ARRIS Wireless Solutions

Patented Smart Wi-Fi® Technology

ARRIS provides wireless networking solutions from Ruckus Wireless.™ Ruckus is known for its patented Smart Wi-Fi technology, and its unique ability to support streaming multicast IP video over the 802.11 standard protocol. This adaptive antenna technology that leverages high-gain directional array technology and best path selection algorithms to form and direct Wi-Fi signals over the best performing paths to each and every client.

Smart Wi-Fi is actually a collection of technologies, all designed to extend the range and reliability of wireless signals. It constantly steers signals around obstructions and obstacles, mitigates interference and focuses RF energy only where it is needed to ensure unprecedented coverage and consistent performance at longer ranges. These technologies eliminate much of the cost and complexity of conventional wireless LAN (WLAN) deployments.

Ruckus Smart Wi-Fi Patented Technologies include:

- **BeamFlex**—a sophisticated smart antenna system that combines a multi-element antenna array and best path selection algorithms, to continually find the ideal route and best S/N for a Wi-Fi signal to a given client at any time.
- **SmartMesh**—a state-of-the-art RF routing system that provides the ability to construct an adaptive, resilient, reliable, self-healing, high-speed wireless mesh network.
- **SmartCast**—an advanced traffic engineering and quality of service system that classifies, prioritizes, and queues even untagged traffic, to ensure high-quality transmissions.
Proprietary adaptive antennas with unique interference avoidance technology combine with industry standard beamforming to provide unmatched Wi-Fi range and reliability. Directional, high-gain antennas dynamically rearrange per packet per user to deliver 2X to 4X the coverage of competing APs, resulting in 30 – 40% fewer APs needed for deployment.

Completely standards based, the BeamFlex smart antenna system works with any off-the-shelf 802.11a/b/g/n chipset and is integrated into every Ruckus ZoneFlex™ Smart Wi-Fi® AP.

How BeamFlex Works

Unlike omnidirectional antennas that radiate signals in all directions, BeamFlex directs transmit energy towards the best path to the receiving device. And unlike fixed positioned directional antennas, BeamFlex dynamically configures and re-configures its “beam” to achieve omnidirectional coverage with directional performance within a given environment.

The BeamFlex smart antenna is controlled by expert system software that automatically reconfigures the antenna array on a per packet basis, selecting the best performing and highest quality signal path and optimum data rate for each receiving device.

BeamFlex takes advantage of 802.11’s built-in acknowledgement mechanisms using 802.11 acknowledgements to continually ascertain the quality and performance of a physical RF link.

The expert software system within BeamFlex extracts important information from all 802.11 packets received such as the sender’s performance, the optimum data rate, RSSI, error rates and approximate location. It then ranks the optimum antenna patterns for each communicating device keeping track of the best performing signal path at any time for any given client.

BeamFlex Benefits

- Fewer Access Points (APs) reach farther while delivering more reliable client connectivity
- Self-healing, self-optimizing beam steering antenna system proven in more than 1 million installations
- Mitigates interference in a high density client and AP environment
- Extends Wi-Fi range and coverage by focusing Wi-Fi signals toward client
- Maximizes AP and client performance
- Eliminates dead spots
BeamFlex Features

- Multiple directional high-gain elements
- Real time optimization expert system
- Hundreds to thousands of software-controlled beam patterns
- Compatible with 802.11a/b/g/n networks
- Compatible with MIMO
- Continuous learning based on inputs from network layers 0 through 7
- On-the-fly antenna reconfiguration and transmission policy management per packet, per flow, per receiving device
- Up to 9 dBi signal gain and 17 dB interference mitigation results in up to 26 dB improved S/N ratio

BeamFlex Smart Antenna Array has up to 19 discrete directional elements that can be used to form over 4,000 unique antenna combinations for unprecedented Wi-Fi signal reliability.

BeamFlex not only focuses RF energy only where it’s needed but also nullifies interference coming from other directions. This optimizes S/N, thereby ensuring that the highest possible PHY rate is used and that the highest possible throughput is achieved for all clients.
SmartMesh™ High Performance Wi-Fi® Mesh

Ruckus™ Wireless SmartMesh is a unique, new approach to building high-performance wireless LANs (WLANs). It reduces cumbersome RF planning and costly cable backhaul by lowering the need to run Ethernet wiring to individual ZoneFlex™ Smart Wi-Fi® APs.

SmartMesh dramatically simplifies, speeds, and reduces the cost of WLAN deployment. With SmartMesh, enterprises now simply plug ZoneFlex APs into any convenient power source, and walk away. No extensive RF site surveys, cable runs, configuration, or optimization adjustments are required.

SmartMesh delivers three key ingredients that have previously hindered the use of indoor meshing:

1. High performance by combining 802.11n with Smart Wi-Fi technology
2. Reliable connectivity between mesh nodes, using best path selection and interference avoidance techniques
3. Ultra-simple Zero IT deployment through the automation of AP and mesh provisioning

SmartMesh extends Ruckus-patented Smart Wi-Fi technology to create a new class of reliable and high-performance wireless LANs that are self-organizing, self-optimizing, and self-healing. It is the first Wi-Fi meshing approach that combines high-gain smart antenna arrays, sophisticated RF routing and centralized management with a single WLAN system.

SmartMesh Benefits

- Single platform for Wi-Fi service management
- Direct device access and detailed client troubleshooting
- Comprehensive management
- Carrier-grade scalability
- At-a-glance customizable network dashboard
- Bulk configuration and firmware upgrades
- Sophisticated filtering, searching and grouping
- Advanced reporting
- Reduce support costs per subscriber
- Hierarchical administration rights
- Cloud services

SmartMesh Features

- Built on patented Ruckus BeamFlex™ directional smart Wi-Fi antenna array technology
- Centrally managed by Ruckus ZoneDirector™ Smart WLAN controller
- Self-forming network topology
- Automatic AP provisioning
- Secure encrypted backhaul links
- Self-healing around mesh AP failures and environmental problems
- Supported on all Ruckus ZoneFlex 802.11g and 802.11n Smart Wi-Fi APs
- Real-time interference avoidance and automatic interference rejection
- Best path signal selection to clients
- High quality of service and rate limiting throughout the mesh

Smart Wi-Fi Makes All the Difference

Ruckus Smart Wi-Fi technology is used by the SmartMesh to form, direct and steer Wi-Fi signals over the best performing paths between mesh nodes and associated clients.

This enables the SmartMesh to adapt in real time to environmental changes, ensuring highly reliable and available wireless trunk links.

This same smart antenna array allows the SmartMesh to continuously choose from thousands of antenna patterns, to avoid or reject interference, and to maintain high performance connections.
Smart Wi-Fi® Makes all the Difference

Ruckus™ Smart Wi-Fi technology is used by the SmartMesh™ to form, direct and steer Wi-Fi signals over the best performing paths between mesh nodes, as well as to associated clients. This enables the SmartMesh to adapt in real time to environmental changes, ensuring highly reliable and available wireless trunk links.

Each ZoneFlex™ APs within the SmartMesh integrates an intelligent, high-gain antenna array that provides diversity and extended signal range. This ensures high performance by minimizing the number of mesh hops and reducing the number of mesh APs required.

Additionally, this same smart antenna array allows the SmartMesh to continuously choose from thousands of antenna patterns, to avoid or reject interference, and to maintain high performance connections between mesh nodes.

How Ruckus SmartMesh Works

With SmartMesh, each ZoneFlex AP functions as a wireless node within the mesh. SmartMesh uses antenna-ranking techniques to determine the best upstream path through the RF to the backhaul AP.

SmartMesh topology is automatically determined based on the potential throughput of each node. Potential throughput is the actual throughput of its uplink (i.e., how fast the uplink AP can get a packet to the wired network) as well as the potential throughput to the uplink AP. This is based on the actual throughput to the uplink AP, signal strength, and other considerations such as AP load and hop count.

Ruckus SmartMesh is managed centrally from the Ruckus ZoneDirector Smart WLAN controller. Powerful mapping and management tools allow a complete view of the entire SmartMesh, including connections within the mesh, associated mesh clients and other unique controls.
SmartCast® Quality of Service (QoS) Engine

SmartCast is a sophisticated QoS engine specifically developed to maximize the reliability and performance of delay-sensitive applications, such as IP-based voice and video over 802.11 networks.

Based on patented technology, SmartCast delivers a collection of unique capabilities—such as packet inspection, automatic traffic classification, advanced queuing and scheduling.

Unlike any other 802.11 system, Ruckus™ SmartCast algorithms automatically schedule and pre-queue traffic in software on a per client basis. This enables more advanced classification and scheduling that can be applied for each client on a per-traffic-class basis. SmartCast is a superset of the IEEE 802.11e/WMM hardware-based queuing standard, ensuring uncompromised performance while remaining standards-compliant.

With per-client queuing, SmartCast is ideal for video and voice over Wi-Fi applications because it ensures disruptive clients don't negatively affect the performance of others clients on the network (no head-of-line blocking).

The SmartCast engine further optimizes spectrum usage with innovative band steering and airtime fairness technologies. Essential in high-density and diverse client environments such as conference facilities, classrooms and auditoriums, SmartCast works in concert with Ruckus BeamFlex™ smart antenna array technology to deliver greater network throughput and more predictable performance for latency-sensitive applications.

SmartCast uses patented multicast traffic handling to guarantee high-definition video streaming over Wi-Fi. Proven in millions of subscriber homes around the world, providers are using SmartCast to deliver multiple concurrent broadcast quality video streams to subscribers without having to wire or rewire homes or offices.

SmartCast was designed for simplicity, requiring no manual tuning or configuration. SmartCast automatically classifies traffic based on Layer 2 or 3 priority tags and performs and advanced heuristic analysis on untagged traffic.

**SmartCast Benefits**

- Powerful, Superior Performance
- Guaranteed multicast streaming
- Optimal utilization
- Increased efficiency and capacity
- Easy to use

**SmartCast Features**

- Traffic queuing on a per client basis (voice, video, best-effort, background)
- Automatic (heuristics-based) traffic classification
- 802.11e/WMM support
- TOS and 802.1p classification
- Airtime fairness and Band steering
- Rate limiting
- Power save (UAPSD and Legacy)
- IP multicast-to-unicast conversion
- IGMP snooping
- WLAN prioritization *
- Client load balancing *

* With ZoneDirector™
SmartCast® Queuing and Scheduling

Auto Traffic Inspection, Classification and Queuing

At the heart of SmartCast is a sophisticated traffic inspection, classification, and optimization engine that works in software to provide per-client, per-traffic-class queuing.

The SmartCast QoS engine inspects each packet and automatically classifies it into one of four queues—voice, video, best effort, and background. SmartCast can inspect a variety of headers including those of Ethernet frames (both TCP and UDP), VLAN tags, and IPv4 and IPv6 packets.

If the type of service or 802.1p priority field is used, SmartCast maps packets to an equivalent internal field. If no tag is provided, SmartCast employs heuristics to classify traffic.

Once classified and queued, traffic is scheduled using a weighted round robin method based on airtime and throughput potential as well as prioritization defined for the WLANs. Rate limits can also be applied on a per-WLAN basis for every client.

Once SmartCast classifies, schedules and queues traffic, Ruckus’ patented BeamFlex™ smart antenna array then takes over. BeamFlex is a miniaturized intelligent phase array antenna system that constantly steers traffic over the best performance signal paths and away from interference to minimize packet loss and maximize throughput.

Always looking for patterns in the packet flow, SmartCast is automatically enabled on every AP—no configuration is necessary.

Patented Multicast Voice and Video Support

When transported over 802.11 networks, multicast transmissions typically use a best-effort technique that requires no acknowledgement from the receiving devices.

To ensure the delivery of multicast and broadcast traffic, often used in voice and video applications, SmartCast employs a patented multicast technique that converts multicast to unicast packets.

Converting multicast to unicast traffic enables the use of 802.11 acknowledgements to ensure transmissions are forwarded at the highest possible data rate and are properly received.

Receipt acknowledgement provides the guaranteed delivery necessary for streaming broadcast quality video over wireless.

Through IGMP snooping, all APs and mesh nodes are aware of multicast group membership tables, ensuring consistent service anywhere in the wireless network.
**Increased Efficiency and Capacity with Load Balancing and Band Steering**

SmartCast employs sophisticated load balancing and band steering techniques to enable clients to efficiently use the AP and spectrum resources.

Ruckus™ ZoneDirector™ monitors the client load across the APs, and drives new clients to less congested APs. Requiring no specialized software on the client, ZoneDirector, not the client, is in control of how they join amongst available APs, resulting in a more prescribed distribution. ZoneDirector automatically groups APs to balance across—there’s no need for manual configuration. Operating on a per WLAN basis, load balancing can be selectively disabled, for instance disabling on Voice WLANs only to ensure seamless roaming.

Available on Ruckus ZoneFlex™ dual-band APs, band steering automatically "steers" clients to the 5 GHz band, maximizing the use of spectrum resource to ensure higher availability and throughput for users.

This is ideal for high-density client environments such as auditoriums, conference halls and public venues where many users try to concurrently connect to the WLAN.

With only 3 non-overlapping channels within the 2.4 GHz band, it is preferable, when possible, to automatically steer dual-band clients to the 5 GHz band where 23 non-overlapping channels are available.

For dual-band clients with a poor signal to the 5 GHz radio, the 2.4 GHz band would used instead. This results in a more optimal distribution of traffic across available channels and a better use of the available air resources. Performance is further improved because there are fewer users sharing (and colliding) on a given channel.

**Band Steering Features**

- Ideal for high-capacity environments
- Takes into consideration RSSI levels across both bands and, where appropriate, automatically steers clients to 5 GHz
- Supported in Ruckus dual-band APs
More Efficient Use of Spectrum with Airtime Fairness

Airtime fairness is an advanced scheduling technique that ensures legacy Wi-Fi® clients as well as under performing 802.11n clients don’t slow down the performance of faster 802.11n clients by taking too long to transmit.

With airtime fairness enabled, transmit queues are scheduled based on the airtime constraints per station using weighted round-robin algorithms.

With airtime fairness, users have an equal time on the air and can continue to send packets so long as their airtime use allows. This allows clients with faster potential throughput to recapture the advantages of their higher rate potential and increases overall network capacity.

ARRIS Company Overview

ARRIS is a global communications technology company specializing in the design, engineering and supply of technology supporting triple- and quad-play broadband services for residential and business customers around the world. The company supplies broadband operators with the tools and platforms they need to deliver reliable telephony, demand driven video, next generation advertising and high speed data services.

Contact ARRIS: (888) 353-9473  www.arrisi.com

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