ANT - Wireless connectivity

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Introduction

ANT is a Wireless Sensor Network (WSN) RF protocol for short range wireless communication of ultra-low power networking applications – from simple point-to-point to complex mesh networks. ANT is meant to run with low cost, low power microcontrollers (MCUs) and transceivers operating in the Industrial, Scientific and Medical (ISM) band. The ISM band is a global licence-free part of the RF spectrum.

ANT is optimal for any low data rate application in personal area networks(PAN) and local area networks(LAN) for homes and industrial automation applications.

Developed through several generations evolving the sensor connectivity problems of previous protocols like Bluetooth and ZigBee, ANT is the first technology in the digital sensing market for sport and fitness today.

ANT actually is the most promising technology in more applications for collection, automatic transfer and tracking of sensor data within sports, wellness management and home health monitoring.[1] (http://www.thisisant.com/technology)

This Ultra low power(ULP) protocol was designed by Dynastream Innovations Inc. (http://www.dynastream.com), a canadian company, now owned by Garmin(R)ltd. Nowadays the main manufactures are Nordic Semiconductor (http://www.nordicsemi.com) and Texas Instruments (http://www.ti.com/? DCMP=TIHeaderTracking&HQS=Other+OT+hdr_home). ANT transceiver are globally distribuited by Nu Horizon Electronics (http://www.nuhorizons.com) and Rutronik (http://www.rutronik.com) (european market).[2] (http://www.thisisant.com/company)

Working principles

Technology capabilities

- Proprietary protocol operating on world-wide licensed-free 2.4 GHz ISM band
- Micro-watt power consumption (Approx. 4 years of battery life on a 2032 coin cell when sending a message every 2 seconds, 24 hours per day)
- WSN protocol intentionally engineered for simplicity and efficiency
- Support for broadcast, burst and acknowledged transactions up to a net data rate of 20 kbit/s. (ANT's over the air data rate is 1 Mbit/s)
- Uni-directional and bi-directional communications and adaptive isochronous channels
- Support peer-to-peer, star, tree and practical mesh network
- Capability of up to 65,536 slave nodes talking to one master over a time slot shared single channel

- Nodes equally capable of acting as "slaves" or "masters" within a network and swapping roles at any time
- No "coordinator" or "supervisory" node required
- Ability to support *ad hoc* interconnection
- Up to 2^{32} addressable devices

Network and other features

The ANT protocol has an efficiency (determined by the ratio of overhead to data) of 47 percent.[3] (http://en.wikipedia.org/wiki/ANT_(network))

ANT's wireless networking protocol is optimal for WSN with high demands in fields of ultra-low consumption, resource optimization, flexibility and use easiness. Excluding Bluetooth (that is not able of running from a coin cell), its best competitor within the ultra-low power wireless network solution market actually is ZigBee. Anyway, ANT is 4x lower power and almost 60% less expensive than ZigBee.

ANT's uses a self-adaptive network that automatically adjust and synchronize network nodes in order to provide robust and non-destructive network operations. Moreover, ANT-powered nodes are able to act as slaves or masters within a WSN, and in addition can also determine when to transmit based on the activity of its neighbors.

- Ability to trade-off data rate against power consumption
- Tens or hundreds of nodes
- Message rate 0.5 Hz to 200 Hz with 8 byte data load per message
- Inherent data security with 64 bit network key with additional application layer security definable
- 16 bit CRC data validity detection
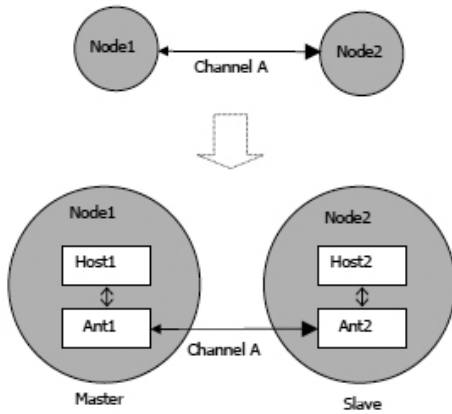- Immunity from cross-talk

ANT Node:

Made of one ANT engine and one host MCU
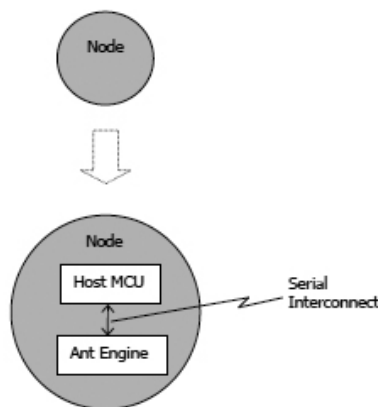
ANT Channels:

Every channel has a master endpoint and one or more slave endpoints, it can support both unidirectional and bidirectional communication
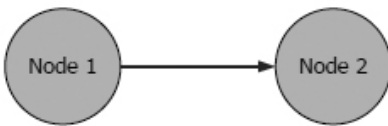
Channel messaging:

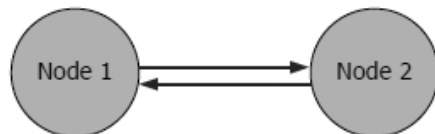ANT allows three types of messaging between the nodes:

Broadcast:

Unidirectional communication, with no acknowledgement by slave node; ideal for sensor applications
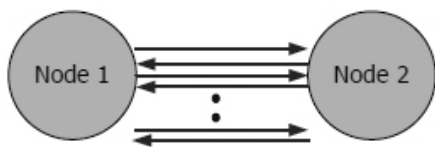
Acknowledged:

Acknowledgement automatically sent back to master node; for control applications

Burst:

Multi-message modality, uses the whole bandwidth (20 kbps), automatic retry for failed messagges; for data downloading

Comparison with ZigBee and Bluetooth

Market name	ANT	ZigBee	Bluetooth
Standard	proprietary	IEEE802.15.4	IEEE802.15.1
Application	PANs and WSNs	PANs and WSNs	PANs
Host resources (kByte)	2(0 with SensRcore™)	100	250
Battery life (with coin cell battery)	3+ years	4 to 6 months*	1 to 7 days*
Max. network size (nodes)	2^32	2^64	7
Over the air transmission rate (kbit/s)	1000	250	1000
Required PCB area (mm^2)	125	Depends on architecture	Depends on architecture
Range (meters)	1 to 30	1 to 100+	1 to 10+
Success metrics	Ultra-low power, cost	Power, cost	Cost, convenience
Supported networks	Peer-to-peer, star, tree, mesh	Peer-to-peer, star, tree, mesh	Peer-to-peer, star
Min. node configuration	Transmit only or transceiver	Transceiver	Transceiver

Table ref. [4] (http://www.thisisant.com/why-ant/how-ant-compares)

(*)Theoretical only. Peak current requirement for ZigBee and Bluetooth exceeds coin cell battery capability
so coin cell operation is impractical.

In the power consumption comparison, ANT resulted the best, being 10 times less thirsty than Bluetooth V2.1 standard
protocols and 4 times less than ZigBee. Power consumption is comparable with Bluetooth V4.0 Low Energy protocol, the
technology status is comparable with the very same chip foundries. Bluetooth foundries have single chip prices higher than for
ANT.

Compared to ZigBee, the lower complexity of the ANT protocol allows to save up to 50% of development time. Thanks to its
simplicity, ANT significantly decreases the work-load of the MCUs.

ANT+

ANT+ represents an important evolution of the ANT technology, with the addition of the following functions:

- Collecting of data
- Automatic transfer
- Tracking of sensor data

This improved technology, formerly known as "ANT+Sport", was firstly designed specifically for sports and fitness
applications:

- Heart rate monitoring
- Speed and distance monitors
- Weight scale
- Fitness equipment data sensors
- Temperature sensor

All these information are sent to a PC with which the performance can be analyzed.

Just like ANT, this technology is multi-channel so it's possible to monitor many people at the same time, making it very useful in races and team training.

ANT+ is also going to be applied in the field of Home health and industrial monitoring; the non-invasive nature of this transmitters makes them really suitable for these applications

Applications

"ANT was designed to solve real problems – and it does. It is the lightest protocol available that still has the ability to scale into complex network topologies and communication methods. This means that ANT can achieve lower cost and lower power, the most important criteria in mobile personal monitoring technology."

Rod Morris, Director, ANT Wireless

ANT is already a RF protocol solution employed in a wide range of different consumer product that strictly require:

- Ultra low power
- Low system cost
- Flexible networking topology
- Easy to use

ANT dominate the market of digital sensing today because of its ability to maintain an high data rate and an ultra-low power consumption at the same time. It is actually covering all the product range using a previous protocol like Bluetooth and ZigBee. Bluetooth has a larger stack, but its average power consumption is 10 times greater than ANT and its hardware costs reach to 90% higher. In addition ZigBee protocol demands more powerful external microcontrollers, increasing the total system cost of 60%.
For those reasons, ANT protocol can currently be found in several kinds of applications in sport, wellness, tracking, home and industrial automation. There are many companies today that have selected the ANT protocol and the ANT+ interoperability, like Adidas, Falcon, Garmin, iBike, and many more.[5] (http://www.thisisant.com/modules/mod_product-directory.php)
Prime examples include:

- Wrist-mounted instrumentation
- Heart Rate Monitoring (HRM)
- Speed and Distance Monitoring (SDM)
- Bike computers
- Medical instrumentation
- Industrial sensors
- Low data-rate communications
- Active RFID
- Location-based services
- Utilities wireless Automated Meter Reading (AMR)
- Smart toys
- Automotive instruments

As ANT continues to expand in function, it facilitates more other applications, like e.g. USB sticks capable to connect PC or Mac with ANT wireless sensors (wearable or not) and therefore store, analyze and display data collected by them.[6] (http://www.thisisant.com/pages/products/usb-stick)

The last innovation in ANT wireless connectivity application is the Sony Ericsson Xperia^{TM} arc[7] (http://www.thisisant.com/pages/special/sony-ericsson-xperiatrade-arc-connects-to-14-million-ant-devices),the first commercially available smartphone designed to communicate with all the ultra-low power (ULP) ANT+ network of health and fitness devices, so up than 14mln of devices. It have been presented by ANT Wireless and Texas Instruments (TI)

Incorporated[8] (http://www.ti.com/ww/en/mcu/ant/index.shtml?DCMP=TI_ANT&HQS=Other+OT+ant) as part of TI's exhibition at Mobile World Congress (MWC) on 14 February 2011.

Moreover, designers and developers who want to develop their own application or product can buy various ANT apposite development kits.

Some actual products using ANT-powered wireless sensors:

HeartRateMonitor.jpg

Forerunner310.jpg

ANT usb stick.jpg

Ant-chip-shot.gif

Further readings

- Sidedbar: Comparing ANT and ZigBee (http://www.eetimes.com/design/signal-processing-dsp/4012954/Sidedbar-Comparing-ANT-and-ZigBee)
- ANT SensRcore[TM] Technology (http://www.thisisant.com/technology/sensrcore)
- TI's WiLink[TM] Technology (http://focus.ti.com/general/docs/wtbu/wtbugencontent.tsp?templateId=6123&navigationId=12025&contentId=4645&DCMP=MISCELLANEOUS+Other&HQS=Other+OT+wilink)

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- [3] ANT network protocol http://en.wikipedia.org/wiki/ANT_(network). [Accessed 19 March 2011]
- [4] ANT's Competitive Advanatages http://www.thisisant.com/why-ant/how-ant-compares. [Accessed 20 March 2011]
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- [6] ANT Usb Stick http://www.thisisant.com/pages/products/usb-stick. [Accessed 19 March 2011]
- [7] The first ANT+ communicating smartphone, SonyEricsson Xperia arc http://www.thisisant.com/pages/special/sony-ericsson-xperiatrade-arc-connects-to-14-million-ant-devices. [Accessed 17 March 2011]
- [8] TI's ANT ultra low power chip http://www.ti.com/ww/en/mcu/ant/index.shtml?DCMP=TI_ANT&HQS=Other+OT+ant. [Accessed 18 March 2011]
- Dynastream Innovation Inc. Official site http://www.dynastream.com/. [Accessed 21 March 2011]
- Nordic Semiconductor - ultra low power wireless solutions http://www.nordicsemi.com/. [Accessed 21 March 2011]
- NU Horizons Electronics official site http://www.nuhorizons.com/. [Accessed 22 March 2011]
- Rutronics official site http://www.rutronik.com/. [Accessed 22 March 2011]

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