# 使用ModusToolbox®构建系统, 灵活应对物联网设计挑战





## Unleash Your IoT-AdvantEdge™ with the Flexible ModusToolbox<sup>®</sup> Build System

Presented by: Harris Chan





- Agenda
- > Flexible and Adaptable ModusToolbox Solutions ©
- > Overview of the ModusToolbox design goals & philosophy
- > Live walk through and demo of ModusToolbox v2.1
  - Sneak peek of the coming ModusToolbox v2.2
- > A real-world ad-hoc, continuous integration and deploy system example
  - Using ModusToolbox make with git and Jenkins
- > What's more?
  - Cirrent IoT Network Intelligence (INI) and Mobile App Intelligence (MAI)
  - Cirrent INI & MAI demo



### Flexible and Adaptable





### ModusToolbox Design Goals

- > Flexible
  - You can use any resource in your own workflow
- > Comprehensive
  - It has the resources you need
- > Atomic
  - You get just what you want
  - Minimal dependencies among the many resources
- > There's a lot of meat here...
  - Our focus is mostly on tools
  - And the build infrastructure
  - We'll talk a bit about all of it

#### AnyCloud Solution Libraries





### What It Does and How It Works

- > All tools are cross-platform: Linux, macOS, Windows
- > Create a project with Project Creator independent of any IDE
  - A folder with everything you need for the project a lot of magic here
- > Add, update, or remove libraries with the Library Manager
  - Includes board support packages (BSPs)
  - Every release of every library is readily available
- > Configurators to set things up
  - Device, CapSense, QSPI, Smart I/O, USB, Bluetooth, Segment LCD
- > Export it all to any supported IDE
  - IAR Embedded Workbench, Keil µVision; Visual Studio Code, Eclipse
- > Includes the Eclipse IDE for ModusToolbox entirely optional
  - You can do all the above (except IDE Export) from within the Eclipse IDE

### Using offline content



- > If a network connection to online resources is not available, you can download a copy of all manifests and content, and then point the tools to use this copy in offline mode.
- > Download ModusToolbox v2.1 offline package, password wvg3 (thanks a lot, Hao)
- https://pan.baidu.com/s/1KKgTFx8DTduizZGdwzZBwQ
- > Extract the modustoolbox-offline-content.zip file and put it into your home directory, for example on Windows, under \$USERPROFILE/.modustoolbox/offline
- To use the Project Creator GUI or Library Manager GUI in offline mode, select Offline from the Settings menu
- > To use the Project Creator CLI in offline mode, execute the tool with the --offline argument. For example:
  - project-creator-cli --board-id CY8CPROTO-062-4343W --app-id mtb-example-psoc6-hello-world --offline
- > To execute the make getlibs target in offline mode, pass the CY\_GETLIBS\_OFFLINE=true argument:
  - make getlibs CY\_GETLIBS\_OFFLINE=true
- Once network connectivity is available, you can use the Library Manager tool to update the ModusToolbox project previously created offline to use the latest available content.

### Create a Project

- > Pick a BSP, then an example
  - Put it where you want
  - Click Create
  - Automatically gets every library and every file
- Driven by manifest files from GitHub
- **For v2.2** 
  - You can pick multiple examples
  - You can share libraries among projects



### Project Creation Background

- Totally transparent it just works >
  - Based on that application's makefile, and its associated .lib file(s)
  - You don't need to know dependencies
  - But you learn what's required
- Typically start with a BSP
  - make getlibs parses the first lib file and gets files
  - Search recursively for .lib files
  - Parse those and get files
  - Lather, rinse, repeat until done

### For v2.2

- Call them .mtb files
- In a *deps* folder (dependencies)
- Instantiated libraries are in the *lib* folder
- Libraries can be shared so each app doesn't have its own complete set

Fetches that repo, finds these .lib files







### All on GitHub

- > All libraries delivered on GitHub
  - https://github.com/cypresssemiconductorco
  - You don't need to clone or copy any library
- > Resources available span hundreds of GitHub repositories
- > Low-level resources
  - E.g. the **make** infrastructure, hardware abstraction layer, driver libraries, etc.
- > BSPs
  - The BSP automatically gets all the low-level resources a board needs
- > Middleware from us or from 3rd parties
  - CapSense, Bluetooth, FreeRTOS, BLE, MQTT, WiFi Connection, Secure Sockets, etc.
- > Examples
  - Example applications automatically include all necessary libraries

### ModusToolbox **make**



- > It is GNU make, with goodies
- > Ease of use designed in
  - e.g. Autodiscovery of source files
- > Multiple targets added to make
  - getlibs, IDE export, create your own BSP, etc
- > For most users, simple to manage
  - Define values for one or more variables
  - Set the variable value and go
  - e.g. TARGET, TOOLCHAIN, APPNAME, etc.
- > For master users, completely flexible
  - You can even add your own make target(s)
- > GUI tools are just a UI on top of this
  - From command-line or UI, the very same thing happens

27	*****
28	# Basic Configuration
29	*****
30	
31	# Target board/hardware
32	TARGET=CY8CKIT-062-WIFI-BT
33	
34	# Name of application (used to derive name of final linked file).
35	APPNAME=mtb-example-psoc6-empty-app
36	
37	# Name of toolchain to use. Options include:
38	ŧ
39	# GCC ARM GCC 7.2.1, provided with ModusToolbox IDE
40	# ARM ARM Compiler (must be installed separately)
41	<pre># IAR IAR Compiler (must be installed separately)</pre>
42	ŧ
43	# See also: CY COMPILER PATH below
44	TOOLCHAIN=GCC ARM
45	-
46	<pre># Default build configuration. Options include:</pre>
47	<b>#</b>
48	# Debug build with minimal optimizations, focus on debugging.
49	<pre># Release build with full optimizations</pre>
50	CONFIG=Debug
51	
52	# If set to "true" or "1", display full command-lines when building.
53	VERBOSE=



### Library Manager

- > Pick a different BSP
- > Add, remove, or update any library
- Instant access to any version of any library
- > For v2.2
  - Some UI changes for shared libraries
- NOTE: Our examples use the "latest", it's easy to lock on a specific release

🍟 Library	Manager 1.2		- D >							
<u>S</u> ettings	<u>H</u> elp									
Directory:	C:/DemoSpace/Hello	_World	Browse							
Project:	C:/DemoSpace/Hello	_World								
Active BSP:	CY8CKIT-062-WIFI-	вт								
Enter filter	text		psoc6pdl							
BSPs	Libraries		The PSoC 6 Peripheral Driver Library (PDL) integrates device							
Name		Version	single package.							
Board BT Min PSoC V V V V V V V V V V V V V V V V V V V	Utils ddleware libraries 6 Base Libraries core-lib psoc6cm0p psoc6hal psoc6make	Latest 1.X release Latest 1.X release Latest 1.X release Latest 1.X release	Version details: Latest 1.X release							
► PSoC	psoc6pdl 6 Middleware	Latest 1.X release								
▶ WiFi N	Aiddleware libraries	1.3.0 release								
		1.3.1 release								
Getting ma	nifests from remote se	1.4.0 release								
#######	*************	1.4.1 release	*******							
Processing	super-manifest https:	1.5.0 release	rco/mtb-super-manifest/raw/v2.X/mtb-super-manifest-fv2.xml							
Successfull	y acquireu the informa	1.5.1 release								
Reading pr Successfull	oject (C:/DemoSpace/ y acquired project info	1.5.2 release								
		1.6.0 release	Update Close							
		1.6.1 release								



### Configurators (e.g. the Device Configurator)

### > Each generates code







### Pick Your IDE

- > There is a make target for each supported IDE
  - make ewarm8 TOOLCHAIN=IAR
  - make uvision5 TOOLCHAIN=ARM
  - make vscode  $\leftarrow$  uses the default GCC TOOLCHAIN
  - make eclipse  $\leftarrow$  for some other Eclipse IDE, not necessary for our IDE
- > See the ModusToolbox User Guide chapter on IDE export for details
  - Details vary per IDE on what to do next
  - The make command tells you what to do





### EXAMPLE: Create a Custom BSP

### > Help built in (you could read the manual <sup>(2)</sup>)

- make help CY\_HELP=bsp

#### jett@AUSLJT2 /cygdrive/c/Users/jett/mtw/Empty\_PSoC6\_App

\$ make help CY\_HELP=bsp Tools Directory: C:/Users/jett/ModusToolbox/tools\_2.1

Topic-specific help for "bsp" Brief: Generates a TARGET\_GEN board/kit from TARGET.

This target generates a new Board Support Package with the name provided in TARGET\_GEN based on the current TARGET. The TARGET\_GEN variable must be populated with the name of the new TARGET. Optionally, you may define the target device (DEVICE\_GEN) and additio nal devices (ADDITIONAL\_DEVICES\_GEN) such as radios. E.g.

make bsp TARGET\_GEN=NewBoard DEVICE\_GEN=CY8C624ABZI-D44 ADDITIONAL\_DEVICES\_GEN=CYW4343WKUBG

### Specify device (and radio if that applies)

- make bsp TARGET\_GEN=NewBoard DEVICE\_GEN=CY8C624ABZI-D44 ADDITIONAL DEVICES GEN=CYW4343WKUBG

#### jett@AUSLJT2 /cygdrive/c/Users/jett/mtw/Empty\_PSoC6\_App

\$ make bsp TARGET\_GEN=MyNewBoard DEVICE\_GEN=CY8C624ABZI-D44 ADDITIONAL\_DEVICES\_GEN=CYW4343WKUBG Tools Directory: C:/Users/jett/ModusToolbox/tools\_2.1

Creating MyNewBoard TARGET from CY8CKIT-062-WIFI-BT... Populating cy8c6xxa linker scripts and psoc6\_02 startup files... Running device-configurator for CY8C624ABZI-D44 CYW4343WKUBG... MyNewBoard TARGET created at ./TARGET\_MyNewBoard





### ModusToolbox in a Continuous Integration/Deployment Environment

### > What environment?

- Headless Ubuntu 18.04 server with:
  - Gitlab
  - Jenkins
  - ModusToolbox 2.1
- Target hardware is CY8CKIT-062-WIFI-BT
- > GNU Make makes it easy!
  - Jenkins build requires two commands
  - Very familiar to any ModusToolbox command line user
- > Let's see it in action (video)!







### Installation

- Installed Jenkins and gitlab on same server
- Took a bit to get Apache (web server), Jenkins, and gitlab all to play nicely
- Otherwise mostly searching and configuring

### > Deployment challenges

- Permissions for USB devices in /etc/udev/rules.d for openocd
- All the various enables and such in Jenkins/gitlab project
  - Gitlab "push webhooks" for example
- > I'm not a devops person
  - ...but I managed to get it working
  - If your team includes devops, it should be easy
  - You should use secure techniques!

Webhook	URL				
Webhooks can be used for binding	http://urack.local:8080/project/webinar-example/				
events when something is happening within the project.	Secret Token				
	Use this token to validate received payloads. It will be sent with the request in the				
	Trigger				
	Push events				
	Branch name or wildcard pattern to trigger on (leave blank for all)				
	This UDL will be delegated have much by the operations.				



### > What's up with all this CI stuff anyway?

- As "embedded development" connects more to the software world, techniques blend
- > Always available artifacts from team
  - A push/merge to master will create the "golden" hex
  - Central location for this one source of truth

### > Testing and more testing

- CI systems can launch test scripts





### Summary

### > Flexible

- Pick your host OS, your IDE,
- Create your project, manage your libraries and versions
- Work in a GUI or from a command line
- Use resources in your own workflow
- You can script it all, drive continuous integration or automated regression testing
- Comprehensive
  - It has the resources you need, hundreds of repositories on GitHub
- > Atomic
  - You can get just the resources you want
- > What better proof than this
  - We provide an outstanding, flexible, project creation and build system
  - If you want, you can completely ignore it
  - Go to GitHub, get the code you need, put it on your company server
  - Use it



### Learning Resources & Links

- > Download ModusToolbox
- > Software on Silicon Blog
  - <u>It's Make Time</u>
  - One Build to Make Them All
- > Running ModusToolbox from the Command Line
- > Managing the Makefile (KBA in the Cypress community)
- > ModusToolbox User Guide
  - The make system, custom BSPs, manifest files, exporting to IDEs, and more
- ModusToolbox Enablement Software Overview (on GitHub)
- <u>Code Examples for ModusToolbox Software</u> (on GitHub)
  - All found automatically by the Project Creator
- > Other Documentation
  - Project Creator Guide
  - Library Manager Guide
  - Device Configurator Guide
  - Eclipse IDE for ModusToolbox User Guide



#### **User Application** ModusToolbox Software For MCU and For Mbed OS For Amazon Bluetooth SOC FreeRTOS **Build System** Infrastructure Bluetooth SDK AwS IoT AwS IoT Program & SecureBoot Enterprise Security Secure Sockets **Debug Support** CapSense Wi-Fi CapSense Eclipse IDE HTTPS USB Device Cirrent Cordio BLE BLE BLE Configurators etc. etc. etc. Tools Board Support Packages (BSPs) Utilities Hardware Abstraction Layer (HAL) Wi-Fi Host Driver (CYW43xx) PSoC 6 Peripheral Driver Library Included in the Delivered by Delivered by a 3<sup>rd</sup> Party ModusToolbox Installer Cypress on GitHub

### > Cirrent

- IoT Network Intelligence (INI)
- Mobile App Intelligence (MAI)





## Identify & Solve Connected Product Issues Faster

Gartner. COOL VENDOR

### MAKING YOUR PRODUCTS EASIER TO USE, MORE RELIABLE, MORE SECURE

#### **Connected Product Experts**

Cirrent is 100% focused on solving problems plaguing IoT products, including connectivity issues. We help you deliver better products, faster with our purpose-built solutions.

#### **Full Stack Expertise**

Leaders in Wi-Fi Chips and strong expertise in embedded, app and cloud software







A SUBSIDIARY OF



### CUSTOMER EXPERIENCE IS CRITICAL AND YOU HAVE NO VISIBILITY

33% of consumers said ease of use is the key factor when buying an connected product

#### Yet 83% of consumers have difficult connecting their devices









Lack of visibility to devices in the field makes it hard to debug issues



### PROBLEMS THROUGHOUT YOUR PRODUCT LIFECYCLE

#### **New Product Launch**

- Long and unpredictable cycles → 60%+ projects delayed
- Challenging debug
   process
- Bugs escape to the field

#### App and Firmware Releases

- Slow rollout of patches and new features
- Hard to do A/B testing and rollbacks
- Bugs escape to the field

#### **Field Issues**

- No visibility into devices in the field
- Hard to solve customer issues like onboarding → bad reviews, lower sales, returns
- Challenging debug process

Pre Launch

Post Launch



### VALUE OF THE CIRRENT PLATFORM



#### **Reduce Development Cost**

Quicker problem identification and solution

Make better, data-driven decisions

#### Accelerate Time to Market

Focus engineering on high-value product features

Deliver quality products faster

#### **Optimize Customer Experience**

Better user experience

Reduce negative reviews and product returns



### CIRRENT PLATFORM IMPROVES YOUR CONNECTED PRODUCTS

#### Mobile App Intelligence

- Monitor onboarding issues with mobile apps
- Measure where users drop off in mobile app
- Improve connection rates by fixing issues
- Measure impact after fixing issues

## Application Performance

### Monitoring

- Monitor application code issues using Custom Events
- Monitor system resource
   usage
- Measure impact of each issue
- Diagnostics to get system logs

### IoT Network Intelligence

#### Network Performance Monitoring

- Identify and prioritize network problems
- Discover shared attributes of impacted devices
- Measure impact on customers
- Diagnostics to dig deeper



### HOW THE CIRRENT PLATFORM WORKS







DEMO



### Cirrent Mobile App Intelligence (MAI) App Inspector





### Cirrent Mobile App Intelligence (MAI) App Deep Dive

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	Step	Duration	Next step						
0 Start C	nboarding	2000	1 Find Devices						
1 Find D	vices	12000	2 Connect Via Bluetooth						
2 Conne	: Via Bluetooth 6000		3 Get Device Info						
3 Get De	rice Info	10000	4 Setup Device Manually						
4 Setup	4 Setup Device Manually 20000		5 Send Credentials Via Bluetooth						
5 Send C	edentials Via Bluetooth	9000	6 Perform Bind Process		<pre>ne: "1_find_devices", CirrentApplication.getAppContext(),</pre>				
6 Perfor	Bind Process	2000	-20						
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	iem iem								



### Cirrent IoT Network Intelligence (INI) Console





**CASE STUDIES** 

### CASE STUDY: MOBILE APP INTELLIGENCE

#### **Products: Connected Appliances using Bluetooth for Wi-Fi onboarding**

Onboarding By Phone OS	*	Success Rate by Phone and App						
		Os	Phone Model	App Version	App Count	Success Rate		
		android 9	Xiaomi Mi MIX 2	1.4.6 Build 40				
		android 9	samsung SM-G950U	1.4.6 Build 40				
		android 9	motorola moto g(7)	1.4.6 Build 40				
Success rate		ios 13.4.1	iPhone12,5	1.4.6				
		android 8.0.0	samsung SM-G935F	1.4.6 Build 40				
		android 10	Xiaomi Mi MIX 2S	1.4.6 Build 40				
		ios 13.5	iPhone12,5	1.4.6				
		android 9	HMD Global TA-1004	1.4.6 Build 40				
		android 9	samsung SM-J530FM	1.4.6 Build 40				
		android 9	samsung SM-G950F	1.4.6 Build 40				
		android 8.1.0	motorola Moto G (5)	1.4.6 Build 40				
ios	android	android 10	Xiaomi Mi A2	1.4.6 Build 40				
		android 9	samsung SM-J530FM	1.4.5 Build 39		•		

#### Low Success rate for onboarding on both iOS and Android





### CASE STUDY: MOBILE APP INTELLIGENCE



Using filters, confirmed that main issue exists in varying degrees across all iOS and Android versions and all phone models



### CASE STUDY: MOBILE APP INTELLIGENCE





### CASE STUDY : APPLICATION PERFORMANCE MONITORING

#### **Products: Linux based Smart Camera and TV with INI installed**





### CASE STUDY: APPLICATION PERFORMANCE MONITORING

By Attribute view revealed problem was limited to Smart Cameras. Device List showed significant % of Smart Cameras showed High CPU Usage.



**Device List** 

**Bv** Attribute

#### Root Cause: Code diff and several tests revealed bug (semaphore issue) in firmware



By Environment

### CASE STUDY: APPLICATION PERFORMANCE MONITORING

Fast time to resolution: 1 day to identify and solve the issue



### CASE STUDY: INI NETWORK PERFORMANCE MONITORING

#### **Products: Android based POS device with Wi-Fi and GPRS interfaces**





### CASE STUDY: INI NETWORK PERFORMANCE MONITORING

Problem 1: Device List shows that top devices have the same problem signature. Wi-Fi Not Associated count is same as Running count

Metrics Summary					
Events per day	Time Window	Last day	Last 7 days	Last 30 days	
Dns Error	0	0	0	0	
Gateway Internet Error	0	0	0	0	
Running	537.27	1320	287.14	537.27	
High Per	0	0	0	0	
Wifi Associating	0	0	0	0	
Gateway Error	0	0	0	0	
Bssid Switch	0	0	0	0	
Low Signal Strength	0	0	0	0	
Wifi Not Associated	537.27	1320	287.14	537.27	

## Valuable insights to save costs

Root cause: Device is connected via GPRS and not Wi-Fi

Fix: App change to encourage users to stay on Wi-Fi



### CASE STUDY: INI NETWORK PERFORMANCE MONITORING

#### Valuable insights to improve user experience

ny Eirar	~ + Add 1	iters ~	Reset									E April 30, 2020	- May 30, 2020 *	
Over Time				By Attribute			Device List				By Environment			
10W 22 rins @						5.8	NGF EDUNT - 281 RF	10.00		AVALADA MP	NIC COUNT BE AT		Customire Table	
Device ID	Average Metri	Device Type Name	Ca Version	Region	Os Distribution	isp	Router Brand	Country	Asn	City	Os Version	Router	Router Brand Mod	
302P98540	1120.12	Cloud Printer	WCM_1.24	Zhojiang	#1 PREEMPT	Chinanet	Huawei Tech	CN	4134	Lishui	Linux 3.10.14	Huawei Tech	Huamei Tech	
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302201540	605.52	Cloud Printer	WCN_1.24	Zhejlang	#1 PRIEMPT	Chinanet	TP-Link	CN	4134	Ningho	Linux 3.10.14	TP-Link_TL	TP-Link_TL	
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302203L40	561.13	Cloud Printer	WCM_1.24	Qinghai	#1 PREEMPT	Chinanet	Shenzhen YO	CN	4134	Nomhon	Linux 3.10.14	Shenzhen YO	Shenzhen YO	
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302P98540	455	Cloud Printer	WCM_1.24	Zhojiang	#1 PREEMPT	Chinanet	MERCURY	CN	4134	Shaoxing Shi	Linux 3.10.14	MERCURY_D1	MERCURY_D1	
302P98T40	568.3	Cloud Printer	WCM_1.24	Guangdong	#1 PREEMPT	Chinanet	Huawei Tech	CN	4134	Guangzhou	Linux 3.10.14	Huawei Tech	Huanei Tech	
3029988740	367	Cloud Printer	WCNUL24	Lisoning	#1 PREEMPT	CNC Group C	Huawel Tech	CN	4837	Chaoyang Sh	Linux 3.10.14	Huswel Tech.	Hussel Tech	
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302998740	337.33	Cloud Printer	WCN_3.24	Beijing	#1 PREEMPT	China Networ	SUNMI	CN	4847	Beijing (Haidi	Linux 3.10.14	SUNM_SUN	SUNM_SUN	
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302203L40	S01	Cloud Printer	WCM_1.24	Guangdong	#1 PREEMPT	China Mobile	ZTE	CN	56040	Guangzhou	Linux 3.10.14	ZTE_E8820V2	ZTE_E8820V2	
302203K40	289.58	Cloud Printer	WCM_1.24	Zhejiang	#1 PREEMPT	China Mobile	HUAWEI TEC	CN	56041	Hangzhou	Linux 3.10.14	HUAWEI TEC	HUAWEI TEC	
302201040	283.77	Cloud Printer	WCM_1.24	Guangdong	#1 PREEMPT	China Mobile	XEROX CORP	CN	9808	Guangzhou	Linux 3.10.14	XEROX CORP	XEROX CORP	
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Signature: Intermittent DNS Errors

Root Cause: Further investigation revealed config issue causing caching of stale DNS entries





### Cirrent Platform Launch Program

Applicable for companies launching new products, apps or firmware.



### Mobile App Intelligence

Get started quick! No changes to embedded code -- only the mobile app.





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