



# Radio Frequency Systems (RFS), Transit Wireless and SOLiD Bring Wireless Service to New York City Transit Authority (NYCTA) Riders

Massive endeavor will bring wireless voice and data communications capabilities to 277 New York subway stations by 2018



New York City

CASE STUDY

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## Summary

Governor Andrew M. Cuomo announced in April 2013 that 30 new subway stations now have wireless voice and data communication capability allowing New York City subway riders to make and receive cell phone calls, send and receive texts and e-mails and access Wi-Fi underground. Metropolitan Transportation Authority (MTA) officials were joined by executives from Transit Wireless, AT&T, T-Mobile USA and Boingo Wireless to demonstrate the new capability at the city's busiest station, Times Square. 36 stations total are now online and have an average annual ridership of approximately 7 million customers per station. Phase II of the project, which is currently underway and expected to be completed in mid-2014, includes 40 more stations, including Grand Central Station, 34th St. Herald Square and Bryant Park in mid-town Manhattan, as well as stations throughout the Borough of Queens.

**W**ith the explosive proliferation of wireless voice and data in the 21st century, users have come to expect at least some degree of service nearly everywhere to enable their array of telecommunications needs. One area that has long proven a thorn in the side of mobile users and wireless carriers alike is the New York City Subway system, a stronghold of wireless isolation. Due to a multitude of challenges, there was no public wireless connectivity in the subway system prior to 2011. Under a Metropolitan Transportation Authority (MTA) license agreement, Transit Wireless undertook the massive endeavor of enabling wireless voice and data communications capabilities in New York subway stations – more than 270 stations by 2018.

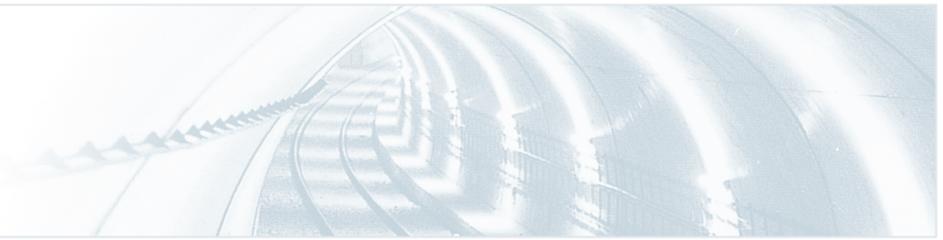
## New York City Subway – Lifeblood of a City

- Opened in 1904
- 24 x 7 operation
- 468 stations across 4 boroughs
  - 277 underground
  - 191 aboveground
- 659 track miles – local and express
- At peak over 570 trains operating simultaneously
- Annual ridership 1.65 billion
- Prior to 2011 no public wireless connectivity!



“ New York City’s subway system is currently one of the largest – and one of the oldest – in the world. Coupled with the harsh subterranean environment, the project was particularly challenging. Using time-tested, reliable solutions from companies like RFS ensures that our designs meet the precise coverage, traffic and route requirements necessary for such a large scale and complex project. ”

**Saeid Malaki**  
Design & Construction Manager  
at Transit Wireless



## The Project

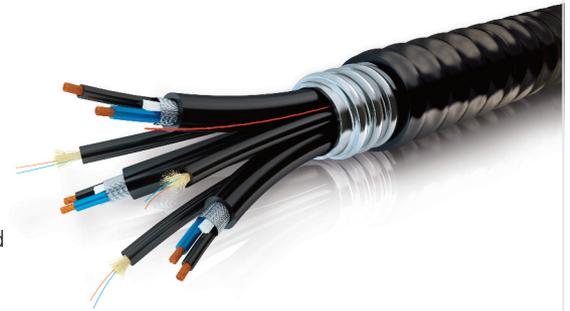
MTA officials contracted with Transit Wireless to build the system and rent bandwidth to mobile providers, as it would be impossible both structurally and economically for each wireless carrier to construct their own networks in the 110-year-old subway venue. Upon its completion, the Transit Wireless New York City Transit Authority (NYCTA) network will be one of the most expansive distributed antenna system networks worldwide, allowing the use of a wide variety of mobile devices anywhere within the system with cellular and Wi-Fi coverage options along with passenger access to expanding transit applications. This includes service information, alerts and advisories, access to the Help Point high-tech intercom system, location-based applications consisting of rider awareness, local business support and E911, and commercial wireless services for public safety and security personnel. The system will also harness the potential to support additional NYCTA business applications and Wi-Fi applications.

Transit Wireless owns and operates the wireless communications network and acts as a neutral host for extending a variety of wireless carrier services. NYCTA is the sixth largest carrier market in the US by subscriber traffic. The four major U.S. wireless carriers – T-Mobile, AT&T, Sprint and Verizon – have already signed on to become partners in the project. Customers of T-Mobile and AT&T are already receiving service and Sprint and Verizon customers will be able to use service later this year.

## The Challenge

Enabling the underground environment to be effectively connected is a priority that has been voiced collectively by the 1.6 billion transit riders, MTA-NYCT, and various public safety agencies. Making the subway stations wired and operational for mobile device service, however, proved to be a complicated task for engineers, requiring a distributed antenna system (DAS) and specialized cabling to support it.

New York City's subway system is the largest U.S. rapid transit rail system and one of the largest in the world – but it is also one of the oldest. Unlike a lot of modern subway stations, many of New York's stations were built when the system first opened in 1904 – more than 100 years ago – and are comprised of heavy steel. While this makes the stations extremely enduring, it blocks radio signals in many areas and plays havoc with propagation in the few places where signals do get through. On top of that, the moving metal of the trains and the constant vibration makes it nearly impossible to design a pervasive wireless system that functions well. Furthermore, dust accumulates on ground plane surfaces, causing passive intermodulation (PIM) interference that makes signal integrity even more degraded. As a result, ensuring communications devices perform as desired requires more than the typical distributed antenna system. Off-the-shelf equipment needed significant re-engineering to account for the unusually challenging environmental conditions.



“It's going to be a lot more convenient. You can access your email. You can send text messages. That's the most frustrating thing about being in the subway system ... that you're completely cut off from communication with work, with family so it will be really be convenient,” John Dioso of Park Slope told CBS 2's Hazel Sanchez. ”

**CBS New York,**  
Underground Wi-Fi Service Expanding  
to 30 More Subway Stations



Demanding the highest quality standards for the equipment used for the project ensures an efficient and superior network that is required for mission critical communications.

## About Transit Wireless

Transit Wireless owns and operates the subway station wireless communications network and acts as a neutral host for extending a variety of wireless carrier services to NYCTA's more than 1.6 billion riders annually. Major wireless carriers have already signed on to be partners on the Transit Wireless Network. In addition, there is interest for several applications from public/private wireless providers.

Services to all 277 underground stations will be rolled out over the coming years. First services were launched in six stations in Chelsea in September 2011.

CASE STUDY

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## The Solution

In order to overcome these obstacles to successfully extend wireless services to the subway stations, special considerations had to be made. Transit Wireless selected Radio Frequency Systems (RFS) and SOLiD to support its distributed antenna system in order to provide wireless coverage and capacity throughout the New York City Subway system including underground stations, mezzanines and corridors.

The layered DAS/Wi-Fi architecture consists of two wireless networks utilizing common assets: fiber, power, conduit and mounting structures. There are three distinct network elements:

- Base station hotels (BSH)
- Citywide fiber trunk network connecting BSH to stations (OSP)
- Station network (ISP)

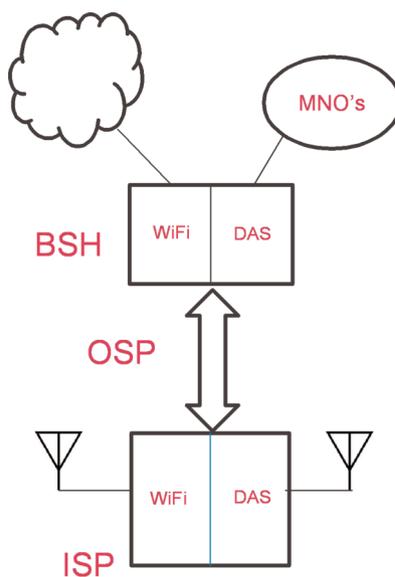
A remote fiber node with integrated bidirectional amplifiers was intended to be mounted in public access areas but, in this case, the integrated amplifiers had to be redesigned to handle all frequency-band slots from 700 MHz to 6 GHz. Moreover, the box had to be specially designed to handle passive cooling because of the large amount of metal dust in the air. With ventilator cooling, the metal dust would be drawn into the unit and cause a number of failures. As a result, the boxes were designed to meet industry specifications for water and dust resistance. They also were designed for wall and ceiling mounting.

Fiber optic cables had to be routed along city streets and dozens of antennas had to be installed. Ensuring the cell site handoff between underground and above-ground antennas as callers walked in and out of stations proved to be a particularly challenging factor.

Transit Wireless collocated the carriers' base stations with its optical distribution equipment in its fault tolerant, environmentally controlled facility. Each

carrier's base stations connect with Transit Wireless' radio interface and optical distribution system at the facility, combining the radio signals and converting them to optical signals for distribution on Transit Wireless' fiber optic cables. These cables run throughout ducts under city streets to subway stations where the cables connect to multiband RFNs on every platform and mezzanine and at various points within public access passageways. Coaxial cable connects each remote fiber node and extends signals to strategically located antennas throughout each station.

The intricate design distributes low-level radio signals everywhere to provide seamless coverage both above ground near the stations and below ground. An integrated network management system monitors the service and if it detects a problem, it automatically dispatches a technician and logs the event.



The two primary technological challenges involved RF wave propagation in an environment hostile to RF, and component (primarily antenna and cables) aesthetics.

Transit Wireless selected RFS products including HYBRIFLEX™ conduit cable and

transmission line cabling with low smoke and zero-halogen jackets and jumpers to support the project. HYBRIFLEX™ combines optical fiber and DC power in a single corrugated cable. The compact and durable design makes it faster, easier and more cost-effective to install than bringing both traditional optical fiber and DC power to the antenna. HYBRIFLEX™ is ideal for connecting power-saving Remote Radio Heads (RRHs), especially where space is constrained, and is also well suited for in-building Distributed Antenna Systems, for microwave backhaul networks and as bundled cables in harsh environments.

“Transit Wireless chose RFS because the company was able to quickly adapt its products to meet the project’s specific needs,” said William Bayne Jr., CEO at Transit Wireless. “As an approved supplier to the NYCTA, RFS has developed a solution that is readily deployable and scalable in this unique environment.”

Proven in other high-traffic subway systems including the Seoul Metro, the SOLiD DAS solution supports all four major U.S. cellular providers using just a single strand of fiber and delivers reliable, high-capacity wireless service with guaranteed RF power for each carrier. SOLiD’s NEMA 4X-rated rugged components have no moving parts and feature a modular design for simplified installation and maintenance which is critical for success in the extremely challenging physical environment of the New York City subway system.

“New York City’s subway system is currently one of the largest – and one of the oldest – in the world. Coupled with the harsh subterranean environment, the project was particularly challenging,” said Saeid Malaki, design & construction manager at Transit Wireless. “Using time-tested, reliable solutions from companies like RFS ensures that our designs meet the precise coverage, traffic and route requirements necessary for such a large scale and complex project.”



## Conclusion

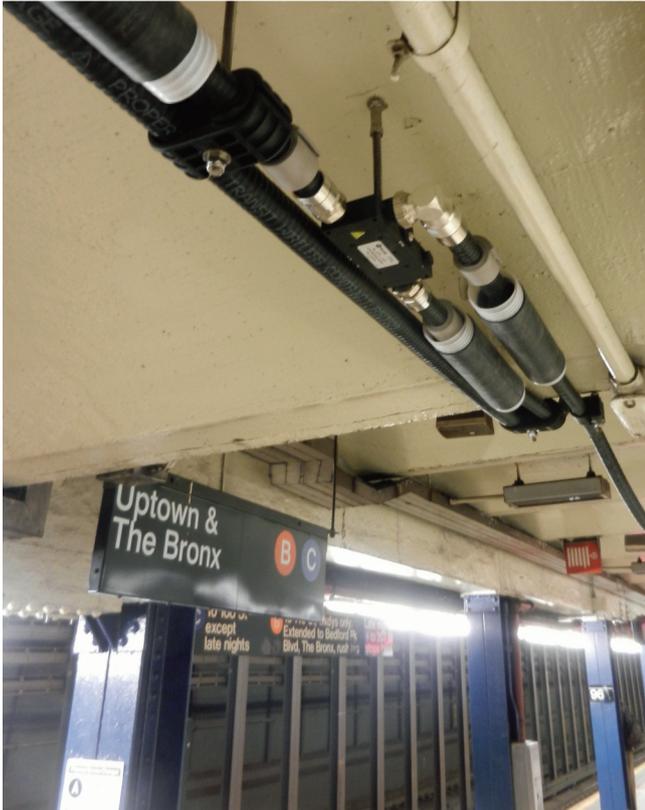
The multiyear project will bring wireless service to all 277 of New York's underground stations, including major stations such as Times Square, Rockefeller Center and Columbus Circle, enable 5,000 Wi-Fi hotspots and use several hundred feet of cabling to transport wireless signals.

In addition to supporting 700, 850, 900, 1700, 1900, 2100 and 2500 MHz cellular bands, the NYCTA project includes public Wi-Fi at 2.4 and 5.8 GHz supporting a variety of data, advertising and other relevant services and an NYCTA band. The Wi-Fi network will further support machine-to-machine, direct-to-consumer and business-to-business wireless applications and services. It will allow for secure private networks and public Wi-Fi in the same architecture. All the carriers will support 4G LTE service in all the stations in the phases moving forward.

"The New York City subway system is the most heavily trafficked system in the world, and now all riders will have access to wireless service during their commutes," said Mr. Bayne. "Furthermore, this network benefits not only riders, but city workers and first responders, and will be the backbone for future technology and safety improvements to the city's subway stations."

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**William Bayne Jr.**  
CEO at Transit Wireless



RFS cabling being used in a New York City subway station to support wireless service during the Phase 1 rollout.



## About SOLiD

SOLiD is a global communications technology innovator that empowers capacity and coverage for cellular, public safety, and Wi-Fi services at large venues and campuses through industry-leading Distributed Antenna System (DAS) and carrier-grade Optical Network solutions for Small Cell Backhaul and Passive Optical LAN (POL) deployments. In addition to metropolitan subways, SOLiD counts among its global customers major wireless operators; leading hospitals; Olympic, professional, and college sports venues; government, university and Fortune 500 corporate campuses; and other marquee customer sites.

# RFS: The Telecommunications Partner of the Transportation Industry

Enabling seamless coverage and high-quality reception in the world's tunnels with the most extensive cable portfolio in the industry.

Transportation operators rely on mission-critical communications to ensure the safety of millions of passengers, employees and assets every day. Their network solutions must enable continuous, high-quality communications across tunnels, complex in-building environments and diverse outdoor terrains. At the same time, these solutions must support commercial applications that increase passenger satisfaction and provide new revenue opportunities.

For more than 40 years, RFS has provided innovative communications solutions for transportation operators with all the essential elements of a complete end-to-end RF solution including the most extensive cable portfolio in the industry. Every cable comes with a guarantee of reliability, performance and cost-effectiveness from the most experienced and innovative cable manufacturer in the world – Radio Frequency Systems.

## HYBRIFLEX™ hybrid feeder cabling solutions

HYBRIFLEX is an innovative, hybrid cabling solution that combines optical fiber and DC power in a single, highly flexible, lightweight aluminum corrugated conduit.

### A cost-effective solution

HYBRIFLEX makes innovative use of materials to reduce structure load and maximize existing infrastructure investments. Also, with mounting procedures similar to RF feeder cable, additional training is not necessary.

### Maximum flexibility and reliability

To simplify installation, the corrugated aluminum outer armor offers outstanding

bending characteristics, which allows it to be installed like a conventional coaxial RF cable. It is designed to standard RF feeder diameters, therefore, commonly available RFS feeder accessories can be used in all HYBRIFLEX™ installations. And to further simplify installation, it is delivered pre-connectorized for fiber optic and DC connectors.

### Low weight and extra protection

The extremely lightweight cable features aluminum armor. Aluminum also offers the fragile fiber optic cables inside more protection than polyethylene tubes and at a much lower cost than cable trays. It also incorporates the grounding function.

## RADIAFLEX® high-performance radiating cables

RADIAFLEX is the world's leading "leaky feeder" cable solution. Designed to deliver contoured RF coverage, the cables provide a scalable and practical means of tailoring RF coverage in even the most challenging confined spaces. Where required, corrugated outer conductors and small bending radii provide the flexibility needed for easy installation.

### Broadband solution

RADIAFLEX cables support all major services from 75 MHz to 6 GHz, making them optimally suited for multi-operator and multi-band applications.

### Flame and fire retardant

RADIAFLEX cables are low-smoke and halogen-free to meet all major flame- and fire-retardancy standards.

### Low loss

Featuring low longitudinal and coupling losses, RADIAFLEX cables are available with optional "vario" coupling loss configurations for longer installation runs.

### Comprehensive range

With diameters spanning 1/2" to 1-5/8", the cables are available with different jacketing, coupling losses & bending radii.

## CELLFLEX® low-loss cables

CELLFLEX foam dielectric coaxial cables combine high flexibility with superior strength and electrical performance.

### Low attenuation

Low attenuation enables extremely efficient signal transfers.

### Complete shielding

The solid outer conductor creates a continuous shield against radio frequency and electromagnetic interference (RFI/EMI) to minimize system interference.

### Low VSWR

Special low voltage standing wave ratio (VSWR) CELLFLEX variants help maintain system integrity.

### Outstanding intermodulation performance

The solid inner and outer conductors virtually eliminate intermodulation.

### High power rating

Low attenuation, excellent heat transfer properties and temperature stabilized dielectric material ensure a safe long-term operating life at high transmit power levels.

### Wide range of applications

CELLFLEX cables support a wide range of frequency bands to support many applications.

## CELLFLEX® Lite lightweight aluminum cables

CELLFLEX Lite aluminum cables are the lightest RF transmission cables on the market today. They are specifically designed for fast, easy and cost-effective cable installations. They combine an innovative corrugated aluminum outer conductor design with:

- Single and multiple bending radii as per industry standards
- Robust construction
- Advanced electrical performance
- An attractive entry price point

# Why RFS?



**Radio Frequency Systems (RFS) is a global designer and manufacturer of cable, antenna and tower systems, as well as active and passive RF conditioning modules, providing total-package solutions for outdoor and indoor wireless infrastructure. RFS serves OEMs, distributors, system integrators, operators and installers. Its customers currently include the four largest wireless carriers, the majority of tier 2 and 3 wireless carriers in North America and many of the top wireless and microwave OEMs worldwide.**

## 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 tradition 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.

**For more information about this project:**

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