**ANT/ANT+**

**Joseph Zaloker, Director of Technical Marketing, Arrow Electronics**

ANT is a wireless network protocol and RF solution designed for use in ultra-low power Personal Area Networks (PANs) and Wireless Sensor Network (WSN) applications. Designed for operation in the 2.4 GHz frequency band, ANT is perfectly suited for any kind of low data rate sensor and network topologies from simple point-to-point, to complex mesh networks. Adding wireless connectivity to applications such as health and wellness applications, industrial sensor monitoring and sports monitor related products are examples where ANT is the preferred wireless choice. ANT has been designed to simplify network development and optimize network operational efficiency. ANT powered network nodes can operate for years on coin cells compared to days or months for other technologies. ANT+ provides interoperability functionality on top of the base ANT protocol to allow products from different manufacturers to communicate seamlessly.

**What is ANT?**

ANT is a wireless proprietary network protocol and RF solution using a proprietary wireless communications protocol stack. ANT enables silicon based RF tranceiver radio solutions operating in the 2.4 GHz Industrial, Scientific and Medical (ISM) band to communicate using standard rules for co-existence, data representation, signaling, authentication, and error detection provided by the stack. ANT protocol transceivers come pre-loaded with the ANT protocol software, but must be controlled by low power low cost microcontroller via a UART, SPI, or USB interface. ANT is a technology used for collecting, transfer and tracking sensor data within sports, wellness management and home health monitoring based applications.

**Key attributes of ANT**

- Ultra low power master and slave designed to run on a coin cell for years
- Simple to complex network topologies possible
- Established ANT interoperable ecosystem
- Low development and system cost
- Stack size orders of magnitude smaller than Bluetooth Low Energy (resulting in lower ANT chip size and cost)
- ANT operates on world-wide license-free 2.4GHz ISM band
- 64-bit network key with additional application layer security definable
- Up to 2^32 addressable devices
- Unidirectional and bidirectional channel support

ANT offers the user low latency and the flexibility to trade-off data rate against power consumption and support for various transmission modes up to a net data rate of 20 kbit/s. Ant’s over the air data rate is 1 Mbit/s for low duty cycle operation.

**What is ANT+**

ANT+ provides predefined network parameters and data payload structures enabling products from different manufacturers to communicate seamlessly. Device profiles are defined for various classes of products. Current ANT+ Device profiles include heart rate monitors, Bicycle speed and power, weight scales and stride/speed/distance. Device profiles are managed by the ANT+ Alliance.
Types of applications served by ANT

ANT has been designed to simplify wireless network development and optimize network protocol efficiency while at the same time being low-cost. ANT+ provides the user reliable data communications; flexible and adaptive network operation and cross-talk immunity.

ANT is targeted at applications where there is a periodic transfer of small amounts of sensor information between several or many interconnected devices in a variety of topologies such as point-to-point, star, tree or mesh. Health and wellness sensor applications are one of the most common applications for ANT. These applications are often constrained by strict power, footprint and cost requirements. Typical applications measure parameters that don't change rapidly such as temperature and humidity where telemetry updates every few seconds are satisfactory.

Typical ANT applications

- Heart rate monitors
- Speed and distance monitors
- Bike speed and cadence sensors
- Bike power sensors
- Weight scales for the measuring of BMI (Body Mass Index)
- Fitness equipment data sensors
- Temperature sensors

Wireless sensor networks require high reliability and need to offer low power consumption to extend battery life and minimize maintenance of the remote device. Sensors and the networks need to be low cost to purchase and easy to install and maintain. Given all of that, ANT transceivers must co-exist with other higher-powered radio modules and wireless technology such as 802.11 or cellular and be able to transmit and receive without interference from their neighbors and other wireless devices operating in the 2.4 GHz or other bands.

What is the range of ANT+?

As with all wireless protocols, range is always a question. Range is application specific, as a number of factors affecting range include the antenna subsystem class of radio chosen and environmental obstacles, to name a few. The applications of the ANT wireless protocol will typically be applications where longer range is not required, like with very local sensor network. One popular ANT transceiver device available from Arrow has a maximum RF power of 5dBm. The expected range for this transceiver will be on the order of 10-30 meters. For this device, RF power is programmable to values less than 5dBm.

Can ANT nodes act as masters and slaves?

ANT powered nodes can act as both masters or slaves within a wireless sensor network. This means the nodes can act as transmitters, receivers or transceivers to route traffic to other nodes within the wireless sensor network. In addition, every node is capable of determining when to transmit based on the activity of its neighbors.
**ANT Technical specifications**

The basic ANT protocol has an efficiency (determined by the ratio of overhead to data) of 47 percent. ANT can be configured to spend long periods in a low power “sleep” mode (consuming of the order of microamps of current), wake up briefly to communicate, (when consumption rises to around 22mA (at -5dB) during reception and 13.5mA (at -5dB) during transmission), and return to sleep mode.

Each ANT channel consists of one or more transmitting nodes and one or more receiving nodes depending on the network topology. Any node can transmit or receive so the channels are bi-directional.

**Types of messaging supported by ANT**

ANT accommodates three types of messaging: broadcast, acknowledged, and burst.

*Broadcast* is a one-way communication from one node to another. The receiving node transmits no acknowledgment. This technique is suited to sensor applications and is the most economical method of operation.

- No acknowledgedment
- Default for master endpoint
- Only message type supported on TX-only channels
- 8 bytes per message period
- Best suited for sensor applications where lossss of data is not critical
- Most ANT sensors use Broadcast messages

*Acknowledged* messaging confirms receipt of data packets. The transmitter is informed of success or failure, although there are no retransmissions. This technique is suited to control applications.

- Message is acknowledged
- Fully bi-directional
- 8 bytes per message period
- Best suited for sensor applications where sender must know data received
- Parts of ANT+ FS protocol use acknowledged messaging

*Burst* transmission technique uses the full data bandwidth and runs to completion. The receiving node acknowledges receipt and informs of corrupted packets that the transmitter then resends. The packets are sequence numbered for traceability. This technique is suited to data block transfer where the integrity of the data is paramount.

- Optimized to send bulk data
- Fully bi-directional
- 8 bytes per message period
- Each packet re-tried up to 5 times
- Maximum data rate is 20kbps
- ANT-FS is heavily based on burst messaging
How does ANT compare to other wireless technologies?

Standards-based protocols such as Bluetooth® and ZigBee® are compromised by additions made to the protocol in order to satisfy the wide application needs of all interested parties (namely SIG or Alliance members). The net result is a large protocol overhead, lower efficiency, increased power consumption and increased costs.

How do I certify and register my ANT+ product?

The ANT+ Certification/Registration Program is designed to standardize ANT+ products. This Certification/Registration process involves:

- An ANT+ device profile implementation testing or review
- An ANT+ brand review on product and product collateral
- Products that pass certification receive:
  - Approval to use the ANT+ logo and profile icons on the product and software interface, and in marketing materials
  - Certification/Registration reports
  - ANT+ Compliance Certificates
  - Listing(s) in the ANT+ Product directory

Certification/registration types:

Type 1: Products with new implementation of ANT+ profiles. This category requires the most comprehensive set of profile testing.

Type 2: Products with upgraded or modified ANT+ profile implementations based on previously certified products. This category requires a reduced set of profile testing.

Type 3: Products with changes not related to the ANT+ profile implementations. Such changes may include cosmetic changes, user interface adjustments or sensing technology revisions. An ANT+ brand review is the only certification requirement for this category.

Registration: Software applications that are to be downloaded, installed and upgraded by consumers directly, e.g. software to be run under Android, iOS, OSX, Windows etc. This registration requires a review of the ANT+ branding and the self-verification report.

Preparation

The application package includes ANT+ device profile checklists, brand review documents and a certification/registration application form to assist with your submission. The ANT+ device profile and brand checklists also serve as a development guide for proper implementation.

Self-verification

All products requesting Registration, or Type 1 or 2 Certification must go through the self-verification process using the ANT+ Profile Verification Software Tool to generate a self-verification report. This software tool is provided to all members and adopters free of charge.
Submission
The submission page is available in the Adopter Zone. A fee quote and schedule will be provided once the required submissions are received. The fee and product samples must be received prior to the arranged start date.

Testing & Review
Contacts listed on the application form will be regularly informed of the status throughout the process.

Fees

Fees are based on the following factors:
- ANT+ membership status. Membership discount rates apply
- Certification / Registration type
- Product complexity
- Number of implemented profiles and the sophistication thereof

How well does ANT handle interoperability with other 2.4GHz radios?

ANT, ZigBee, Bluetooth, 802.11 and some cordless phones all use the 2.4 GHz band as well as 868- and 915 MHz in regional deployments. Additionally household microwaves and other consumer products share this crowded frequency band.

802.11, ZigBee and Bluetooth employ Direct Sequence Spread Spectrum (DSSS) and Frequency-Hopping Spread Spectrum (FHSS) schemes respectively to maintain the integrity of the wireless link. ANT+ uses an adaptive isochronous network technology to ensure co-existence.

Adaptive isochronous network technology provides the ability for each transmission to occur in an interference-free time slot within the defined frequency band. The radio transmits for less than 150 µs per message, allowing a single channel to be divided into hundreds of timeslots. The ANT messaging period (the time between each node transmitting its data) determines how many time slots are available. ANT's adaptive isochronous scheme doesn't require a master clock. Transmitters start broadcasting at regular intervals but then modify the transmission timing if interference from a neighbor is detected on a particular timeslot. This flexibility allows ANT to adapt to hostile conditions but ensures there is no overhead when interference is not present. The absence of a system clock simplifies the sensor node hardware design and avoids clock skew/sync issues.

If the radio environment is very crowded, ANT can use frequency agility to allow an application microcontroller-controlled "hop" to an alternative 1 MHz channel in the 2.4 GHz band which can then be subdivided into timeslots.

Summary

The ANT technology provides a compelling option to provide wireless connectivity where power consumption is the primary technical driver. ANT enables the productization of simple, low-cost wireless end points with straightforward design implementation. Arrow’s M2M staff and network of experts can assist in the selection of ANT hardware and firmware solutions for cost and size challenged applications.
Arrow Machine-to-Machine Solutions
Arrow's M2M Solutions offer wireless expertise, a vast selection of products from world-class suppliers, unmatched M2M engineering support, comprehensive services and renowned supply chain management capabilities. Arrow's Solutions can be tapped at any point, from concept to production, and at each step of your design cycle, to maximize efficiencies and streamline your journey to market.

Contact Us Today!
Call 800-833-3557 to speak with your local Arrow M2M representative, or visit www.arrownac.com/m2m for more information.