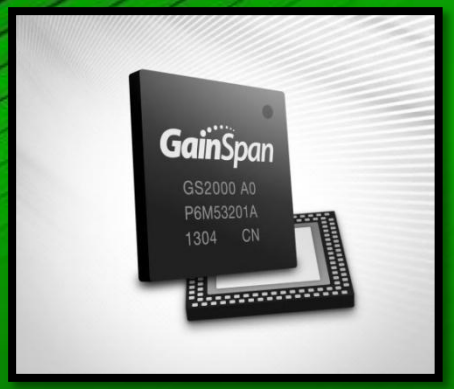
IP Everywhere…

Ultra Low Power Wi-Fi
for Embedded Applications



Wireless Connectivity for NXP-based IoT Designs Made Easy!

Getting Connected with GainSpan®

Agenda

- What Makes Wireless Connectivity to an IoT Device Difficult?
- GainSpan's Solutions to IoT Challenges
- GainSpan Module Product Portfolio
- GainSpan NXP Smartphone demo
- Summary – Putting the pieces of the puzzle together
- Q & A

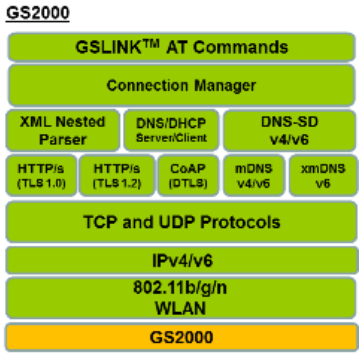
Wireless IoT Connectivity, Easy?

What Makes Wireless IoT Connectivity Difficult?

GainSpan's Solutions to IoT Challenges

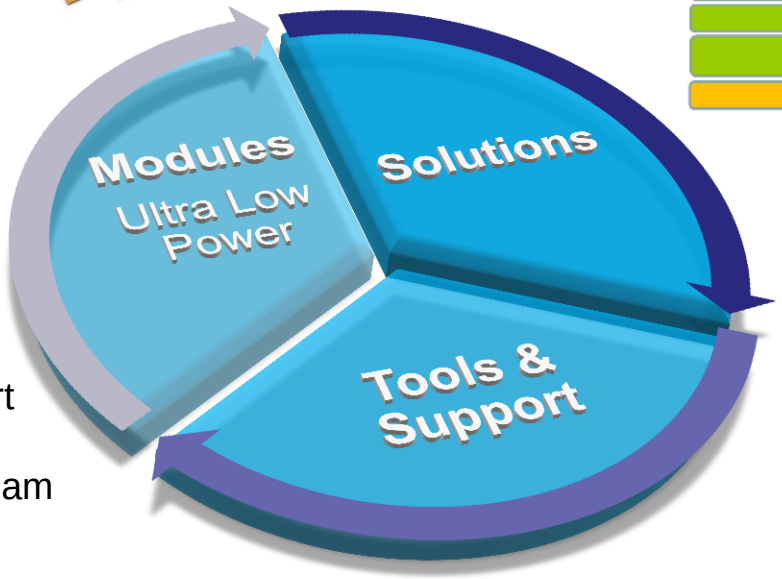
Module Family

- Based on GS2000 SoC
- Certified
- Size Optimized
- Ultra Low Power



Architectures

- Hosted
- Hostless



AE/FAE Support

- Worldwide Technical Support Team
- Worldwide Sales Support Team

Embedded Firmware

- Complete IoT embedded software
- Serial to Wi-Fi
- Provisioning, OTA updates
- Cloud connectivity

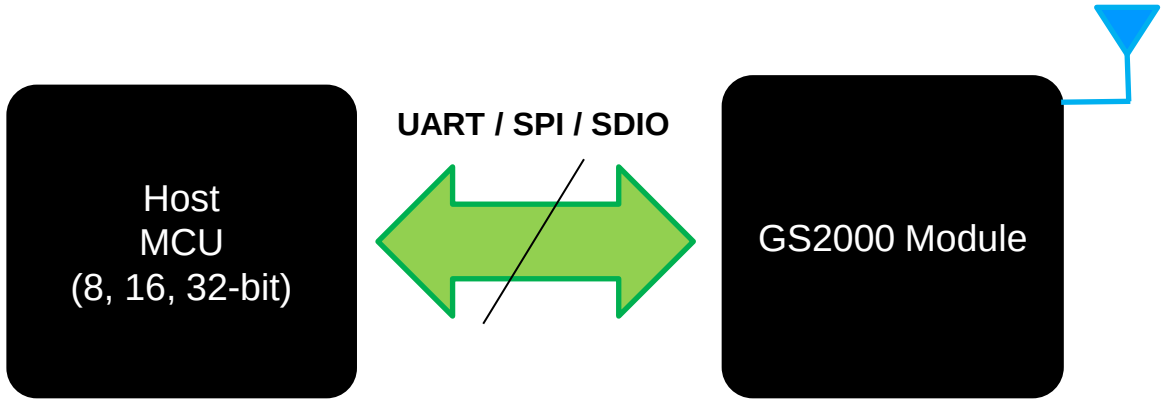
Application Specific Reference Designs

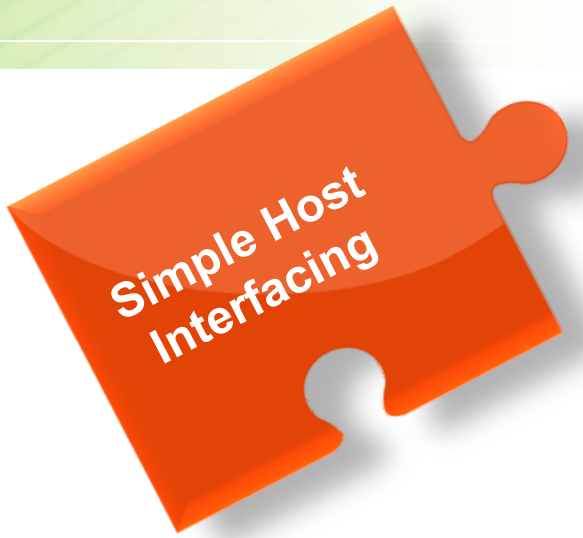
- Mobile apps, embedded code, hardware
- Cloud connectivity

GS2000 Module Family

Description	GS2011MIE GS2011MIZ	GS2011MIES GS2011MIPS	GS2100MIE GS2100MIP	GS2200MIZ	GS2101MIE GS2101MIP	GS2011MED
Application Type	**Battery / Line powered**	**Battery / Line powered**	**Cost sensitive line powered**	**Size Optimized Battery / Line powered**	**Battery / Line powered**	**Battery / Line powered**
Wi-Fi Standard	802.11 b/g/n @ +16dBm output	802.11 b/g/n @ +16dBm output	802.11 b/g/n @ +16dBm output	802.11 b/g/n @ +14dBm output	802.11 b/g/n @ +16dBm output	802.11 b/g/n @ +18dBm output *High Tx output across data rates*
Operating Voltage	2.7V – 3.6V	2.7V – 3.6V, 1.8V I/O option	2.7V – 3.6V	3.0V – 3.6V, 1.8V I/O option, External regulator option for low power	2.7V – 3.6V	2.7V – 3.6V
Debug port	**JTAG**	NA	**JTAG**	**JTAG**	**JTAG**	**JTAG**
ADC 12-bit	2 channel	1 channel	NA	1 channel	NA	2 channel
ADC 16-bit	NA	NA	3 channel	1 channel	3 channel	NA
Flash Size	**4MB**	2MB	2MB	**4MB**	**4MB**	**4MB**
GPIOs	27	24	16	19	16	27
Antenna Options	Chip: GS2011MIZ U.Fl: GS2011MIE	PCB: GS2011MIPS U.Fl: GS2011MIES	PCB: GS2100MIP U.Fl: GS2100MIE	Chip: GS2200MIZ	PCB: GS2101MIP U.Fl: GS2101MIE	U.Fl: GS2011MED **Antenna Diversity**
Dimensions	32.5 x 22.8 x 3.63 (mm)	28.7 x 19.4 x 3.35 (mm)	25 x 18 x 2.5 (mm)	17.85 x 13.5 x 2.13 (mm)	25 x 18 x 2.5 (mm)	32.5 x 22.8 x 3.63 (mm)

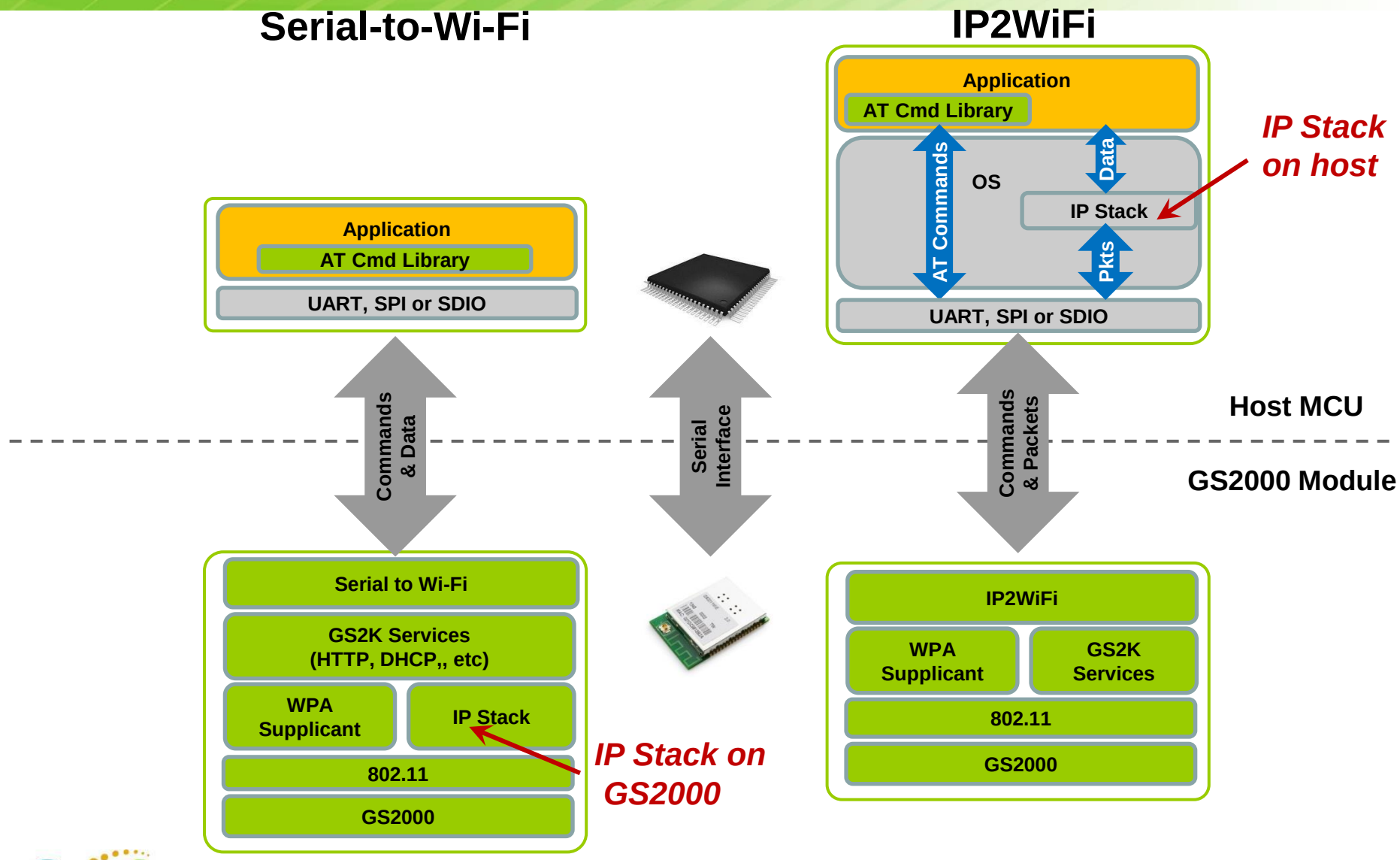
GainSpan's Simple Host Interface





- **UART**
  - Up to 921K baud
- **SPI DMA**
  - Up to 10MHz
- **SDIO Slave**
  - Up to 33MHz
- **Dual Interface Mode**
  - Separate dedicated interfaces for control and data (e.g. UART, SPI)

Host MCU / GS2000 Software Interface Options



GainSpan - NXP MCU Reference Software for GS2000

Reference Software

- C source code
- GS2000 interface drivers
- AT Command processing library

Serial to Wi-Fi

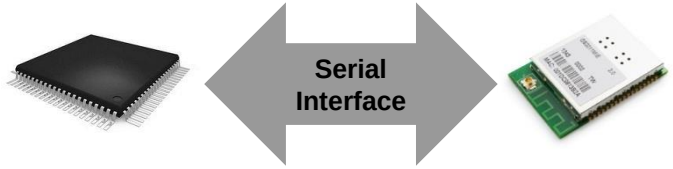
- Industry's most comprehensive AT Command Library
- Software Running on GS2000
- No RTOS or stack required on NXP host MCU
- Low Development Effort / Fastest Time to Market / Lowest BOM Cost

IP to Wi-Fi (for larger hosts)

- Stack running on MCU
- Support patch for Kinetis SDK
- Linux on i.MX

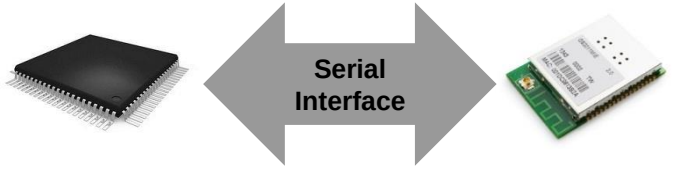
MCU	Interface	S2W	IP2W	IDE	Host RTOS
Kinetis K60/K53/K40	UART/SPI	x		IAR	n/a
Kinetis K60/K53	UART/SPI		x	CW/IAR	MQX 4.1
Kinetis L	UART/SPI	x		IAR	n/a
Kinetis (with KSDK)	UART/SPI	x		IAR	n/a
Kinetis (with KSDK)	UART/SPI		x	IAR	MQX
i.MX	SDIO	x		IAR	Linux
i.MX	SDIO		x	IAR	Linux
LPC17/18/40/43	UART/SPI	x		IAR	n/a
LPC17/18/40/43	SDIO	x		IAR	n/a
Others					

Host Communication Interface Modes



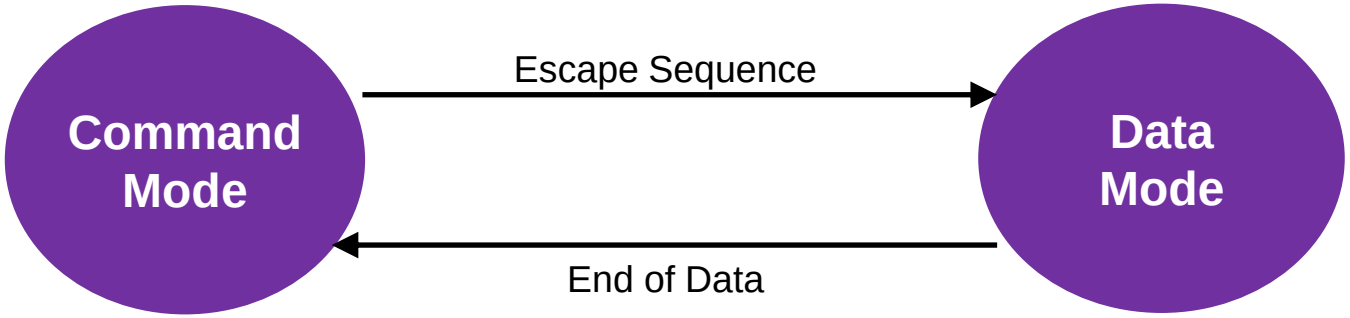
Receive commands from host

- Scan
- Report RSSI
- Open TCP Socket

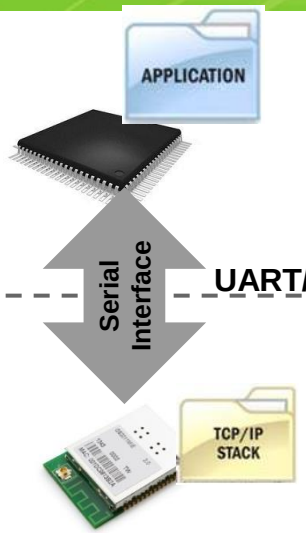


Receive data from host

- TCP Data
- UDP Data
- HTTPS Data



GainSpan Software: Built-in Protocols and Services



UART/SPI/SDIO

Application Code

GSLINK™ AT Commands

UART, SPI, SDIO Drivers

GSLINK™ AT Commands

Connection Manager

Apple HomeKit (Protocol &Profiles)

Apple WAC

Apple Session Security

XML Nested Parser

JSON Parser

DNS/DHCP Server/Client

DNS-SD v4/v6*

HTTP/s (TLS 1.0/1.2)

mDNS v4/v6*

xmDNS v6

TCP and UDP Protocols

IPv4

IPv6 (HomeKit)

802.11b/g/n WLAN

STA + AP Concurrent Mode

GS2000

Built-in Protocols and Services

GainSpan Makes Embedded Networking Stack Easy!

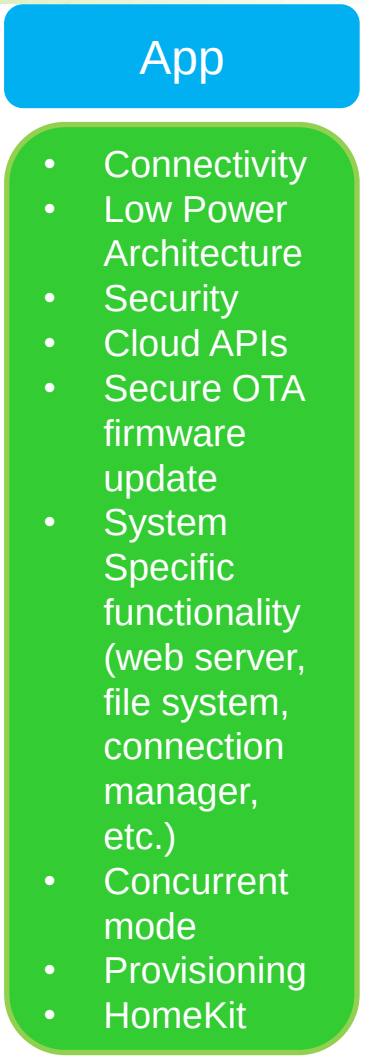
From Scratch Design

- Long design cycles
- Not field proven until deployment
- Multiple code base to maintain
  - Host MCU
  - Module (stack + WLAN)
- Limited flexibility on MCU platform choices

GainSpan Software

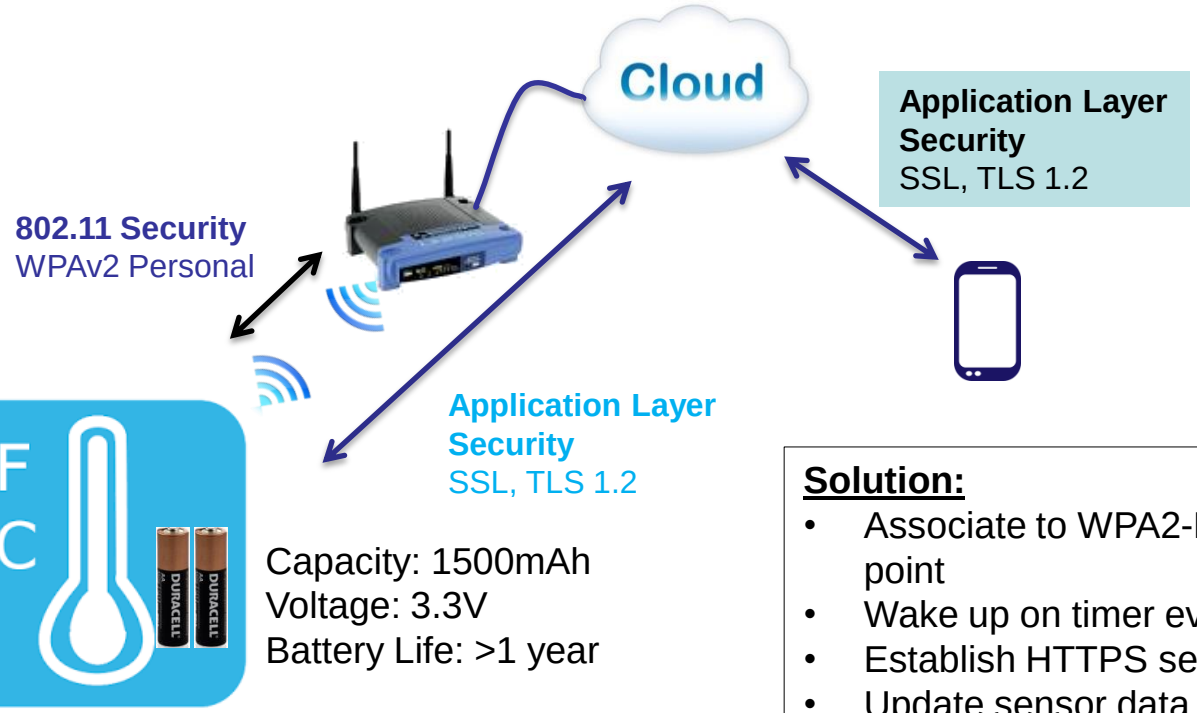
- Compete system built for IoT solution
- Built in Wi-Fi net. Stack
- Field proven solution
- Low Power System Architecture
- Security is thought through
- Developer focuses only on their App development

From Scratch



GainSpan Software

Battery Powered Wi-Fi



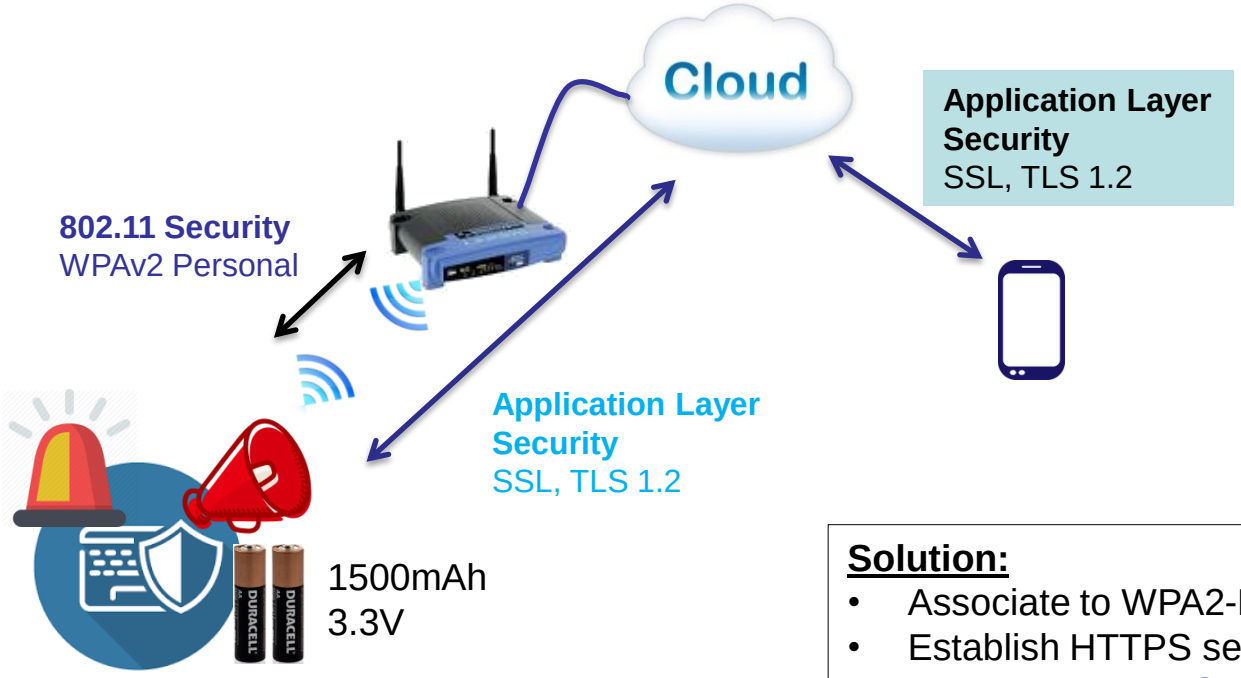
Capacity: 1500mAh
Voltage: 3.3V
Battery Life: >1 year

Solution:

- Associate to WPA2-PSK secured access-point
- Wake up on timer event
- Establish HTTPS session with cloud server
- Update sensor data to cloud server
- ***Transition in to GainSpan's Industry leading Ultra low power mode***

Wakeup (mins)	Battery Life (Years)
0.5	1.38
3	5.91
5	8

Smart Intrusion Detector

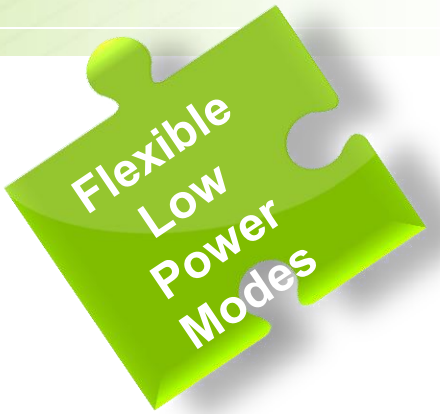


Wakeup (mins)	Battery Life (Years)
5	0.75
30	4.5
60	8.8

Solution:

- Associate to WPA2-PSK secured access-point
- Establish HTTPS session with cloud server
- ***Transition in to GainSpan's Industry leading Ultra low power mode***
- Wake up on timer expiry
- Wake up on motion

GainSpan' Industry Leading Ultra Low Power Modes



- **Hibernate Mode (260nA long term avg)**
  - External wakeup
    - Asset Tracking Tags
    - Data Loggers,
    - Sensors (Intrusion detection, occupancy, motion etc.)
- **Standby Mode (2.4 – 8μA long term avg)**
  - External & Timer wakeup
    - Periodic cloud connectivity e.g. Door Bells, Video Cameras, etc.
- **Deep Sleep Mode (470μA long term avg)**
  - External & Timer wakeup, SRAM state maintained
    - Continuous network connectivity / Real time
    - Door Locks, Garage Doors
- **CPUs Running (~12 mA)**
- **Radio Transmitting (~300 mA)**

- **Fast Wake Up from Standby** (~10ms)
  - Wake-up on timer (Real-Time Clock)
  - Wake-up on external events (alarm pins)

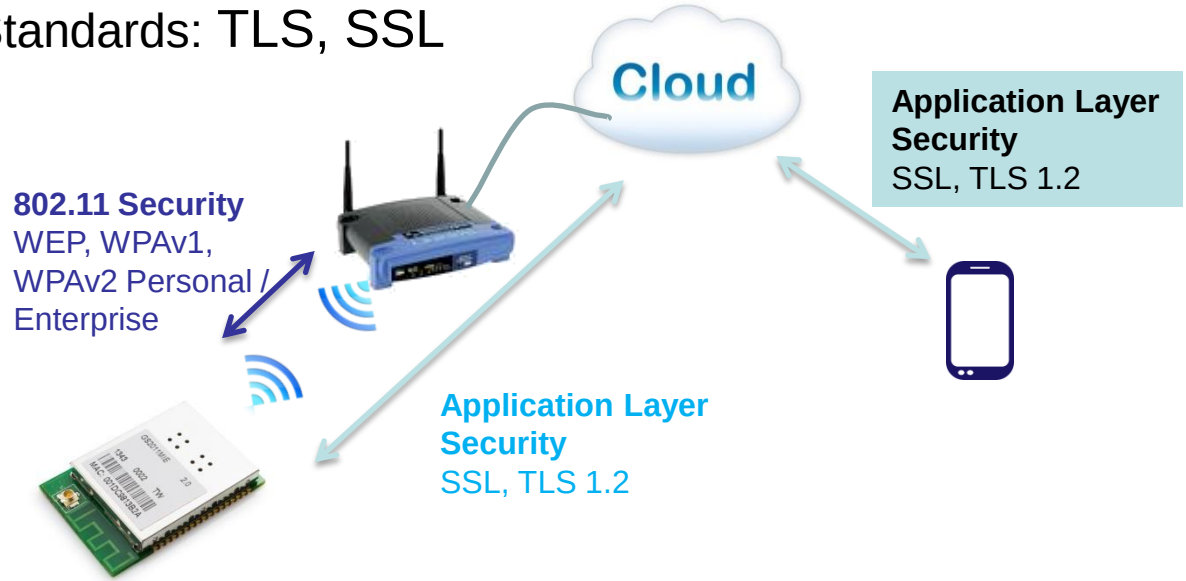
IoT Security Overview

❑ Over the Air Security

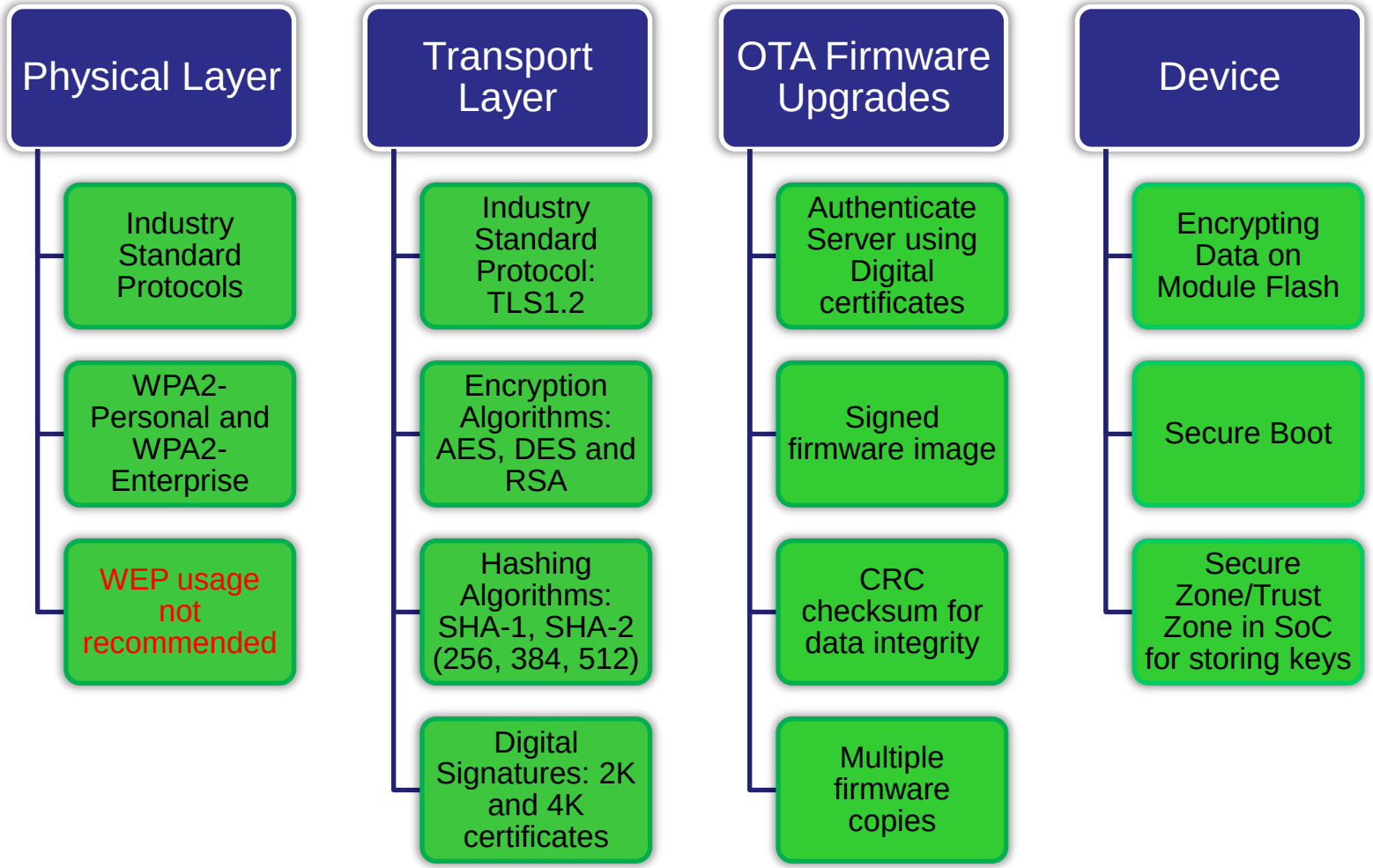
- From Station to AP
- Standards: WEP, WPA Personal / Enterprise

❑ End to End Application Security

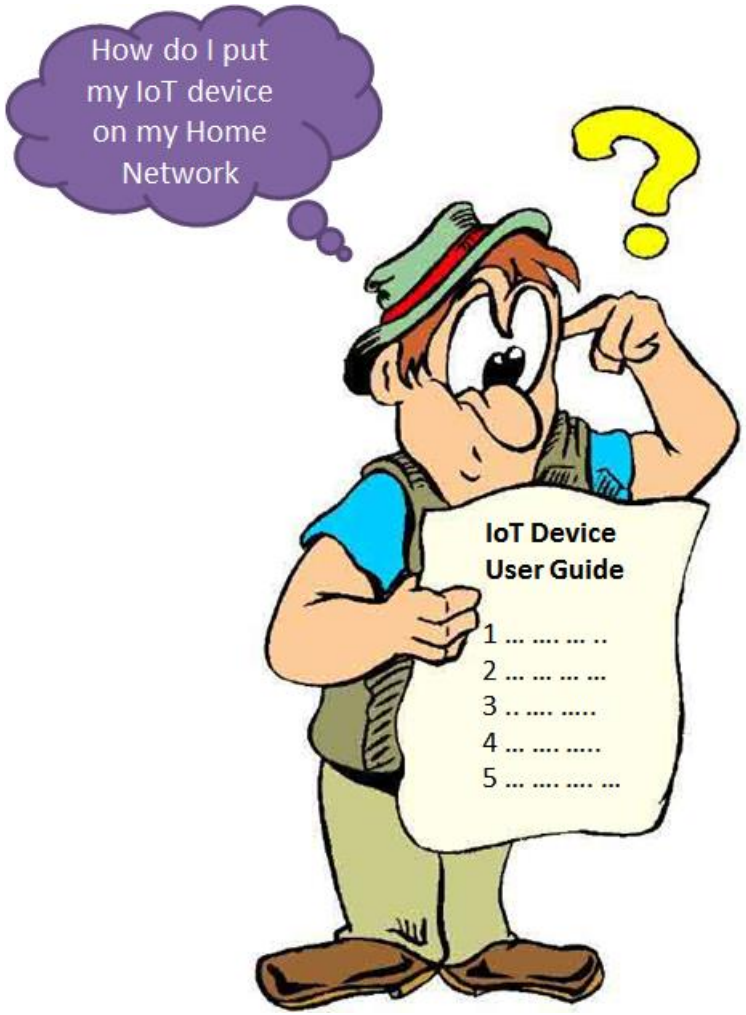
- From One Device to Another
- Standards: TLS, SSL



Security on a Systems level



Provisioning Techniques



Provisioning Support

GainSpan's Patented Provisioning Techniques

- **Limited AP mode**
  - Come up at Limited AP mode
  - Mobile App pushes network credentials
  - Reboot into station mode
- **Wi-Fi Protected Setup**
  - Push Button on Router
  - Push Button on IoT Device
- **Apple WAC Protocol**
  - Use iOS framework
  - iPhone already provisioned onto Home network
  - Provides success / failure feedback

- **Concurrent Mode Provisioning**
  - Come up in Limited AP mode
  - Mobile App pushes network credentials
  - Initiate station interface while maintaining Limited AP interface
  - Success / failure feedback
- **Group Provisioning**
  - Come up in special unprovisioned mode
  - From Mobile App, push network credentials to all devices
  - Sequentially connect to each device and provision

Embedded User Interface

Pros

- Slower changes in Browser versions
- Similar feel across platforms

Cons

- Updating UI requires field update of already deployed devices
- Stricter memory requirements on IoT device for graphics, images, etc.

Pros

- High resolution phone interface
- Lighter memory requirements on IoT device
- Easier to update UI

Cons

- Requires App installation on user's phone
- Support multiple OS versions

Firmware Updates

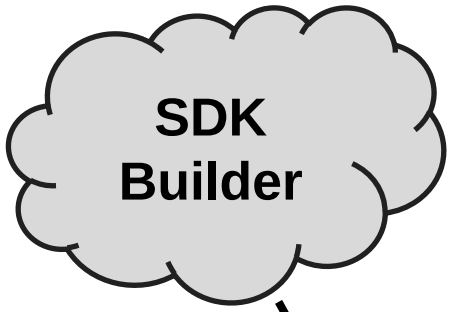
- Download new features
- Maintenance updated (e.g. Bug fixes)
- Firmware download options
  - Via Cloud
  - Locally via smartphone App by service tech
- Secure Firmware updates
  - Verify identity of server
  - Verity firmware image not tampered with
  - Verify firmware image not corrupted during download
- Maintain multiple copies of firmware images
- Option to default to factory image

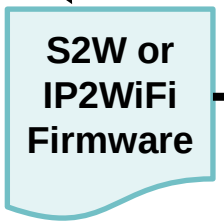
Tools – SDK Builder, Dev. Kits, Solutions

- **Customized S2W builds**
  - Choose MCU interfacing methods
  - Configure serial interface (e.g. UART settings)
  - Choose network setting defaults (e.g. SSID)
  - Customize web page logos

SDK Builder – Free binary Customizations

Build customized Serial-to-Wi-Fi firmware via GainSpan's website





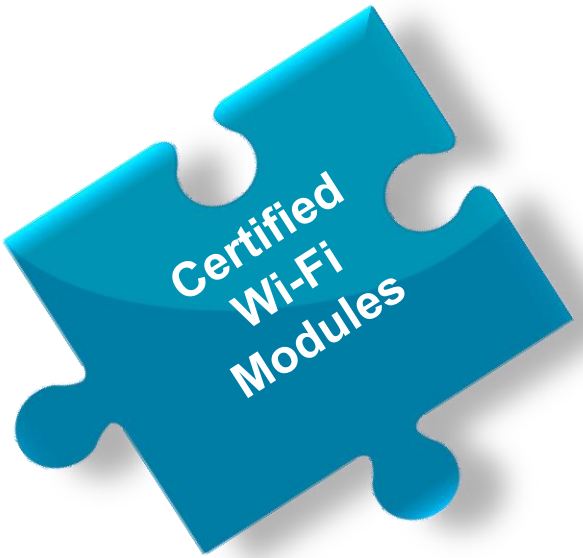
- Log in to support portal
- Choose MCU interface method
- Configure settings (e.g. UART settings)
- Initiate build

- Download firmware (includes documentation and flash programmer utility)

- Program firmware into GS2000 module

Certified Wi-Fi Modules

- All modules calibrated and RF optimized for best performance
- Integrated antennas and option for external antenna via U.Fl. Connector
- Saves ~$30K in certification costs and RF expertise
- Global certifications:
  - U.S. (FCC)
  - Europe (CE)
  - Canada (IC)
  - Japan (MIC)
  - China (SRRC)
  - Korea (KCC)



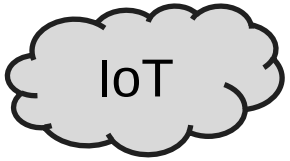
Interoperability Amongst Wi-Fi Devices

- ❑ **AP Compatibility Testing**
- ❑ **Smartphone Compatibility Testing**
- ❑ **Wi-Fi Alliance Certification**
  - Hardware (SoC and Modules)
  - Software stack and services

GS2000 Development and Factory Tools

Reference Application

Mobile Application



3rd-Party Cloud

Development Tools

Evaluation Board

SDK Builder

Documentation

NXP-Compatible GainSpan Wireless Adapter Boards

GainSpan Wi-Fi Adapter Boards

Shield
- SPI/ UART

PMOD Adapter Board
- SPI/ UART

SD Card
- SDIO

Tower Peripheral Card
- SPI/ UART

NXP Development Platforms

Freedom
- Kinetis

Sabre
- i.MX

LPCXpresso
- LPC

Tower System
- Kinetis

GainSpan's Solutions Reference Designs

MCU Host Integration

Video

Apple HomeKit

Cloud Connectivity

HD Music

Low Power Sensor

Thermostat

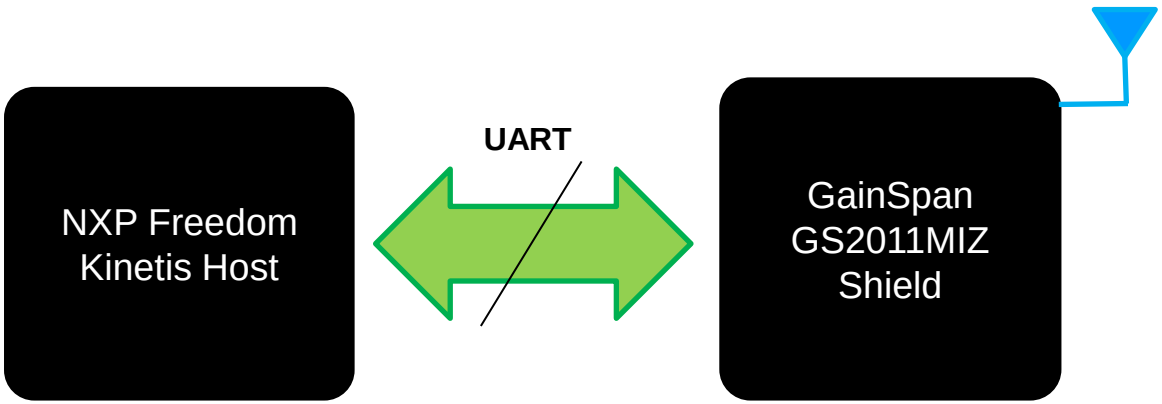
Smart Plug

NXP / GS2000 Reference Software Demo

Smartphone

NXP Kinetis Freedom Board
+
GainSpan Wi-Fi Shield

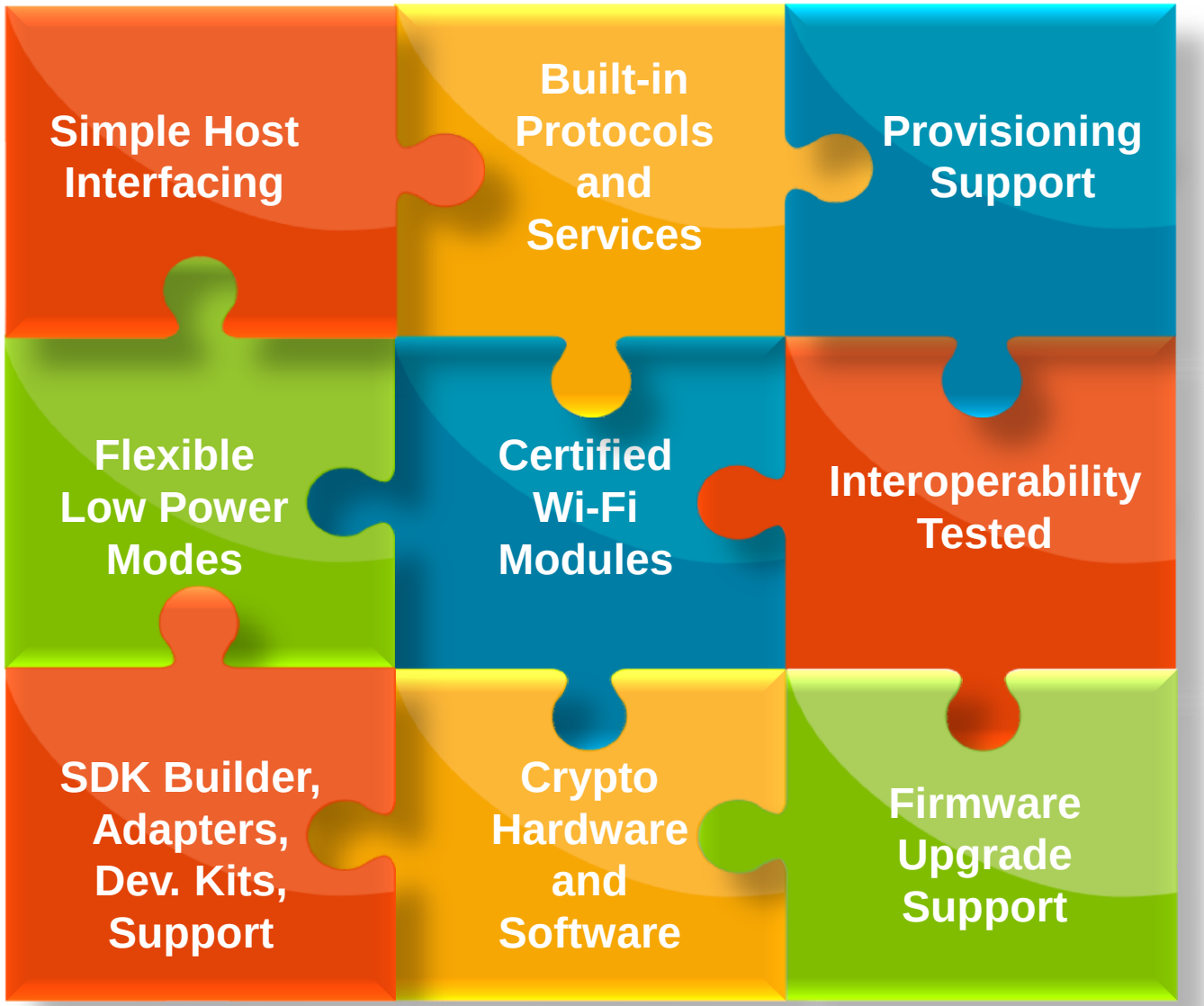
Demo Description



- Host Application
- Touch Sensor
- LED Interface

- GainSpan Networking Software
- Limited AP mode
- Device Discovery
- Cloud Connectivity

GainSpan: Wireless IoT Device Connectivity Made Easy!








THANK YOU

Rohit Bhola

Product Marketing Manager

Contact Info: Rohit.Bhola@GainSpan.com

Come See us in Technology Lab: Section 113

Imagine.
IP Everywhere…

Questions