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Wireless Control That Simply Works

ZigBee: Make or Buy?

ZigBee Dev Con Chicago, June 2006

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Why ZigBee?

- #1 - Low Cost

  Allows addition of wireless to any price product

- #2 - Ease of Deployment

  Mesh networking overcomes line-of-sight fears

- #3 - Multi-source Products

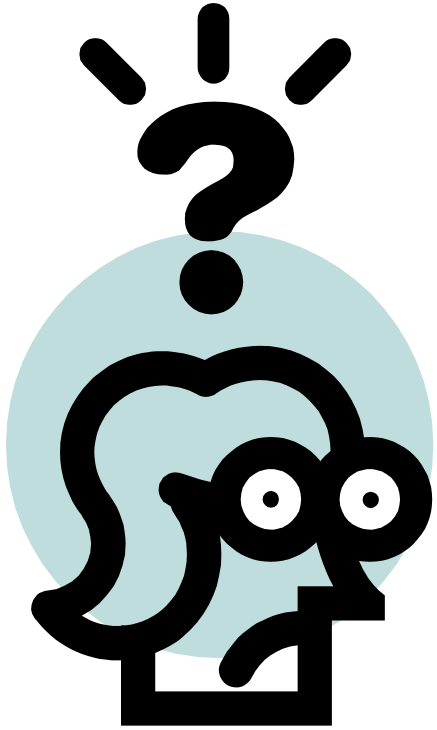
  Not betting on a single company

- #4 - Battery Operation

  Allows products to be un-tethered from power cords

ZigBee – Make or Buy?

- When a chipset costs less than $10 for 1Ku, why pay $20 for a module?



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ZigBee – Make or Buy?

- Concerns about Buying:
  - Cost
  - Flexibility
  - Control

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ZigBee – Make or Buy?

- Agenda
  - Comparison of Development and Manufacturing Costs
  - Comparison of Times to Market
  - Impact of Volume on the Decision
  - Flexibility – What can Modules Offer?
  - Control – Making it Your Own
  - Control – Intellectual Property
  - Control – Leverage with Vendors
  - Choosing a Module Vendor
  - Conclusions

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ZigBee – Rolling Your Own

- Evaluate/select chipset/stack vendor(s)
- Acquire Development Kit
- Attend Vendor Training
- Implement design
  - Your own
  - Vendor's reference design
- Integrate design into product
- PCB Layout with RF considerations
- Debug design
- Type acceptance tests – FCC, ETSI

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ZigBee – Rolling Your Own

- Join ZigBee Alliance
- ZigBee Tests if advertising ZigBee
- Release product into production
- Monitor production yields on RF characteristics

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ZigBee – Off-the-Shelf

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ZigBee – Off-the-Shelf

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ZigBee – Evaluating/Selecting Vendor(s)

- Eval kits for chipsets or modules cost about the same ~ $500
- Developer's Kits and Vendor training cost about $10,000

	Make	Buy
Running Total:	$12,000	$2,000

ZigBee – Implementing a Design

- Even simply implementing reference designs require special test equipment:
  - Spectrum Analyzer
  - Signal Generator
  - Network Analyzer
- Count on spending in excess of $100,000 for test equipment

	Make	Buy
Running Total	$112,000	$2,000

ZigBee – Implementing a Design

- RF designs require an RF designer

- Count on spending $150,000/year for an experienced RF designer. (You'll need to keep 'em on board through the life of the product.)

	Make	Buy
Running Total	$262,000	$2,000

ZigBee – Layout with RF Considerations

- A single mistake on an RF layout can render the best design unusable

- Out-of-house layout services with RF expertise - $5,000 for the initial layout

	Make	Buy
Running Total	$267,000	$2,000

ZigBee – Type Acceptance

- Test Lab and Filing Fee for FCC Type Acceptance $5,000 if passes on first attempt. Add $2,000 for each additional attempt
- Ditto for ETSI

	Make	Buy
Running Total	$277,000	$2,000

ZigBee – Incremental Indirect Costs

- Development Costs $275,000
- Ongoing Support Costs $150,000/year

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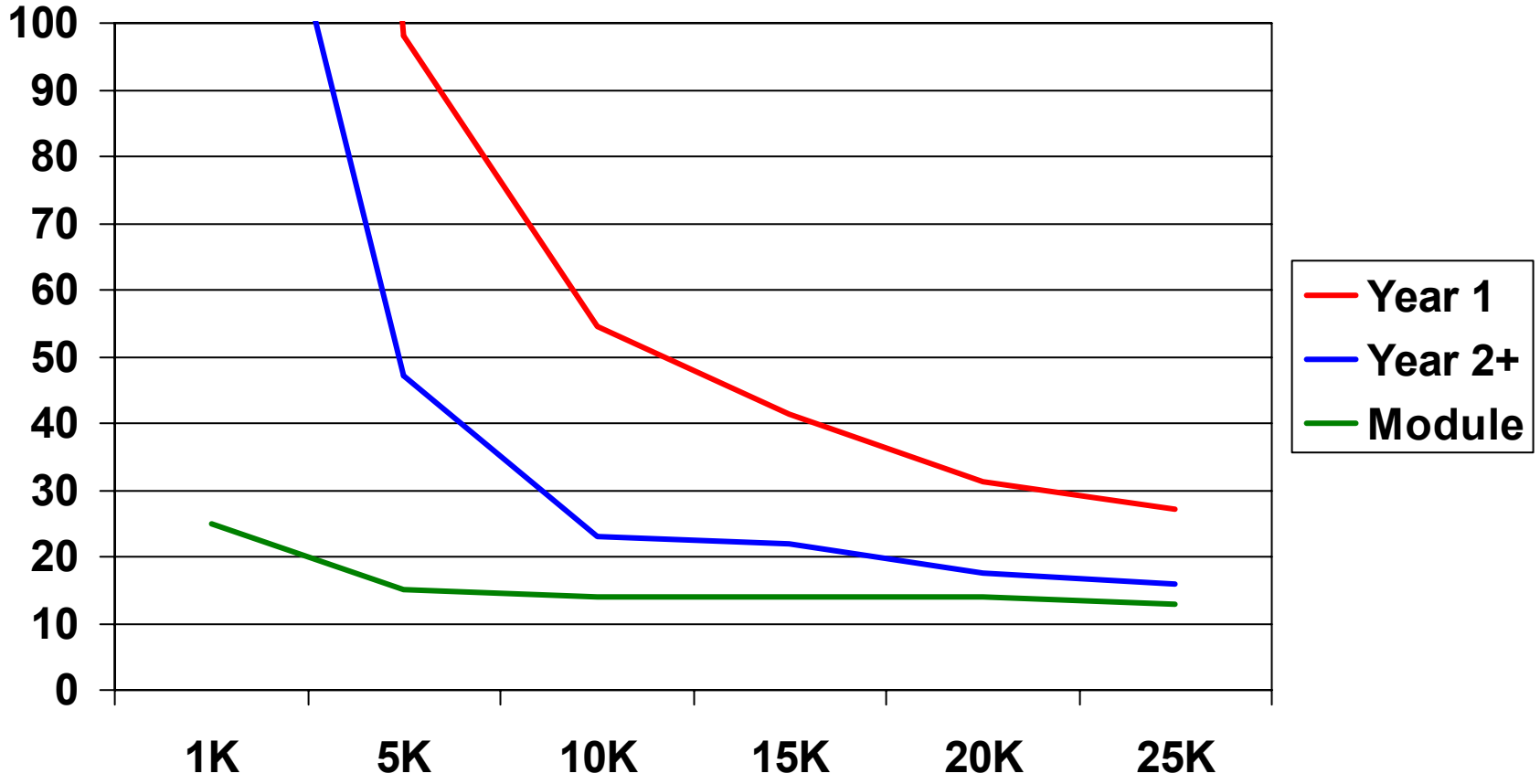
ZigBee – Impact of Volume



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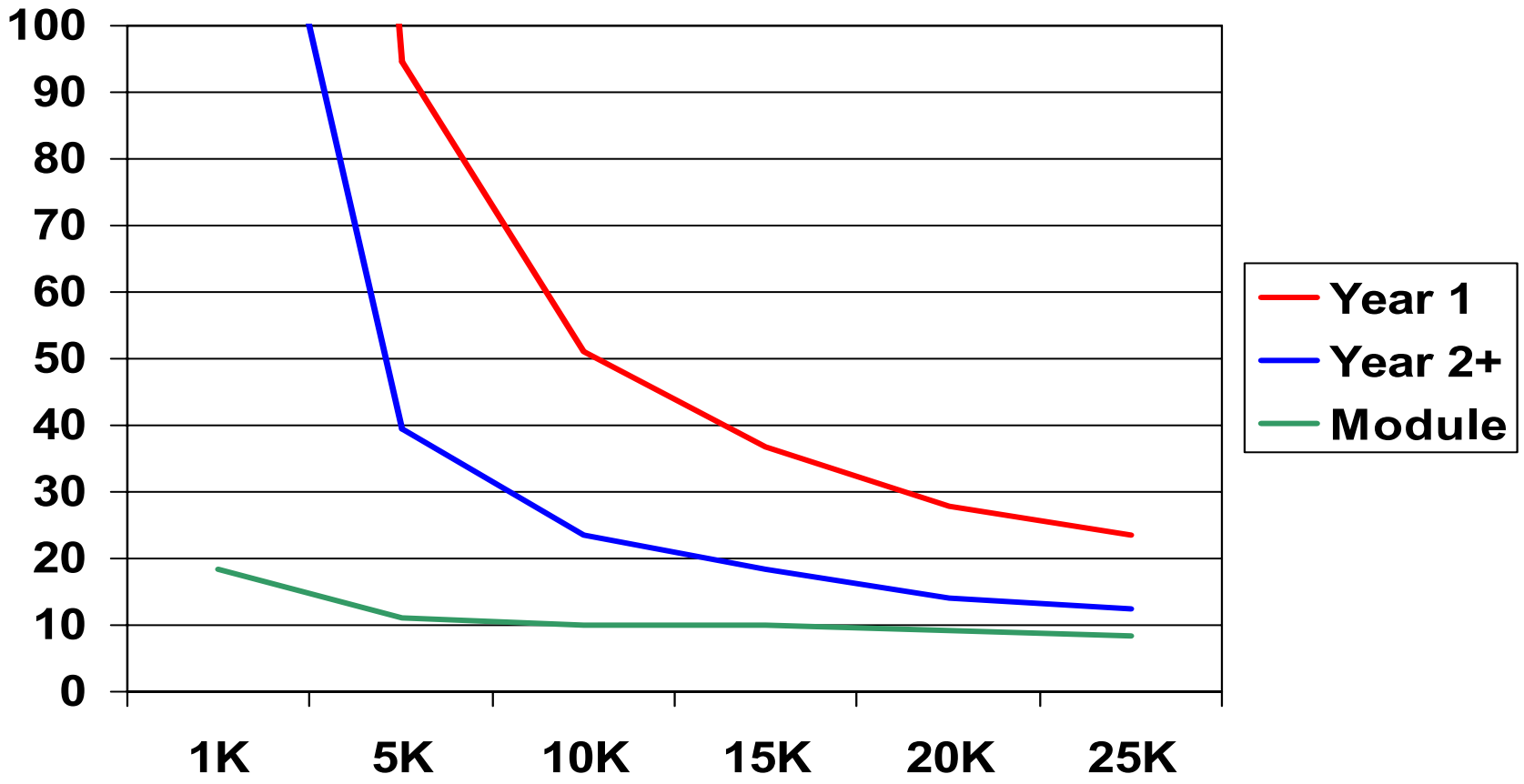
What About Single Chip Designs?

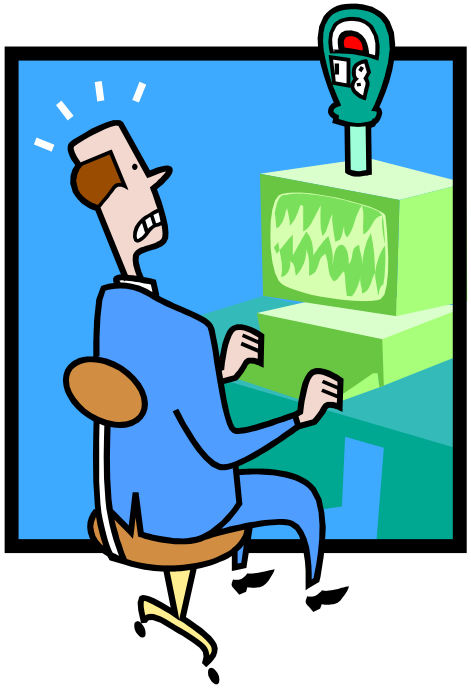
- Two chip chipsets are replaced by single chip solution
- Cost savings that accrue to OEMs also accrue to module manufacturers
- Other BOM costs are the same
- Fixed costs don’t change
- Single chip modules will cost less than two chip solutions

Impact of Volume – Single Chip Designs



ZigBee – Manufacturing Yield

- "Anybody can build one of anything."
- Consistent volume production without manual labor is key to keeping costs low.



ZigBee – Manufacturing Yield

- Yield issues due to component tolerances
  - Can only be discovered through producing volumes of product
- How much does it cost to rework your product?

ZigBee – Time to Market

- Additional Development Time:
  - RF Debugging 2 weeks
  - Type Acceptance Testing 2 weeks
  - Type Acceptance Grants 8 weeks
- Time to Market Savings 12 weeks MINIMUM

ZigBee – Time to Market

- What is the value of time-to-market?

ZigBee – Time to Market

- Hypothetical Example
  - Limited selling window
  - 10K annual quantities at $400 ASP
  - 3 Months of additional selling time = 2,500 additional units
  - 2,500 units at $400 ASP and 40% Gross Margins

= $400,000 incremental gross profit

ZigBee – Cost

- The Economics are Compelling:

Unless you are planning on volumes well in excess of 25,000 pieces per year, third party modules are the most cost effective.

ZigBee – Flexibility

- Using third party modules means working my design around what the module manufacturer thinks is important, right?

NO. There are a variety of third party modules available with a variety of features.

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ZigBee – Flexibility

- I/O Options
  - UART Ports
  - SPI Ports
  - GPIO
  - ADC Channels
  - DAC Channels
- Transmit Power Options
  - 1mW
  - 10mW
  - 100mW

ZigBee – Flexibility

- Form Factor Options
  - Various less than 1 square inch in area
  - Higher power modules a little larger
  - Variety of standard form factors announced

ZigBee – Flexibility

- Profiles
  - Home Control and Lighting
  - Building Automation and Control
  - Industrial Plant Monitoring
  - Automatic Meter Reading
  - Other Public Profiles
  - Private Profiles
  - Custom Profiles

ZigBee – Flexibility

- Profiles can provide an API to the module, simplifying integration.
  - Network Discovery
  - Send/Receive Serial Packet
  - Write/Read SPI Port
  - Read ADC Inputs
  - Write DAC Outputs
  - Read/Write GPIO

ZigBee – Flexibility

- If I use a third party module, can I develop my own profile?

YES. It will be necessary to purchase the developer kit for the stack used on the module.

ZigBee – Flexibility

- Can I get a custom profile developed by a third party?

YES. Some module manufacturers offer this service as well as some stack/software companies.

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ZigBee – Flexibility

- Connection to an embedded microcontroller
  - Connects directly to UART or SPI Port pins
  - 50 Ohm trace from module to antenna connector OR
  - Use module with chip antenna on board

ZigBee – Flexibility

- External Circuitry Needed for RS-232 Port
  - Buffer/level shifter IC
  - Use UART Tx and Rx for transmit and receive data
  - Use GPIO pins for status and flow control lines

ZigBee – Flexibility

- External Circuitry Needed to Implement USB
  - USB transceiver IC
  - Use SPI port SDO and SDI for transmit and receive data

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ZigBee – Flexibility

- External Circuitry Needed to Implement Ethernet
  - Ethernet magnetics
  - PHY chip
  - Use SPI port or GPIO for Ethernet transmit and receive data

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ZigBee – Flexibility

- Third party modules offer as much flexibility as in-house designs
- Given the variety of modules available, each end product's needs may be better met than with a single in-house design

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ZigBee – Control

- Making it My Own
  - Creating barriers to entry for my competition
- Intellectual Property
  - Maintaining ownership of key intellectual property
- Leverage with Vendors
  - Not be at the mercy of a third party's product plans

ZigBee – Control

- Barriers to Entry for Competition
  - Interoperability requires more than the same hardware platform
  - Availability of custom profiles or creating your own profile provides a mechanism for product differentiation
  - First to market is a competitive advantage

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ZigBee – Control

- Ownership of Key Intellectual Property
  - With chipsets from multiple vendors, the technology embodied in the module design is widely available
  - Key Intellectual Property is resident in the profile if in the wireless piece of the end product at all
  - Custom profiles performed as “Works for Hire” or in-house profile development allows ownership of key intellectual property when using a third party module

ZigBee – Control

- Leverage with and Independence from Vendors
  - Use of standards-based module brings same benefits as the use of standards-based chipsets
  - From a hardware perspective, it is easier to change modules than it is to change chipsets
  - There are more module vendors than there are chipset vendors creating more pressure for low costs

ZigBee – Control

- The use of third party modules does not mean less control than in-house designs and can offer long-lasting benefits through reduced time-to-market.

ZigBee – RF Truths

- With chipset vendors' reference designs, there's no design effort needed, right?

ZigBee – RF Truths

- There is a big difference between getting a design to work and getting it to work well.

ZigBee – RF Truths

- Getting a design to work and getting a design to pass FCC and ETSI testing are two very different things

ZigBee – RF Truths

- And if I do run into problems, my chip vendor will support me, won't they?

ZigBee – RF Truths

- Chipset vendors do not have the resources to support a large number of developers. They target customers that will buy a very high volumes of chipsets.

ZigBee – Choosing a Module Vendor

- RF hardware company
- Stable company with experienced management
- Profitable company with long track record
- Well-developed support
- Full line of products

Some Module Vendors*

- Cirronet
- Eazix
- Helicomm
- Innovative Wireless Technologies
- Telegesis

* Partial list. Inclusion does not constitute an endorsement of the companies or their products

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Conclusions – Caveat Designor

- There is no one right answer for all companies
- Third party modules can provide cost-effective, flexible solutions while allowing the required control
- Each company should make their own decision based on their expected volumes, existing resources and corporate strategy
- The correct decision for one company may be the wrong decision for another company
- Making the correct decision but choosing the wrong vendor is as bad as making the wrong decision

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Questions?

www.cirronet.com