RFS LTE Solutions

Enabling the communications revolution at the cell tower top



Efficiently migrate to **LTE** technology

More than any other wireless innovation, Long Term Evolution (LTE) technology has the capability to change the face of communications. It will provide the bandwidth and flexibility to support more advanced services for business and consumer end users, thereby creating new revenue opportunities for wireless network operators worldwide. As a result, operators around the world are making plans to enhance their networks by integrating LTE technology. Regular market updates by the Global mobile Suppliers Association (GSA) continue to confirm a growing global commitment and support for LTE as the next generation mobile broadband system of choice. And many operators are already building out their networks and transforming them to take advantage of all the benefits LTE has to offer.



RFS provides complete wireless infrastructure solutions that enable an efficient migration to LTE. These solutions offer an evolutionary path that keeps the real estate changes at cell sites to an absolute minimum, while allowing operators to optimize each site for today's network technology, tomorrow's LTE requirements, and beyond. Based on an unrivaled knowledge of wireless infrastructure, RFS' proven portfolio of lightweight, high performance RF equipment is optimized to provide the best possible performance, compatibility and cost-effective longevity for the full range of the most common bands, applications and emerging technologies, including LTE (700 MHz and 2.6 GHz), Cellular 850, GSM 900 and 1800, PCS 1900, AWS and UMTS 2100.

This complete portfolio includes world class LTE solutions already deployed around the world, such as base station antennas (BSAs), site optimization products (SOPs), and microwave antennas. It also includes innovative hybrid cabling and connection solutions that make it easier to streamline operations when upgrading or replacing traditional base station configurations with the latest distributed base station architectures.

All RFS solutions are the result of ongoing investments in R&D and a close working relationship with customers, which ensure all products are designed to meet the demanding network infrastructure needs of today and the requirements of emerging communications standards.



Optimize base station operations

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One of the biggest challenges operators face is ensuring their base stations can cost-effectively support a variety of frequencies. The time, cost and risk associated with antenna site evolution can negatively impact an operator's bottom line because replacing or adding antennas to accommodate different technologies or frequencies delays time-to-market, is expensive and can lead to difficult negotiations with landlords.

These challenges are of particular concern for operators moving to LTE, where allocated frequencies may be unknown or may change from the trial stage to the deployment stage. While LTE will eventually be the prevailing technology across the entire spectrum, operators may want to take advantage of frequencies down to 1800 MHz, if and when spectrum becomes available. On the other hand, operators may want to use LTE at 700 MHz or 800 MHz to achieve specific market objectives.

RFS offers antennas for all frequencies as well as feeder sharing solutions designed to address the space and deployment constraints operators will face as they add LTE capabilities to their base stations. These solutions reduce the cost associated with materials, site installation and ongoing operations, lower the risk of migration to LTE technologies, and improve time-to-market with new, revenue-generating services. In addition, they help operators optimize base station operations and maximize 4G investments by reducing the loading on cell towers and minimizing both leasing costs and visual impact on the environment.

Leverage a complete portfolio of LTE antenna options

The complete portfolio of RFS LTE antenna solutions offers state-of-the-art base station antenna options designed to meet the full spectrum of operator footprint, pattern, gain and tilt requirements.

Low band antennas for capacity and precision

RFS **Optimizer® low band antennas** are designed to provide capacity, precision and durability to support 800 and 900 MHz LTE operations. These high gain antennas are available in fixed electrical and variable electrical tilt configurations. They are built to provide the best network performance and coverage and deliver a combination of reliability and growthadaptability that ensure ongoing costeffective operation for small and large operators alike. They feature:

Our Passive Intermodulation (PIM), which eliminates system down-time, guarantees high call quality and reduces the number of dropped calls

 Excellent upper sidelobe suppression, which allows for high mechanical tilt applications

Wideband frequency performance, which enables a single antenna to be used for a variety of applications, thereby streamlining deployments and reducing inventory

Dual band antennas to reduce tower loading

For applications that require a minimum number of antennas at a cell site to reduce tower loading RFS offers **Optimizer® dual band antennas** designed to operate at 790-960 and 1710-2200 MHz frequencies. Available in variable electrical tilt dual polarization or side-by-side quad polarization versions, these antennas include premium performance features, including high upper sidelobe suppression for reduced interference, excellent front-to-back ratio, and performance stability across frequencies.

High band broadband antennas for best-inclass coverage

LTE network performance in the 2.6 GHz frequency band can be maximized with RFS **Optimizer® high band broadband antennas**. These variable electrical tilt narrow and wideband antennas offer the perfect balance between energy efficiency and RF performance with advanced features, including a new dipole design, improved radiating geometry, and a high performance phase shifter network. They offer superior gain tracking and best-inclass coverage to ensure optimal network performance for advanced applications, while providing flexibility for future growth.





Ultra-broadband antennas for ultra-flexible spectrum support

RFS **ultra-broadband antennas** dramatically simplify antenna requirements by supporting a range of LTE-frequencies from 1710 to 2700 MHz on a single platform. Ready for LTE testing today, they eliminate the need to replace or add antennas as operators trial and deploy LTE services at different frequencies.

Available in dual polarization or side-by-side quad polarization versions, these antennas feature RFS premium performance: high gain, high upper sidelobe suppression and

performance stability across frequencies. They also provide easy adjustments, optional remote tilt, and a low-profile design to minimize visual impact. The variable electrical tilt feature allows

the antennas to be adjusted from zero to 12 degrees for enhanced precision when controlling intercell interference. And the side-byside version gives operators increased flexibility to support multiple technologies, seamlessly add capacity and benefit from additional capabilities.



Multiband antennas for multiple applications

RFS also offers **multiband antenna** options engineered to help operators further reduce tower load and the environmental visual impact of multiple antennas on a single tower. RFS multiband antennas optimize base station performance for LTE by reducing the total number of visible antennas from two – and sometimes three or four – to just one. This is achieved by co-locating multiple cross-polarized antennas within a single antenna-sized radome. RFS is continually expanding its multiband antenna portfolio with a variety of configuration options, including:

Dual band antennas:

- 790-960 MHz with 2300-2700 MHz
- Two 1710-2700 MHz ultra-broadband

Striple band antennas that combine:

- One low band with two high band in a 1.6 m, 2.1 m, or 2.6 m enclosure
- One low band with two high band, which include one LTE 800 MHz
- One low band, one high band, and one 2.6, which includes 800 and 2600 MHz

Ouad band antennas :

• One low band, two high band, and one 2.6 GHz

→ Hexport antennas:

• Two high band and one 2.6 GHz

These multiband antenna options provide the widest RF technology range to ensure optimal site fit-out flexibility, and are available with variable electrical tilt capabilities.

Improve coverage with UltraAmp[™] Tower Mounted Amplifiers

To enable operators to further optimize their base station configurations, RFS offers an innovative UltraAmp[™] Tower Mounted Amplifier (TMA) platform specifically engineered for LTE applications.

TMAs are used in wireless networks to improve coverage by boosting base station sensitivity. Higher BTS sensitivity leads to better voice quality and fewer dropped calls. Using a TMA can also improve bit rate coverage for data transmissions, thereby enhancing coverage and capacity. TMAs can also be used to achieve cell enlargement, which allows operators to serve more subscribers from the same BTS site, ultimately generating additional network revenue. As one of the leading global suppliers of TMAs, RFS supports the largest operators and original equipment manufacturers. Its renowned UltraAmp[™] TMA portfolio covers all major bands and applications, and the RFS 2600 LTE TMA is designed to help operators improve LTE coverage.

The RFS 2600 LTE TMA uses a higher level of RF component integration and a new filter tuning concept in a smaller, lighter enclosure than traditional TMAs.





The twin TMA module consists of a one dual filter design with two low-noise 12 dB gain amplifiers and an auto-bypass function. It is available with an Antenna Interface Standards Group (AISG) detector and interface towards the base station, or a Current Window Alarm (CWA) base station interface, if required.

This advanced TMA design offers nextgeneration performance with 30 percent fewer components, thereby reducing total weight on a tower. And with fewer components, the 2600 LTE TMA offers improved reliability because there are fewer points of potential failure.

Finally, as with all RFS TMAs, power distribution units and bias-tees are available as part of a complete RFS solution.

ShareLite combiners multiply deployment options; divide the costs

RFS also offers diplexers and triplexers engineered to allow several systems to use the same feeder cable between the base station and the antenna. With these combining solutions operators can simultaneously reduce tower load while achieving a corresponding cost savings through a streamlined feeder cable arrangement.

RFS' ShareLite Combining Solutions efficiently support LTE migration on the cell tower, and are also backwards compatible with 2G and 3G frequencies. The solutions' unprecedented compact design allows cell tower installation on a swap-out basis, boosting service capabilities while avoiding added weight to the site.

In addition, ShareLite's very low insertion loss limits the impact on total system loss, ensuring high quality wireless cellular services for years to come.

The complete line of lightweight ShareLite combiners includes diplexers for all bands (LTE700, Cellular800, EDD, GSM900, GSM1800, PCS, AWS, UMTS, LTE2600). Each unit offers extremely low insertion loss and optimized link budget performance, as well as high protection against interference. High power handling capabilities support multiple simultaneous operators and MCPA deployment, and the integrated DC-pass option supports TMA and RET solutions. All ShareLite combiners are designed to exceed industry standards and have been field tested and proven in deployments around the world to provide maximum performance under the most extreme operating and environmental conditions.

DUAL BAND

4 X CABLE

RFS LTE SOLUTIONS

Supports LTE migration on the cell

tower

BROADBAND

HYBRIFLEX[™] Designed for new RRH deployments

Engineered for maximum flexibility and reliability

RFS also offers innovative, hybrid cabling solutions engineered to streamline LTE base station operations. HYBRIFLEX[™] is the first hybrid cabling solution to combine optical fiber and DC power for Remote Radio Heads (RRHs) in a single, highly flexible, lightweight aluminum corrugated cable that allows operators to ground the cabling system. It is designed specifically for new RRH deployments and base station upgrades.

This integrated cabling solution replaces traditional multi-cable approaches, which require additional infrastructure components, long site installation times, difficult implementation accessories and training for installers who must work with the delicate optical fiber. And it is available in 1-Sector or 3-Sector configurations to allow operators to connect up to three sectors with a single, composite cable.

As a result, HYBRIFLEX[™] provides the cabling expenditure reductions, ease-ofinstallation and operational efficiency mobile operators need to evolve their networks while limiting their power consumption and carbon footprint at cellular sites.

HYBRIFLEX[™] is engineered to provide maximum flexibility at installation and ongoing reliability long after installation is complete.

To simplify installation, the HYBRIFLEX™ corrugated aluminum outer armor offers outstanding bending characteristics,

which allows it to be installed like a conventional coaxial RF cable. And it is designed to standard RF feeder diameters.

Therefore, commonly available RFS CELLFLEX® LCF 1/2-inch and LCF 7/8inch feeder accessories can be used in all HYBRIFLEX™ installations. And to further simplify installation, HYBBRIFLEX™ is delivered pre-connectorized for fiber optic and DC converters.

To ensure lifetime reliability, the corrugated aluminum outer armor provides more durable, lightweight protection than polyethylene tubes and at a much lower cost than cable trays. This armor protects the power, fiber optic (multi-mode or single-mode) and grounding cables during and after installation. In addition, a protective jacket on each individual cable pair ensures the inner cables are suitable for outdoor use.

PE external jacket Optical cable (pair) with an internal jacket (PE)

Power cable (pair) with an internal jacket (PE)

Easily migrate to RRHs with **DC-FIT[™] converter**

Designed to reduce upgrade time and costs

Another key component of the RFS portfolio of RRH solutions is DC-FIT[™], the world's first Direct Current (DC) converter. This solution dramatically simplifies upgrades of existing wireless cell sites. It makes it easier for operators to migrate to base station architectures that take advantage of RRH configurations and fiber optic technologies.

Typically, upgrading or replacing old-style base stations with the latest base station architecture requires operators to dismantle cell sites to install new fiber optics, DC power cabling and equipment. This is time consuming and, in many cases, not acceptable because operators cannot generate revenue from a site that is off-air.

With DC-FIT[™], operators can avoid disruptions in service and quickly migrate to RRH architectures by leveraging existing base station hardware. The DC-FIT[™] converter is designed to connect a DC cable with an existing coaxial cable run. It features innovative technology that turns an existing coaxial foam dielectric feeder into a RRH power supply. As a result, upgrading a conventional coax site to RRH technology is a breeze, compared to the time-consuming installation of a new DC cable run. This innovative solution is available for coaxial cables with a 7/8", 1-1/4" or 1-5/8" nominal diameter and is already in use around the world.

By reusing existing, deployed coaxial cable to transport the DC voltage required by the tower top RRH, operators can significantly reduce rollout planning and site preparation time by up to 50 percent. Plus, by combining DC-FIT[™] with the RFS OPTI-FIT optical cabling solution, which enables reuse of existing RF feeders as ducts for optical fibers, operators can quickly and cost-effectively address the space limitations and challenges imposed by weight and wind load allowances associated with distributed RRH architectures.

Upgrades are simplified because only two DC-FIT[™] converters are required per site. In addition, operators do not need to wait for permission from the base station site's landlord to perform upgrades. Plus, additional equipment, such as cherry pickers, is not needed to install the converter. And the upgrade does not require an extension of the cable path for the DC cable, or installation of fire protection in the form of wall glands for the power cable.

Vodafone Germany Leverages DC-FIT[™] for LTE

DC-FIT[™] is being used by operators around the world to simplify upgrades of existing wireless cell sites to RRH configurations. For example, Vodafone Germany is leveraging the benefits of DC-FIT[™] to leverage existing base station hardware as part of its roll out of new technologies, including 4G LTE. More than 6500 units have been installed to date with more on their way as the operator prepares its network to meet subscriber demand for premium services.

As a result, DC-FIT[™] allows operators to perform upgrades where and when they need them. This saves time, money, and operational headaches.

Improve backhaul performance with microwave parabolic antennas

Of course, any LTE technology migration plan must also consider the backhaul portion of the network. To truly deliver the advanced applications and services subscribers will use and take advantage of the business benefits LTE offers, operators must ensure their backhaul networks can efficiently support LTE multimedia and data traffic. Based on an unrivalled history of research and design innovation, the RFS portfolio of microwave antenna systems addresses all elements of the RF chain for installers. OEM integrators and network operators. It offers a true endto-end, future-proof solution set optimized for all popular microwave radio bands and engineered to deliver premium electrical performance to meet the most stringent wireless transmission network requirements.

A variety of backhaul antennas

The RFS portfolio of microwave antenna systems includes a comprehensive suite of antennas designed to support tomorrow's capacity requirements today. Advanced, single- or dual-polarized antennas in a variety of sizes (1 to 15 ft) are available to support all frequency bands between 3.6 and 80 GHz, and in different performance classes (high, ultra-high and high Cross Polar Discrimination (XPD) performance).

RFS CompactLine® antennas with RFS backfire technology feed systems provide an ultra-lowprofile with ultra-high performance in the 6 to 80 GHz range (1 to 6 ft). These antennas can be customized with fittings to allow specific radios and hot-standby couplers to be mounted directly on the antenna. This eliminates the need for a waveguide link between the tower-mounted antenna and equipment building, and simplifies integration with OEM radio systems.

For network deployments that require larger configurations, the **RFS microwave antennas** product line offers large diameter antennas in 8 ft to 15 ft sizes to accommodate 3.6 to 22 GHz frequencies in all performance classes.

All RFS antennas are available with a variety of options, such as advanced mounting structures, wind load kits, sway bars, elliptical waveguides, and associated accessories, including connectors, grounding kits and pressurization equipment. With this total package solution approach operators can quickly deploy the network upgrades that will improve network efficiency.



New CompactLine[®] EASY antennas for optimized LTE backhaul performance

To truly enable operators to optimize LTE backhaul performance, RFS offers singleand dual-polarized RFS CompactLine[®] antennas specifically engineered to support LTE capacity requirements.

RFS CompactLine[®] dual-polarized antennas are available in a variety of sizes from 1 ft to 6 ft. They support wideband frequencies up to 11 GHz and narrow band frequencies up to 38 GHz. In addition, for high frequency band applications, RFS offers new singlepolarized RFS CompactLine[®] EASY 2 ft antennas that can operate at 42 GHz and in the E-Band (71-76 GHz and 81-86 GHz).

The RFS CompactLine® EASY antennas are the most compact on the market. They feature a new, deep dish reflector design and compact mount that results in a very low weight configuration, which makes them ideal for deployments where zoning restrictions and tower loading are key considerations.

A complete antenna portfolio

Together with the RFS High XPD antennas, which are available in frequency ranges from 4 GHz to 23 GHz and in sizes from 2 ft to 15 ft, RFS offers one of the most complete microwave antenna portfolios on the market. This enables operators to address all relevant LTE backhaul applications today and in the future.

Extend LTE indoors with RFS wireless indoor solutions

To truly deliver an anywhere and everywhere LTE mobile experience to end users, operators need solutions that extend high quality coverage where needed, outdoors and indoors.

The heart of an indoor network is typically a broadband passive distributed antenna system (DAS), which includes broadband radiating cable or a distributed antenna network (RF cables, splitters, couplers, and indoor antennas). These networks provide contoured RF coverage of a given confined area. To support a variety of end user applications, they have evolved to be ultra-RF broadband and LTE ready, allowing all services from 30 MHz to 6 GHz to share the same passive distribution system.

Wireless indoor solutions also incorporate many active components that must be fully functional in all frequencies and bandwidths. These include repeaters and amplifiers to support RF-over-fiber systems, which are used in larger buildings and complexes where purely passive infrastructure is insufficient.

Complete indoor solutions portfolio

RFS offers complete, best-in-class wireless indoor solutions that are LTE-ready, and include a wide range of RF broadband passive components for all LTE indoor applications (2.6 GHz, 2.3 GHz, 2.1 GHz, as well as 1900 MHz, 1800 MHz, 1700/ 2100 MHz, 1500 MHz, 900 MHz, 850 MHz, 700 MHz, and 450 MHz):

O World class CELLFLEX[®] and CELLFLEX[®] LITE low loss feeder cables

⊖ Leading edge, high performance RADIAFLEX[®] radiating cables

Broadband and ultra-broadband
indoor antennas

➔ Broadband and ultra-broadband, low insertion loss, indoor passive RF components (couplers, splitters)

These solutions are engineered to provide complete LTE coverage and:

Output high data rate applications that will be an important source of revenue for operators

Or Section Section

 Prevent interference between technologies and match environment constraints

Senable easy migration to future technologies

With these solutions, operators can benefit from the most advanced wireless indoor technology today, confident in the knowledge they can evolve to LTE when the timing is right for their business – without purchasing new hardware.

RADIAFLEX® optimized for LTE

In addition, the RFS RADIAFLEX® suite of radiating cables features RFS' patented "higher order mode suppression technique" in radiating cable design. This unique design allows RFS to offer cables that support current and future in-building commercial and private radio services from 698 MHz to 2700 MHz – including LTE – for valuable cost savings.



RADIAFLEX® cables also ensure low insertion loss and excellent coupling performance. They feature halogen-free, non-corrosive, low-smoke and flameretardant jacket material for safe and reliable long-term cable operation.



Support next-generation traffic with high performance transmission lines

Designing better performing, more durable and lighter cables is part of RFS' long tradition of innovation leadership. Today, RFS provides transmission line solutions for any RF application and deployment scenario. These end-to-end solutions are designed and engineered to support the next-generation of voice and data-rich wireless services that will be enabled by LTE.

Field proven and tested transmission line families

RFS' CELLFLEX® and CELLFLEX® Lite make up the largest corrugated transmission line portfolio in the wireless infrastructure industry. These foam dielectric feeder cables provide a reliable and technically superior solution when used as backbone feeders in cellular radio systems, including GSM, UMTS, CDMA, PDC, WiMAX, and LTE. In addition, they can be used for cable antenna arrays, radio equipment interconnections and jumper assemblies.

To enable quick and hassle-free installation, CELLFLEX[®] and CELLFLEX[®] Lite combine remarkable flexibility with high strength and superior electrical performance. Plus, the entire portfolio is backed by a complete line of accessories, which includes the industryleading RFS OMNI FIT[™] connectors.

Low loss, high strength

The RFS portfolio of LTE transmission line solutions also includes a complete selection of low loss, high strength CELLFLEX® Factory-Fit jumpers designed to provide maximum performance between transmission lines and antennas or system equipment.

They provide excellent contact force, low and stable intermodulation and superior RF screening, as well as reduced attenuation and low loss in super flexible 1/2", flexible 1/2", and ultra-flexible 7/8" versions in a variety of lengths and connector combinations featuring N-type and 7-16 DIN connectors. Other cable and connector types are available upon request.

RFS also offers phase stabilized versions to reduce phase drift with temperature, and phase matched groups to enable connections to antenna arrays and support "quasi omni" configurations.





LTE solutions that cover the entire RF-chain

With over 50 years of design and development experience, RFS provides the most comprehensive portfolio of LTE site solutions in the industry. Our LTE offerings cover the entire RF chain, from base station antennas to diplexers and triplexers, feeders, jumpers and tower solutions.

Based on unrivaled knowledge of wireless infrastructure, RFS has a clear vision of its customers' LTE site optimization needs. That knowledge is matched with extensive experience with LTE trials and deployments worldwide. And it is backed by field tested and proven products optimized to help customers take full advantage of the business opportunities enabled by the improved bandwidth and flexibility LTE offers.

With RFS, wireless network operators can efficiently migrate their networks to LTE while keeping the real estate changes at cell sites to an absolute minimum. This enables operators to optimize each site for today's network technology, tomorrow's LTE requirements, and beyond.





Why RFS? A worldwide leader in wireless and broadcast infrastructure



Radio Frequency Systems (RFS) is a global designer and manufacturer of cable, antenna and tower systems, along with active and passive RF conditioning modules, providing total-package solutions for wireless and broadcast infrastructure.

RFS serves OEMs, distributors, systems integrators, operators and installers in the broadcast, wireless communications, landmobile and microwave market sectors.

As an ISO-compliant organization with manufacturing and customer-service facilities that span the globe, RFS offers cutting-edge engineering capabilities, superior field support and innovative product design.

Serious about services

Customers know they can count on RFS for comprehensive logistical capabilities, flawless execution and outstanding technical skills and support. The company's dedicated shipment coordinators, hotline staff and on-site engineers go well beyond mere technology, striving to offer tailored solutions to meet even the most complex site-engineering and delivery challenges.

RFS' value-added services match the exact needs of business partners large and small.

Ever-present quality guarantee

From design to manufacture, ISO 9001 and ISO 14001 certification standards encompass all aspects of RFS' business worldwide. Every product RFS ships has stood up to the most stringent technical, environmental and quality control tests, continuously meeting and surpassing the expectations of a long list of wireless carriers, transportation and utility operators, and broadcasters.

RFS backs every product bearing its name with a quality guarantee that is unrivaled in the market.

A legacy of innovation

For over a century, RFS has been at the forefront of the wireless communication industry through its unwavering commitment to design and develop the world's most advanced technology in the field. Dedicated R&D teams, along with a privileged partnership with Bell Labs, are at the source of breakthroughs that are ensuring the mobility of an increasingly wireless world.

RFS is at the frontier of wireless technology innovation, sustaining the boldest ventures to enhance the way people communicate and live.

A truly global company

With on-the-ground personnel in more than 20 countries and on every continent, RFS always delivers on its commitments, providing a comprehensive range of premium products, systems and services. Its clients benefit from all the advantages of a global supplier, while relying on dedicated support from RFS' local engineering, manufacturing and shipping teams.

RFS' products, systems and personnel can be found in every corner of the planet. As a global group, RFS is committed to upholding the most stringent environmental, health and safety standards, and seeks to integrate green initiatives in every aspect of its business.

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