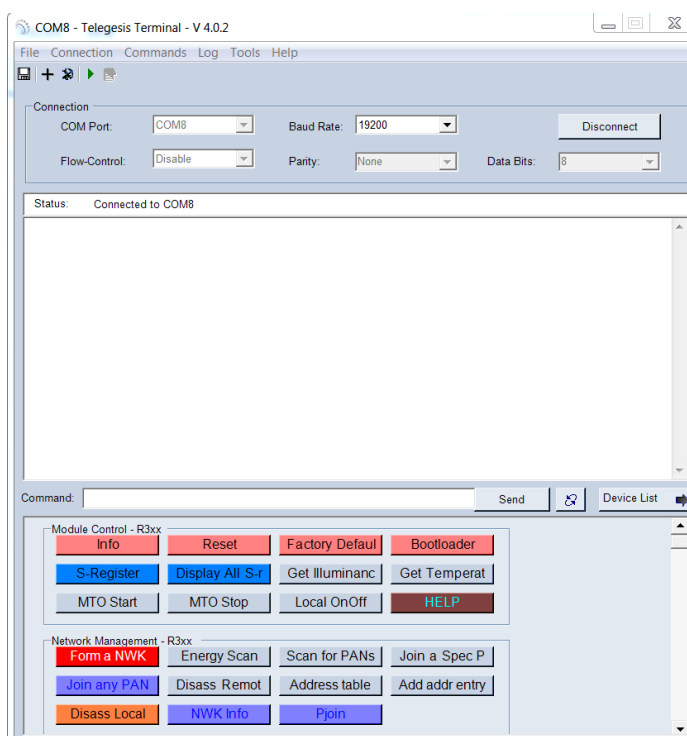
Figure 1.1. Telegesis Terminal for CICIE

When conducting the tests in 2. Basic Usage Scenarios, the user should check that the serial port has been properly connected and the ZigBee module can communicate via serial port communication tool. The user can input "ATI" command and check the response. If the user gets the message, "ERROR:Invalid Parameter Length", check whether the ZigBee module has been equipped with a valid license (input H to access help manual).

Table 1.1. Check Proper Serial Port Connection

Step #	Issue Command	Expected response
1	ATI	Telegesis ETRX358USB CICIE R311 B090316 000D6F0004B91052 OK **Note:** The above response is an example. The information can be different as the build number of the firmware may be incremented when a new version of firmware is released.

2. Basic Usage Scenarios

This section introduces several basic user cases of CICIE.

2.1 Form a HA Network and Commission a HA Device to Join

The CICIE firmware can act as a HA network coordinator (COO) namely it can form a HA network and allow other HA compliant device to join. With assumption that the user is using a CICIE dongle that has not previously formed or joined a network, the user can follow:

Table 2.1. Forming and Joining a HA Network

Step #	Test Step	Expected response	Notes

1	Issue
	
	`AT+EN`
		Example JPAN prompt:
		
		`JPAN:11,1456,717777C765EEC203`
		
		`OK`
			The CICIE forms a network on channel 11, PanID: 0x1234, Extended Pan ID: 717777C765EEC203.

2	Issue `AT+PJOIN`	`OK`	This command will open the formed network for 60 seconds.
3	The user will trigger a join procedure on the joining device (not on any network).	Example prompt after successful join: `FFD:0021ED1000000009,A2DD`	The FFD/SED prompt will show to indicate that a new device has joined to CICIE' network.

2.2 Commission an On/off Output Device and How to Work with It

This section introduces the procedure to commission an on/off output device to CICIE's network and send commands to control on/off. The on/off output device can be a ZigBee light (e.g. Aurora HA bulb) or smart plug (4Noks smart plug).

Note: It is assumed that there are only two devices in this test, CICIE and the joining on/off output device. The two devices are within communication range to each other.

Table 2.2. Commissioning an On/off Output Device

Step #	Test Step	Expected response	Notes

1	Issue
	
	`AT+N`
		Example +N prompt:
		
		`+N=COO,11,3,1456,717777C765EEC20 3`
		
		`OK`
		
		Or
		
		`+N=NoPAN`
			If it shall show:
			
			`+N=NoPAN`
			
			Please follow 2.1 Form a HA Network and Commission a HA Device to Join to form a network first.

2	Issue `AT+PJOIN`	`OK`	This command will open the formed network for 60 seconds.
3	The user will trigger a join procedure on the joining onoff output device (not on any network)	Example prompt after successful join: `FFD:0021ED1000000006,ACC2`	The FFD/SED prompt will show to indicate that a new device has joined to CICIE' network.

4	Issue
	
	`AT+DISCOVER:0006`
		Example DEV prompt:
		
		`OK`
		
		`DEV:ACC2,0A`
			This step is to discover which endpoint on the joined device support onoff server. The response shows that device 0xACC2 supports onoff server on its endpoint 0x0A. The user can use the node ID and endpoint in next step.

5	Issue
	
	`AT+RONOFF:ACC2,0A,0`
	
	(Use the parameters shown after the DEV prompt in the step above.)
		Example response:
		
		`OK`
		
		`DFTREP:ACC2,0A,0006,02,00`
			This step is to send a "Toggle" command to toggle the onoff state of the onoff output device.
			
			When DFTREP prompt is received with last parameter 00(Success status code), the user shall expect the onoff device to be toggled.

6	Issue
	
	`AT+RONOFF:ACC2,0A,0`
		Example response:
		
		`OK`
		
		`DFTREP:ACC2,0A,0006,02,00`
			The user should observe that the device is toggle again (if it was on, now the device should be in off state).

2.3 Commission a Level-controllable Device and How to Work with It

This section introduces the procedure to commission and control a level-controllable output device on CICIE's network. The level controllable output device can be a ZigBee dimmable light.

Note: It is assumed that there are only two devices in this test: CICIE and the joining device. The two devices are within communication range to each other.

Table 2.3. Commissioning a Level-controllable Device

Step #	Test Step	Expected response	Notes
1	Issue AT+N	Example +N prompt: +N=COO,11,3,1456,717777C765EEC20 3 OK Or +N=NoPAN	If it shall show: +N=NoPAN Follow 2.1 Form a HA Network and Commission a HA Device to Join to form a network first.
2	Issue AT+PJOIN	OK	This command will open the formed network for 60 seconds.
3	The user will trigger a join procedure on the joining on/off output device (not on any network).	Example prompt after successful join: FFD:0021ED1000000006,ACC2	The FFD/SED prompt will show to indicate that a new device has joined to CICIE' network.
4	Issue AT+DISCOVER:0008	Example DEV prompt: OK DEV:**ACC2,0A**	This step is to discover which endpoint on the joined device support level control cluster server. The response shows that device 0xACC2 supports the level control cluster server on its endpoint 0x0A. The user can use the node ID and endpoint in next step.
5	Issue AT+LCMVTOLEV:**ACC2,0A**,0,1,FE,0066 (Use the parameters shown after the DEV prompt in the last step.)	Example response: OK DFTREP:**ACC2,0A**,0008,04,00	This step is to send a "MoveToLevel" command to change the level of the level controllable output device to 0xFE (Max level). When DFTREP prompt is received with last parameter 00(Success status code), the user shall expect the device to be dimmed up (more bright if it is a dimmable light).
6	Issue AT+LCMVTOLEV:**ACC2,0A**,0,1,01,0066 (Use the parameters shown after the DEV prompt in the last step.)	Example response: OK DFTREP:**ACC2,0A**,0008,04,00	This step is to send a "MoveToLevel" command to change the level of the level controllable output device to 0x01. When DFTREP prompt is received with last parameter 00(Success status code), the user shall expect the device to be dimmed down.

2.4 Commission a Sensing Device and Configure Report

This section introduces the procedure to commission a sensing device to CICIE's network and configure it to report its measurement periodically. The sensing device can be a ZigBee temperature sensor, illuminance sensor and other similar types of low-power sensors. Note: it is assumed that there are only two devices in this test, CICIE and the joining device. The two devices are within communication range to each other.

Sensing devices usually are sleep end devices, therefore it is recommended that the configuration command should be issued in a short period after the device joins to CICIE to avoid the sensing device going to sleep mode and stops responding to the CICIE.

Table 2.4. Commissioning a Sensing Device

Step #	Test Step	Expected response	Notes

1	Issue
	
	`AT+N`
		Example +N prompt:
		
		`+N=COO,11,3,1456,717777C765EEC203`
		
		`OK`
		
		Or
		
		`+N=NoPAN`
			If it shall show:
			
			`+N=NoPAN`
			
			Follow 2.1 Form a HA Network and Commission a HA Device to Join to form a network first.

2	Issue `AT+PJOIN`	`OK`	This command will open the formed network for 60 seconds.
3	The user should trigger a join procedure on the joining on/off output device (not on any network)	Example prompt after successful join: `SED:0021ED1000000006,ACC2`	The SED prompt will show to indicate that a new device has joined. The user should conduct next step quickly before the sleepy end device goes to sleep mode.

4	Issue
	
	`AT+DISCOVER:0402`
		Example DEV prompt:
		
		`OK`
		
		`DEV:ACC2,0A`
			This step is to discover temperature cluster server.

5	Issue
	
	`AT+CFGRPT:ACC2,0A,0,0402,0,0000,29,0002,0008,0010`
	
	(Use the parameters shown after the DEV prompt in the last step.)
		Example response:
		
		`OK`
		
		`CFGRPTRSP:ACC2,0A,0402,00,00,0000`
			This step is to configure periodic temperature measurement report.

6	Wait for report	`REPORTATTR:ACC2,0A,0402,0000,29,0050`	The user should expect the periodic report.

Notes:

Attribute report command is usually sent via binding. Some sleepy end-device type based sensing devices do binding automatically when they join the network. If REPORTATTR prompt is not shown after step 5 (in above table), the user may need to manually set up a binding on the sleepy end device when the sleepy end device is awake (the user may need to wake up the sleepy end device with some manufacturer specified means e.g. pressing a button). Here is an example command:

`AT+BIND:ACC2,3,0000000000000001,0A,0402,0000000000000002,01`

The user shall replace the parameters ACC2 and 0A to be the sensing device's node ID and endpoint. In addition, the user shall replace the parameter 0000000000000001 to be the sensing device's EUI (this information can be found in step 3). The parameter 0000000000000002 shall be replaced with the CICIE's EUI (please see ATI response).

After issuing the AT+BIND command, the user shall expect a BIND prompt, for example: Bind:ACC2,00. If the status (the second parameter of the BIND prompt), it means that binding has been successfully set up then the user should expect periodic report as shown in step 6.

2.5 Commission an IAS Zone Device

The CICIE firmware supports CIE device type on endpoint 0x02. It can commission a zone device (e.g. a door contact) to join it and allow enrollment. After the device is enrolled, the zone device should report its zone status periodically or upon status change.

When joining the CICIE's network, some zone devices will automatically discover CIE device's EUI and request to enroll. By default, the CICIE will accept the enrollment request and assign a zone ID to the zone device. The CICIE will show "ZONESTATUS" prompt when the zone device sends a command indicating a status change.

Some zone devices require the CIE to set the EUI information to trigger an "enroll" request. The following procedure lists the steps to enroll such a device with the assumption that the user is aware of the requirement of setting CIE's EUI to trigger "enroll".

Table 2.5. Commissioning an IAS Zone Device

Step #	Test Step	Expected response	Notes

1	Issue
	
	`AT+N`
		Example +N prompt:
		
		`+N=COO,11,3,1456,717777C765EEC20`
		`3`
		
		`OK`
		
		Or
		
		`+N=NoPAN`
			If it shows:
			
			`+N=NoPAN`
			
			Follow 2.1 Form a HA Network and Commission a HA Device to Join to form a network first.

2	Issue `AT+PJOIN`	`OK`	This command will open the formed network for 60 seconds.
3	The user will trigger a join procedure on the joining zone device (not on any network).	Example prompt after successful join: `SED:0021ED1000000006,ACC2`	The SED prompt will show to indicate that a new device has joined. The sleep zone device will be in awake state for a couple of minutes. If the user does not set CIE's EUI on the Zone device, some zones device may leave network in about one or two minutes.

4	Issue
	
	`AT+DISCOVER:0500`
		Example DEV prompt:
		
		`OK`
		
		`DEV:ACC2,0A`
			The purpose of this step is to discover the zone cluster server.

5	Issue
	
	`AT+WRITEATR:ACC2,0A,0,0500,0010,`
	`F0,0000000000000002`
	
	(Replace the last parameter 0000000000000002 to be the CICIE's EUI.)
		Example response:
		
		`OK`
		`WRITEATTR:ACC2,0A,0500,00`
			This step sends the CIE address to the zone device in order for the zone device to report its status change.

6	Wait for enroll request.	Example response: `ZENROLLREQ:ACC2,0A,0015,1010`	The user should expect a zone Status Change notification.
7	The zone device will send a notification.	Example response: `ZONESTATUS:ACC2,0A,6410,80`	The prompt should show periodically.

3. Advanced Usage Scenarios

The last section introduced some basic usage scenarios to help users understand some of the AT commands and how to test simple interactions between devices (for example, how to turn a light on and off). This section will introduce more complex scenarios.

3.1 Find a Target HA Device in the Network

In this section, it is assumed that some HA lights have joined the CICIE's network. The user intends to identify the light and find a target light to turn on. The command sequence is:

Table 3.1. Finding a Target HA Device

Step #	Test Step	Expected response	Notes

1	Issue
	
	`AT+DISCOVER:0006`
		Example DEV prompt:
		
		`OK`
		
		`DEV:ACC2,0A`
		
		`DEV:ACC3,0A`
		
		`DEV:ACC4,0A`
			This step allows users to discover all endpoints on the joined device that support on/off server.

2	Issue
	
	`AT+IDENTIFY:ACC2,0A`
		Example response:
		
		`OK`
		
		`DFTREP:ACC2,0A,0003,00,00`
			The user shall observe that one of the three lights is blinking. If the blinking light is the one that the user is looking for, skip to the last step.

3	Issue
	
	`AT+IDENTIFY:ACC3,0A`
		Example response:
		
		`OK`
		
		`DFTREP:ACC3,0A,0003,00,00`
			The user shall observe that one of the three lights is blinking. If the blinking light is the one that the user is looking for, skip to the last step.

4	Issue
	
	`AT+IDENTIFY:ACC4,0A`
		Example response:
		
		`OK`
		
		`DFTREP:ACC4,0A,0003,00,00`
			The user shall observe that one of the three lights is blinking. If the blinking light in steps 2 or 3 was not the target light, this blinking light should be the one the user is looking for.

5	Issue
	
	`AT+RONOFF:ACC4,0A,0`
	
	To toggle the target light.
		Example response:
		
		`OK`
		
		`DFTREP:ACC4,0A,0003,00,00`
			If the user skips to this step from step 2 or 3, then the user shall use the node ID and endpoint used in step 2 or 3 in the AT+RONOFF command.

3.2 Find More Information about a Remote Device in the Network

This section introduce a scenario when the user intends to use CICIE to discover more information from a node on CICIE's network. It is assumed that the user is sending commands to a non-sleepy device. If the user intends to discover information of a sleepy end device, it is suggested that the user shall make sure the sleepy device is awake to receive the following commands.

Table 3.2. Finding More Information about a Remote Device in the Network

Step #	Test Step	Expected response	Notes

1	Issue
	
	`AT+N`
		Example +N prompt:
		
		`+N=COO,11,3,1456,717777C765EEC203`
		
		`OK`
		
		Or
		
		`+N=NoPAN`
			If it shows:
			
			`+N=NoPAN`
			
			Follow 2.1 Form a HA Network and Commission a HA Device to Join and form a network first.

2	Issue `AT+PJOIN`	`OK`	Permits join for 60 seconds.
3	The user will trigger a join procedure on the joining on/off output device (not on any network).	Example prompt after successful join: `FFD:0021ED1000000006,ACC2`	This prompt indicates that a new device has joined to network.

4	Issue
	
	`AT+ACTEPDESC:0021ED1000000006,ACC2`
		Example DEV prompt:
		
		`SEQ:24`
		
		`OK`
		
		`ActEpDesc:ACC2,00,01,0A`
		
		`ACK:24`
		
		It means that the device ACC2 has two active endpoints: 0x01 and 0x0A.
		
		The number in SEQ and ACK prompt are the sequence number contained in outgoing and incoming command. These two prompts are used to track whether a unicast ZDO request received a response. If the request cannot be delivered, the CICIE will show NACK instead of ACK.
			The purpose of this step is to discover the number of endpoints supported by the joining device.

Step #	Test Step	Expected response	Notes

5	Issue
	
	`AT+NODEDESC:0021ED1000000006,ACC2`
	
	(Use the parameters shown after the DEV prompt in the last step.)
		Example response:
		
		`SEQ:25`
		
		`OK`
		
		`NodeDesc:A2DD,00`
		
		`Type:FFD`
		
		`ComplexDesc:No`
		
		`UserDesc:No`
		
		`APSFlags:00`
		
		`FreqBand:40`
		
		`MacCap:8E`
		
		`ManufCode:1010`
		
		`MaxBufSize:52`
		
		`MaxInSize:0052`
		
		`SrvMask:0000`
		
		`MaxOutSize:0052`
		
		`DescCap:00`
		
		`ACK:25`
		
		The response contains information of the remote node. For example: device type, manufacture code, etc.
			The purpose of this step is to send a command to request the node descriptor information.

6	Issue
	
	`AT+SIMPLEDESC:0021ED1000000006,ACC2,0A`
		Example response:
		
		`SEQ:26`
		
		`OK`
		
		`SimpleDesc:ACC2,00`
		
		`EP:0A`
		
		`ProfileID:0104`
		
		`DeviceID:0002v02`
		
		`InCluster:0000,0001,0002,0003, 0004,0005,0006,0600,0704`
		
		`OutCluster:0600,0704`
		
		`ACK:26`
		
		The response contains information about the device type of the endpoint 0x0A of node 0xACC2. Device type 0x0002 means that this device is an onoff output device (maybe a light). Also, the response shows the supported clusters by the endpoint 0x0A of 0xACC2.
			The purpose of this step is to discover the device type and supported clusters on the remote device.

Step #	Test Step	Expected response	Notes

7	Issue
	
	`AT+READATR:ACC2,0A,0,0000,0000,0001`
	
	This command reads the value of basic cluster (cluster ID:0x0000) attributes, ZCL Version (ID:0x0000), and Application Version (ID:0x0001)
		Example response:
		
		`OK`
		
		`RESPATTR:A2DD,0A,0000,0000,00,01`
		
		`RESPATTR:A2DD,0A,0000,0001,00,02`
		
		The response shows the value of the requested attribute.	

4. Conclusion

There may be more complex usage scenarios when the user uses CICIE to develop a control or monitoring device. This document provides some basic scenarios to use the AT commands. It is recommended that the user check AN1003: TG-PM-0523-CICIE R3xx CICIE AT Command Set for Combined Interface & Control Indicating Equipment, as well as the ZigBee Cluster Library and ZigBee HA profile specifications for more detailed information.
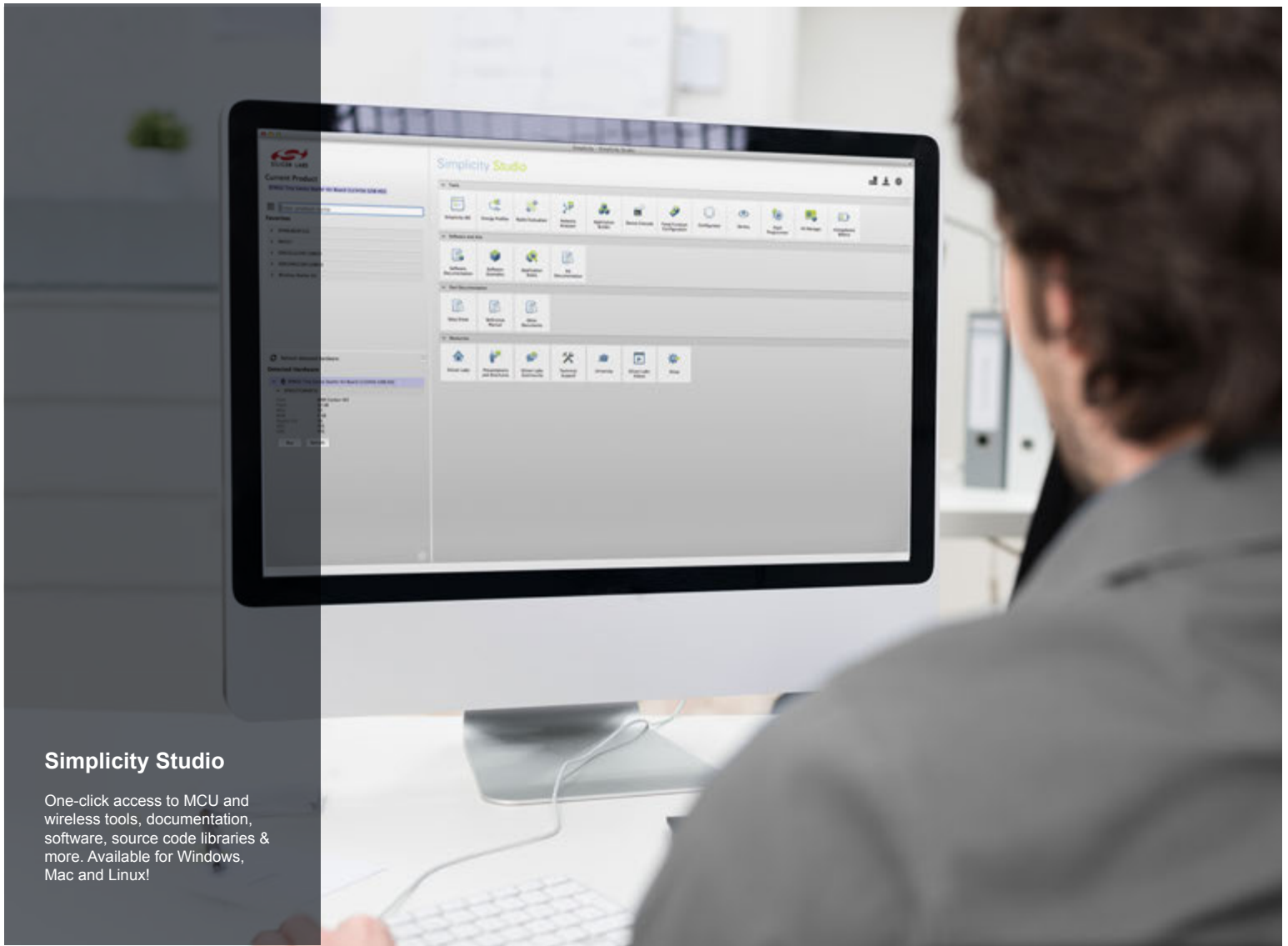
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