WELCOME

This webinar will start at 07:00am PT

Sensors, thermostats, and cloud-based control – why the future for HVAC is Wi-Fi

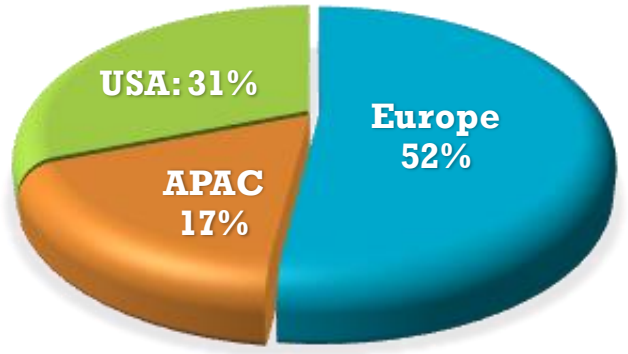
A Dialog VirtualZero ™ Webinar

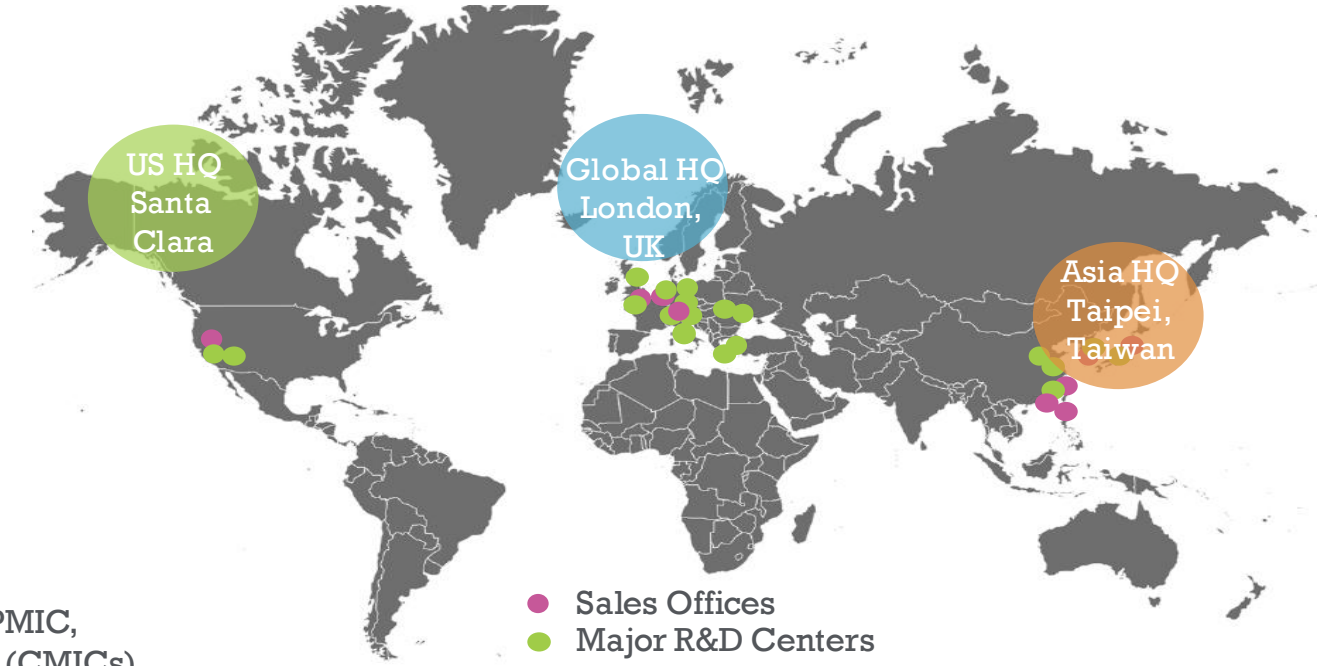
MAY 27TH, 2021

About Dialog

Global design centers coupled with local sales and expert field application support

Employees globally[1]





Dialog Organization

1. Advanced Mixed Signal: AC/DC, power conversion, PMIC, Backlight drivers, SSL and Configurable Mixed-signal ICs (CMICs)

2. Custom Mixed Signal: Custom mixed signal ICs

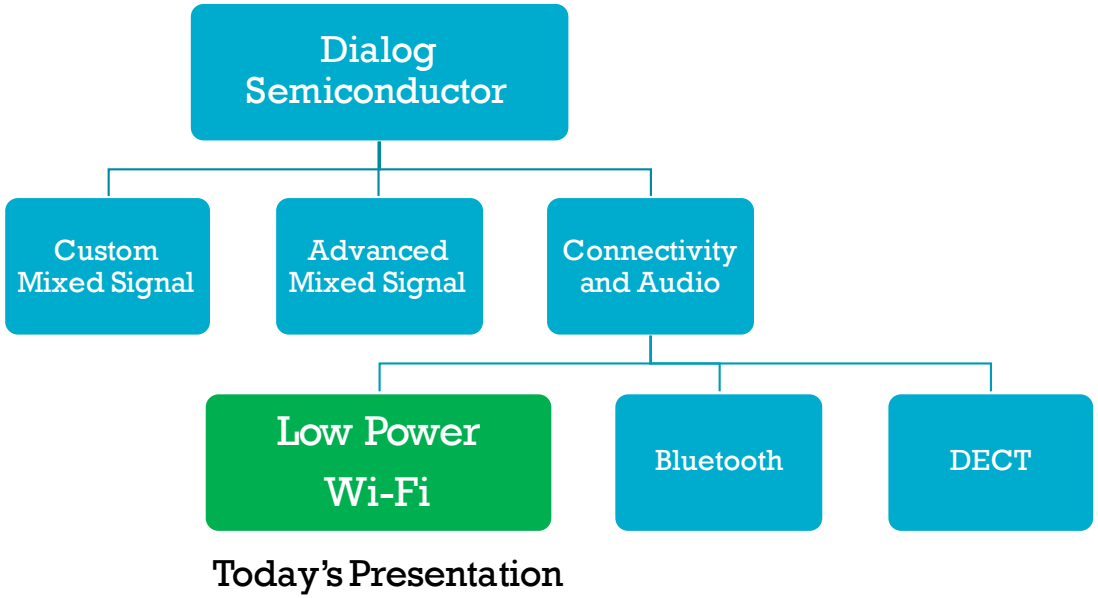
3. Industrial Mixed Signal: Custom and standard products including specialty memory targeted at Industry 4.0 and cloud connected server solutions

4. Connectivity & Audio: Bluetooth® low energy (BLE), IoT Wi-Fi, audio, haptics and low latency wireless solutions

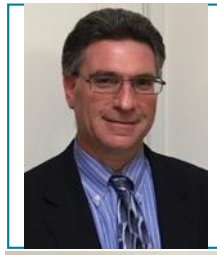
5. Automotive: Leveraging technologies across Dialog

1~2300 Employees as of July 2020

Speaker Introduction



Today's Presentation



David Cohen
Product Marketing Director
N. America

Ian Morris
Principal
Field Application
Engineer

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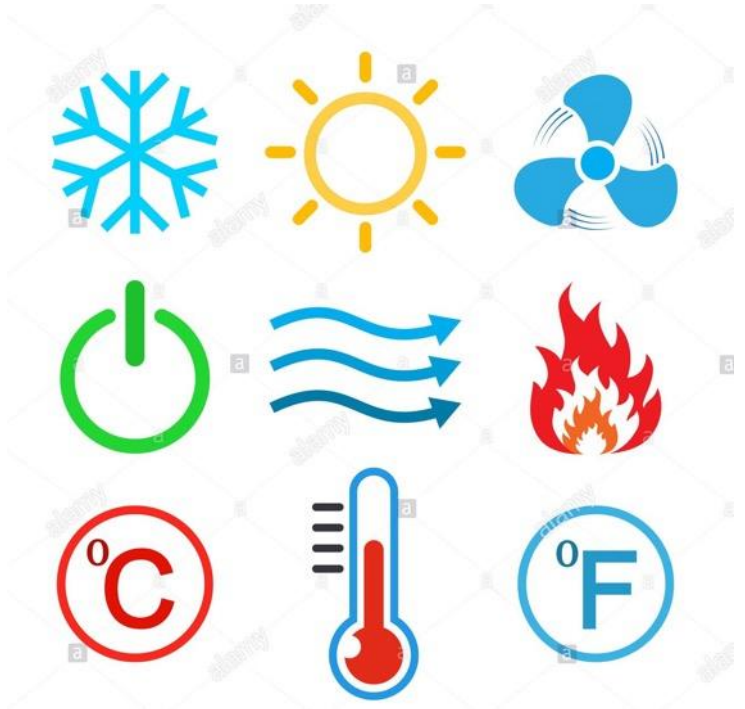
Engineer

Agenda

- Brief history of HVAC
- Line powered vs. wireless sensors
- How ZigBee, ZWave, 802.15.4, and subGHz have made an impact
- Where Wi-Fi fits in
- How the infrastructure to support wireless devices varies
- Demo: Wi-Fi sensors in an HVAC system, and what to expected for battery life
- Final Conclusions
- Q&A

HVAC has an interesting history

- Ancient Greeks and Romans ran channels to distribute heat from fires under marble flooring.
- In 1902, Willis Carrier invented a machine called the "Apparatus for Treating Air." Utilized large fans with coils circulating a coolant **that controlled humidity** throughout a printing plant building in Brooklyn, New York.
- In 1906, Stuart Cramer invented a machine that **added humidity** to the air in textile manufacturing plants. The additional water vapor made the yarn tougher and easier to spin. Cramer is credited as the first to use the actual term "air conditioning."
- In 1914, the first home air conditioning unit was installed in a Minneapolis residence that belonged to Charles Gates, son of barbed wire manufacturer John Wayne Gates.
- In the early 1920s, New York City's Times Square Rivoli Theater installed a Carrier air conditioning system. Within the decade, 300 more theaters around the country added air conditioning systems for the comfort of their patrons.
- In 1931, J.Q. Sherman and H.H. Schultz invented the individual window-ledge air conditioning unit. Few consumers could afford the $10,000-$50,000 units already being used by movie theaters and businesses.
- Packard introduced the first air-conditioned automobile in 1939. To turn off the air conditioning, the driver needed to first turn off the engine, open the hood and disconnect a compressor belt!
- Following World War II, economic prosperity allowed for a steep rise in residential air conditioning. By 1953, over a million units were being sold annually.



HVAC Sensors used to all be line powered/line connected

And many still are…

Duct Air Temperature Sensor

33ZCSENDAT

Type: Duct Mounted Temperature Probes

Application: Airside

Description: When used in conjunction with the VVT® Zoning System and 3V™ Control System the duct temperature sensor is required for use with a bypass controller and must be installed in the supply air duct.

Duct Relative Humidity Sensor

33ZCSENDRH-02

Type: Duct & Outside Air Humidity/Temperature Sensors

Application: Airside, Packaged outdoor, Split systems

Description: The sensor's advanced ceramic technology design overcomes the limitations of other resistance-based humidity sensors that utilize water soluble polymer coatings.

HVAC Sensors used to be line powered/line connected

And many still are…

HiLetgo
DHT22/AM2302
Digital Temperature
And Humidity Sensor

Wireless became a popular choice

ZigBee, ZWave, subGHz, and other wireless sensors

- Ease of Installation
- Location flexibility

ZOOZ Z-Wave Plus 4-in-1 Sensor ZSE40 VER. 2.0 (Motion/Light/Temperature/Humidity)

Tuya ZigBee Smart Temperature and Humidity Sensor, Wireless Thermometer Hygrometer, Tuya/Smart Life App, Requires Zigbee HUB

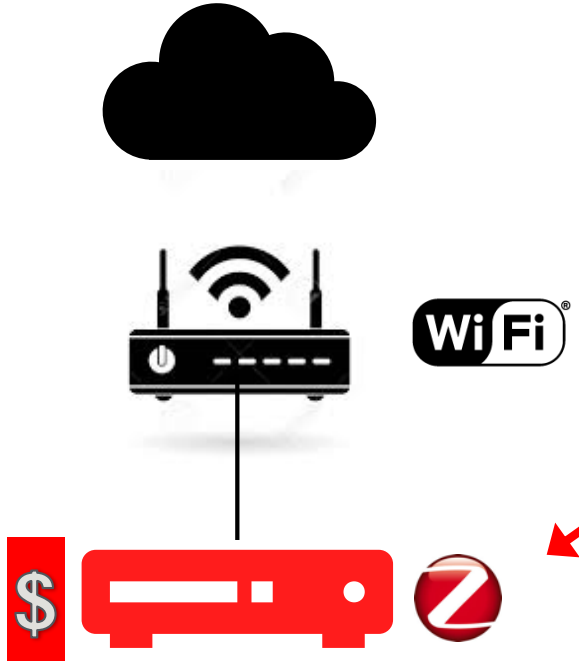
Does Wi-Fi fit into the mix?

Wi-Fi is very popular, but is it too power hungry for a battery powered sensor?

Pros/cons of wireless technologies

	ZigBee/802.15.4	Z-Wave	Wi-Fi
Data Rate (kbps)	250/40/20 (depending on freq band)	100	72,000+
Throughput (kbps)	100/16/8	40	50,000
Range	10-20m	30m	100m
Battery life	Good	Good	Bad/Good ???
Interoperability	Good at PHY/MAC, bad at upper layer	Poor – single silicon vendor	Great
Extra bridge/hub?	Yes	Yes	No

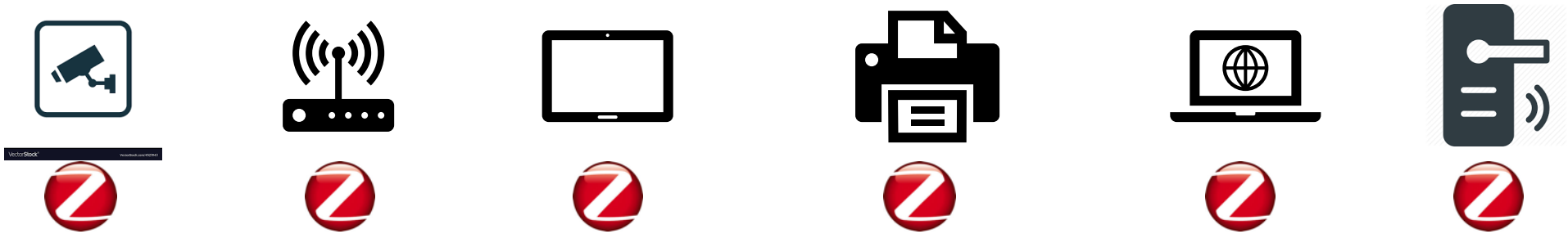
ZigBee, Zwave, SubGHz devices require an extra $ gateway to get to the Internet or cloud services



ZigBee/Z-Wave endpoint devices cannot connect to the cloud without an extra gateway or bridge that converts ZigBee to Ethernet or Wi-Fi.

Adds cost ($K's), complexity, and a new point of failure into the network.

Typically requires professional installation and service.



Wi-Fi devices can connect directly – no gateway required

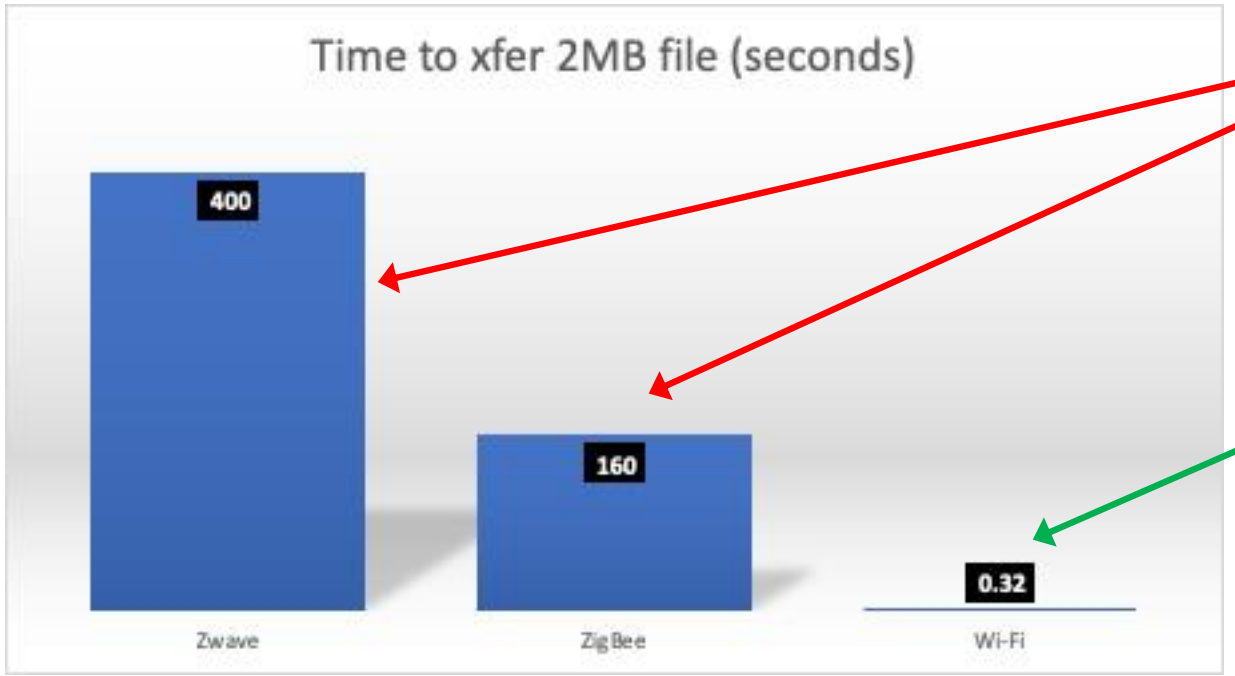
With Wi-Fi, there's no extra bridge or gateway.

Save costs and complexity. No professional installation needed.

Devices are simply Wi-Fi and connect easily and securely to the Wi-Fi Access Point and cloud.

Over the air firmware updates (OTA) with ZigBee, Zwave is slow and battery consuming

Technology	Link Speed (kbps)	Througput (kbps)	Time to xfer 2MB file (seconds)
Zwave	100	40	400
ZigBee	250	100	160
Wi-Fi	72,000	50,000	0.32



Long file transfer time means the radio is on for a long time burning the battery.

Quick file transfer means the radio is on for a very short time saving battery life.

Notes/Assumptions:.
ZigBee published data rates are 40-250Kbps, picked top rate.
Zwave data rates and throughput as published on Wiki page
ZigBee throughput percentage assumed same as Zwave.
Wi-Fi: 802.11n 1x1; higher speed Wi-Fi will be even faster.

Let's return to the low power question for Wi-Fi

Let's see a demo!

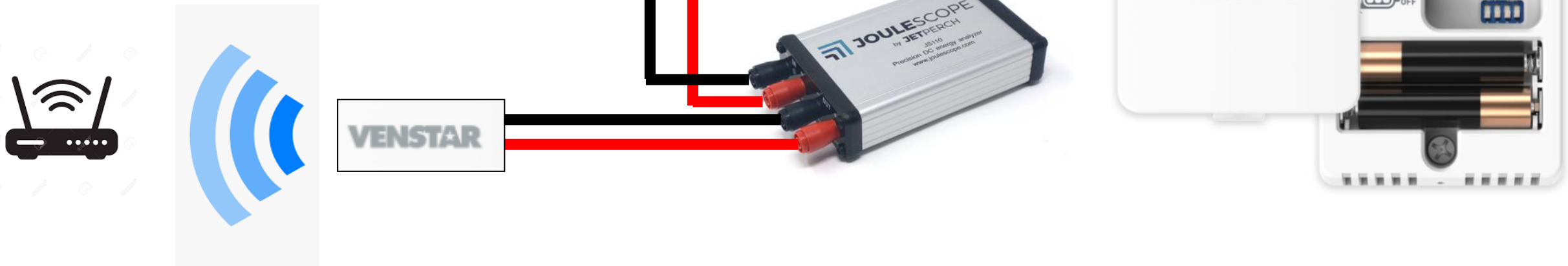
Demo background

Commercially shipping Wi-Fi sensor from Venstar

Sensor posts data to the Wi-Fi Access Point (router)

Sensor wakes up every minute, post data and go back to sleep

We'll take the power measurements with Joulescope power meter and determine the battery life we can expect



What did we learn from this demo?

Expected battery life for Wi-Fi sensors

- Venstar Wi-Fi mini sensor
  - Sends temp/humidity data every minute – 1,440 times/day
  - Avg current over 5 minute period: 122uA
  - 2 AAA batteries: 1,200mAh, 3V, serial configuration
  - Battery life: 1.12 years!

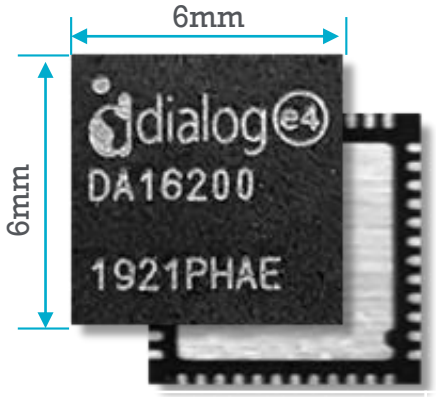
Avg current	0.122	mA
Battery capacity (2 AAAs)	1,200	mAh
	9,836	hours
	410	days
	1.12	years

Final conclusions

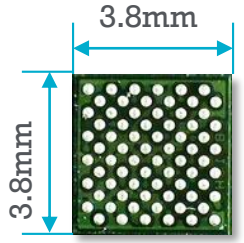
- Wired sensors still have a place
  - Sometimes wireless is not allowed, sometimes the location is already rigged for wires
  - No batteries to change
- But wireless sensors are taking over
  - Convenience, ease of install and flexibility in placing sensors
- ZigBee, Z-Wave, 802.15.4, subGHz all can deliver long battery life
- But those technologies require extra gateways making implementation more expensive and complex – and more difficult to troubleshoot
- Wi-Fi sensors are the simplest and best way to go **IF** they can deliver long battery life
- Today we proved that they can
- Not all Wi-Fi vendors can deliver low power so look for Wi-Fi vendors that specialize in low power

DA16200 Low Power Wi-Fi Summary

- Wi-Fi for IoT and other battery powered applications
- Very low power – VirtualZero™ technology
- More than 1 year battery life for most applications
- Extended range
- Fully integrated Wi-Fi networking system on an SoC
  - Wi-Fi BB/MAC/RF PA, LNA, RF switch – full front end included
  - 802.11 b/g/n 1x1 2.4 GHz
  - CPU, SRAM, ROM, OTP
  - Dedicated hw encryption security block
  - Extensive I/O
- Full offload – network stack runs on chip
- Low power Wi-Fi product page:
- https://www.dialog-semiconductor.com/products/wi-fi



6x6 QFN



3.8 x 3.8 FcCSP

Thank you!

Questions?

Remember – top three questions get a DA16200 Wi-Fi evaluation board

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