"We recognize there is no one-size-fits-all solution to addressing broadband service gaps, and look forward to our new leadership team's efforts to empower community design for operational, financing and technology models best suiting the unique local needs of communities in Western Massachusetts," said Governor Charlie Baker.

"We are committed to close collaboration with these communities and fostering openness, engagement and problem-solving to address Last Mile challenges," said Lt. Governor Karyn Polito.

"This new Last Mile framework emphasizes collaboration, creativity, and problem-solving," said Housing and Economic Development Secretary Jay Ash.

December 7, 2017

Ed Donnelly
Massachusetts Technology Collaborative
75 North Drive
Westborough, MA 01581-3340

Dear Ed,

This letter is being sent in response to the FGP (Flexible Grant Program) announced by MassTech and the MBI on behalf of the proposed partnership between the Town of New Marlborough and a Matrix Design Group and Calix collaboration. The response is being sent to insure that the MBI and MassTech understand that the Town of New Marlborough has a clear path toward a broadband solution that would provide a standards based GPON FTTH network with little or no tax impact on the residents of New Marlborough.

Matrix Design Group in collaboration with Calix (the acknowledged leader for fiber access equipment in North America) would provide the capital and expertise to design, build, own, operate, and maintain a fiber network that would offer a Standard Internet service tier of up to 50 Mbps symmetrical. The network would utilize aerial construction and should be available to all of the residents of New Marlborough.

The Town of New Marlborough, in turn, would be responsible for providing the “right of way” on the utility company poles, police details during the “make-ready” process, a place to house and power the network electronics plus any legal or miscellaneous expenses. It is estimated that to accomplish the above the Town would actually require LESS THAN the $1.71 million in State Last Mile funds being held by the EOHED which were allocated to the Town by the MBI. In other words, this proposed partnership would provide a standards based GPON FTTH network with little or no tax impact on the resident of New Marlborough.

It is important to note that even though Matrix Design Group in collaboration with Calix is responding to this FGP – NEITHER MATRIX DESIGN GROUP NOR CALIX IS APPLYING FOR ANY STATE FUNDS. It is our firm belief that those State taxpayer dollars
should be used by the Town of New Marlborough to pay for their responsibilities under this proposed partnership.

The public notice of funding availability (NOFA No. 2018-MBI-0) clearly states that “Provider will bear all network construction costs as well as all costs associated with owning, operating, and maintaining each network.” This is true under our proposed partnership with the Town of New Marlborough but it would not be true if Matrix Design Group or Calix received public funds to subsidize the fiber network.

As part of this informational response the following documents are being provided:

- Section A: Matrix Design Group Proposal to the Town of New Marlborough
- Section B: Responsibilities of Calix
- Section C: Matrix Design Group History with the MBI

Copies of this letter and associated documentation are being sent to the following:

- Office of the Governor, Charlie Baker
- Office of Lt Governor, Karyn Polito
- Office of Jay Ash, EOHED
- Office of State Representative Smitty Pignatelli

Thank you for your time and consideration.

Sincerely,

Chris Lynch
Director, Business Development
Response to MBI NOFA/FGP on Behalf of Matrix Design Group and the Town of New Marlborough

Prepared For:

Ed Donnelly
Mass Tech Collaborative
75 North Drive
Westborough, MA 01581

12/07/2017
Section A
Town of New Marlborough
807 Mil. River Southfield Road
Mill River, MA 01244
Attention: Board of Selectmen
C/O Richard Long

Dear Richard,

Matrix Design Group is pleased to provide this proposal to Design, Build and Operate a GPON FTTH network for the Town of New Marlborough.

Matrix Design Group and our sister company Millennium Communications Group were founded over 20-years ago. Both companies are privately held with the same principal owners. Matrix can handle the engineering requirements of any fiber project, including the planning, permitting, design, and project management of the installation of our proposed fiber network on budget and ahead of schedule.

Millennium Communications Group handles the installation and electronics for fiber and technology projects. Combined our two companies can handle the “design” (Matrix) and “build” (Millennium) of any fiber project or as we like to say the ability to take any fiber project “from Concept to Completion.” The quality of our work is nationally recognized with our companies being named for three years running one of the Top 100 FTTH Companies in the United States by Broadband Communities Magazine.

During the past 20-years we've done projects such as building the fiber network for Rutgers University, data centers for ADP, network operations centers for Homeland Security and recently two multi-million dollar Smart Grids for Public Service of New Jersey. We have designed and built 10 FTTH Networks for rural New England towns (9 in Vermont and the Town of Leverett in MA) and are in the process of building 5 more (4 in Vermont and the Town of Petersham). Our top billing customers include AT&T, Level 3, and Verizon which also happen to be the three largest Internet providers in the US and they choose to do business with us.

Under the Matrix Plan the Town of New Marlborough would be responsible for paying for the make-ready costs, a place to house and power the network electronics, and police details during make-ready. That's pretty much it. Matrix would design, build and operate the GPON FTTH network at our expense. Matrix would also give the Town the option to purchase the network after 3-years.

Due to the nature of the work and for simplification's sake - this proposal is being submitted on behalf of Matrix Design Group. However, included in this submission is also information on Millennium Communications Group so that the Select Board can better understand the depth of our combined resources and experience.
Matrix Design Group looks forward to working with the Town of New Marlborough to help create a FTTH network that would include the following:

- Matrix Design Group and sister company Millennium Communications would Design, Build and Operate a GPON FTTH network for the Town of New Marlborough.
- **The Matrix Plan would require no State funds going directly to Matrix. All EOHED or MBI grant funds would be going to cover the requirements of the Town of New Marlborough.**
- The Town of New Marlborough or the MLP would have the option to purchase the completed network for **$3,356,660** after 3-years of operation (buy-out price based upon 88 miles of road and 1,086 homes). The Town of New Marlborough would also have the option to purchase after 20-years for $10.
- The 3-year wait to purchase the network is per advice of Koppelman & Paige to the Town of Petersham to avoid any appearance of intentionally avoiding Mass 30B requirements.
- The Buy-Out Option eliminates risk to the Town of New Marlborough by providing cost certainty helping to insure the Town can properly authorize the cost of a network without worrying about cost overruns.
- The 3-year wait period also further eliminates risks to the Town of New Marlborough by allowing them to see what the actual "take-rates" for revenue and real-world estimates of the costs for the operation of the network would be.
- Town or the MLP would be responsible for make-ready costs, police details during make-ready and place to house and power network electronics plus miscellaneous legal and other costs.
- On an on-going basis the Town’s Broadband MLP would be responsible for maintaining the pole attachment surety bond, the yearly pole rental fees and power to the network electronics.
- Matrix would offer residents Standard High Speed Internet Service (up to 50 Mbps symmetrical) for $95 / month and Enhanced High Speed Internet Service (up to 100 Mbps symmetrical) for $135 / month.
- The New Marlborough Broadband MLP would have control over the Standard Internet Tier pricing. The rate of $95 per month would be locked in for 2-years. Thereafter Matrix would only be able to raise the rates by that’s year’s CPI (Consumer Price Index) without approval from the New Marlborough Broadband MLP.
- **The Buy-Out Option and MLP control over the Standard Internet Tier puts the Matrix plan in accord with MGL 164 requirements that the MLP exhibit meaningful control over the network.**
- Matrix would offer residents a VoIP line for an additional $20 / month.
- A second VoIP line may be added for another $20 / month.
- An indoor ONT with built-in 802.11 AC WiFi will be optional for a charge of $5 / month.
- Subscriber would pay a $500 installation fee (split into two payments) and have a 24-month commitment.

This proposal is designed to minimize or eliminate any tax impact on the citizens of New Marlborough.
Based upon 88 miles and 1,086 homes (MBI's updated numbers) - here is a general estimate for the costs for a “town-owned” FTTH build in New Marlborough:

$1,093,200 for make-ready (based upon an estimated 2,733 poles)
$100,000 for telecom shelter for network electronics
$176,000 for police details during make-ready and construction
$3,356,660 estimated construction cost based upon 88 miles and 1,086 homes/buildings
$201,400 for Project Manager (based upon Westfield's 6% of construction cost)
$492,730 for 10% contingency to cover legal, insurance, miscellaneous and cost overruns

Total $5,419,990

Subtracting the full amount of State funds that would be available to the Town of New Marlborough via the EOHED grant process of $1.71 million would still leave an estimated $3,709,990 that would have to be authorized via a two-thirds majority at the Town Meeting.

Meanwhile if the Town of New Marlborough received the State funds allotted to the Town via the EOHED or the MBI then the Matrix offer could possibly not cost the taxpayers of New Marlborough a single dollar.

Plus the Town would have the option to purchase the network after 3-years for $3,356,660. That buy-out price would be reduced by $197,450 per year until after year 20 it would be just $10.

Due to our experience Matrix Design Group is uniquely qualified to provide this scope of work for the Town. No firm better understands the unique problems facing a rural New England town trying to build a FTTH network. We have gained this experience and understanding not just from 20-years of building thousands of miles of fiber networks but also through providing the Town of Alford with their Fiber Design, building the Active Ethernet FTTH network and providing the final Fiber Design for the Town of Leverett and designing and building out nine towns for EC Fiber in Vermont.

Matrix Design Group hopes to put this experience to work for the Town of New Marlborough.

Thank you for the opportunity to submit this proposal for consideration.

Sincerely,

Chris Lynch
Director, Business Development
Town of New Marlborough Proposal

Matrix Design Group is pleased to provide this proposal to the Town of New Marlborough. This proposal is for Matrix to Design, Build and Operate a GPON FTTH (fiber to the home) Network at our own expense. The plan is designed to minimize or eliminate any tax impact to the residents of New Marlborough.

The Town would be responsible for all aspects of the utility pole owners “Make-ready” process including but not limited to pole data survey, utility company pole applications and surety bonds, joint walk-out with utility companies, actual utility company make-ready work, and police details during make-ready. The Town would also be responsible for a place to house and power the network electronics.

The estimated net cost to the Town of New Marlborough for the above would be ZERO if the Town receives its allocated State funds via the EOHEd or MBI grant process.

Matrix would handle the utility pole data survey and preparing and shepherding the pole attachment applications at a rate of $22.55 per pole. Matrix would require doing this work to reduce or eliminate any potential delays. It is estimated that the Town has 2,733 utility poles.

Matrix would also handle the utility company joint walk-out at a rate of $13.95 per pole.

The estimated total overall cost to the Town of New Marlborough for utility company make-ready work based upon an estimated 2,733 poles would be $1,093,200.

The Town would also be responsible for providing a secure area with clean power to house the network electronics. Matrix will assist the Town with specifications for any bids needed to insure a suitable space. The estimated cost to provide a suitable space for the network electronics is $100,000. The costs could be much less if an area in an existing municipal building is utilized for this purpose.

Once again Matrix Design Group would Design, Build and Operate a GPON FTTH Network at OUR OWN EXPENSE. This would include the police details needed during construction.

The cost estimate breakdown for the Town of New Marlborough’s expenses for this project would be as follows;

- $1,093,200 for utility company pole attachment and make-ready process
- $88,000 for police details during utility pole make-ready
- $100,000 for place to house and power network electronics
- $20,000 for legal and insurance
- $10,000 for miscellaneous
- $131,120 for 10% contingency to cover any cost overruns
Estimate total of $1,442,320 minus EOHEd or MBI grant of up to $1.71 million would provide no out of pocket expense to the taxpayers of New Marlborough.

Based upon past experience of building 10 rural New England Towns – Matrix estimates the time to build the GPON FTTH network for New Marlborough to be between 18-24 months. Because Matrix would be owning and operating the network we would be able to “light up” subscribers as we build. That means subscribers in Town could start seeing broadband service in as little as 10 months.

The fees for a Standard Aerial Fiber installation of FTTH service to Subscribers during a three (3) month pre-subscription period established by Matrix and agreed to by the Town or MLP shall be $500. The fee could be broken into two payments of $250 each. The first could be at time of signing up and be fully refundable. The second payment of $250 would be due just prior to construction. The fee includes a standard fiber drop to home and standard ONT installation. Subscribers signing up during the pre-subscription period shall commit to a 24-month minimum term of service.

Matrix would require at least 528 subscribers signing up during the pre-subscription period before beginning construction of the GPON FTTH network. That’s a take-rate of about 49% of the homes in New Marlborough.

Subscribers requesting service after the three (3) month pre-subscription period or who do not wish to commit to a 24-month minimum term of service shall pay a $1500 fee for a Standard Fiber Installation (includes fiber Drop to home, ONT and installation).

The Town MLP would have the option to purchase the completed network for an agreed upon amount after the third year of operation. Based on the estimated 36 miles of network and 380 homes and businesses - the buy-out amount should be approximately $3,356,660. After that third anniversary the purchase price would then decrease by $197,450 each year thereafter. After 20-years the buy-out amount would be $10.

As far as the subscribers - there are two (2) residential service tiers:

**Standard Internet**: Up to 50 Mbps Internet connection for $95/month.

**Enhanced Internet**: Up to 100 Mbps Internet connection for $135/month.

Custom connections of above 100 Mbps up to 1 Gbps are priced on a case by case basis. Dedicated connections of up to 10 Gbps are also available on a custom price basis.

**Internet and VoIP**: A VoIP line will allow for unlimited local and long distance calling (lower 48 US States). The VoIP service will come with standard features including but not limited to Caller ID, Call Waiting, 3-Way Calling, etc. Cost to add a VoIP line would be $20/month. A second VoIP line may be ordered for an additional $20/month.
Digital voicemail services are available for $3 per month per voicemail box. This includes the voicemail to email feature, which allows you to listen to your voicemail from your email account when you are away from your home phone.

Subscribers at time of installation may opt for a Calix GigaCenter indoor ONT with built in 802.11 AC WiFi for an additional equipment charge of $5/month.

Pricing does not include any applicable taxes or estimated $5.27 per month MLP fee. The MLP fee would be used to pay for the yearly pole rentals, surety bonds and miscellaneous MLP expenses. The MLP fee would be set by the MLP.

**General Subscriber Terms and Conditions:** The following are partial general Terms and Conditions of Use for Residential Broadband Service:

- Two year agreement required if customer signs up during three-month pre-subscription period.
- An adult 18 years of age or older must be present during the installation of services.
- Price applies to base monthly rate only; excludes optional services and installation charges.
- Customer will be responsible for the installation of necessary conduit if none is available.
- Payments 30 days past due will result in termination of service. A reconnection fee of $10.00 will be charged for any service disconnected due to non-payment.
- Pets must be restrained or otherwise kept away from the installer(s) until work is complete.
- Electronic equipment is and shall remain property of Matrix.
- Failure to allow for equipment removal upon termination of services, or damaged equipment, shall result in a $500.00 fee.
- Internet service and fees will be billed on a monthly basis.
- Except for the ONT, battery back-up unit and service drop, the Customer is responsible, at its expense, for the installation, maintenance and repair of all equipment and wiring on the Customer’s premises to the point of connection, as specified by Matrix.

**Estimated Broadband MLP Fee:**

The MLP fee is used to insure the Town of New Marlborough would not have any out of pocket expenses after the network is built. Based upon the following estimated yearly MLP Costs:

- $35,529 for Utility pole rental costs
- $9,500 for Utility Company Surety Bonds, legal, insurance and miscellaneous
- $3,000 for accountant
Total $48,029 at a 70% take rate among 1,086 homes and businesses would equal a Monthly Broadband MLP Fee of about $5.27 per month. The monthly MLP Fee would be set by the Town’s Broadband MLP.

**Miscellaneous:**

The Matrix proposal is based upon using existing utility pole routes. No underground served areas are included in the plan. If new utility poles were installed those poles would be paid for by and remain the property of the Broadband MLP. Any work done on underground facilities by Matrix would be done at a mutually agreed cost.

House drops would be 300’ from the road either aerially or via useable customer owned conduit. Drops longer than 300’ may have additional charges.

All physical assets of the GPON FTTH network would be placed into a new LLC to facilitate transfer of ownership if the Broadband MLP decides to exercise their option to purchase the network.
Serving all landscapes across the country, we specialize in fiber optic network deployments, civil engineering, and complete broadband solutions. Our mission is to enable communities, cooperatives, municipalities, and utilities the ability to provide best-in-class broadband communications networks. From feasibility studies, budgeting, underground conduit and aerial cabling, to bridge crossings and outside plant construction, Matrix will provide everything from concept to completion.

Our Experience

As a full service civil engineering and telecommunications design firm, we will perform a variety of public and private sector projects ranging from complete communications networks to storm water management strategies. Whether it's planning the migration of a legacy copper plant, designing a new Fiber To The Premises (FTTP) network, or providing turnkey outside plant managed services, Matrix provides value and savings by being the only go to source for all your project needs.

Our Staff

Our professional staff strives to understand the complexities of each project in order to develop an efficient and effective engineering solution. Our success is built on providing a transparent project environment where clients and their partners are actively involved in the process. We offer unmatched professionalism through a stringent quality control program. Matrix is dedicated to delivering the best services that meet our customers' needs.

Our Promise

We are dedicated to providing next generation technology to all of our industries. We strive to deliver an infrastructure capable of handling the fastest broadband so that our clients can reap the benefits of having the most reliable network. By having Matrix design and engineer a communications system capable of handling big data, our clients get a fast, reliable network infrastructure capable of growing with their business operation.

In addition, we will provide civil engineering services that help our clients solve their toughest challenges. From storm water and environmental services to transportation and traffic engineering and planning, we strive to serve our markets with the utmost quality to deliver the most robust project solutions.
Ron Cassel
CEO

SUMMARY
Ronald Cassel is the Chief Executive Officer of Millennium Communications and one of its founding members. While he was originally brought into the company for his expertise in advanced communications systems, Ron’s dedication to providing value added services has propelled him to the forefront of the company. Ron’s knowledge of advanced telecommunications systems began with his first job as a technician for a fledgling cable television company in New Jersey. In his fifteen plus years working at the company, Ron excelled in every aspect of the telecommunications engineering field. His experience includes broadband RF distribution systems, operation of the most extensive microwave transmission network in the northeast, work on and with scientists from Bell Laboratories on the first amplitude modulated fiber optic systems, the very essence of today’s advanced fiber based broadband networks.

In 2000, Ron took over as the CFO of Millennium immediately following the collapse of the Telecom industry. In his role as CFO, he was able to reorganize Millennium and retrain its focus not only towards supporting the newly emerging telecoms, but also diversifying Millennium’s business offerings to what they are today. Working with our management and recruiting experts in their respective fields, Ron has assembled a competent, disciplined management staff with core competencies in all areas of advanced communications systems.

Today, Ron oversees all aspects of running a successful corporation including looking for new opportunities to expand our service offerings. While his position may have reshaped his role at Millennium, he is never far from the technologies at the heart of our success.

SELECTED EXPERIENCE
Fiber-To-The-Home
AT&T Research (New Jersey/ California)
Responsible for the design and installation of two experimental communication networks. These networks deliver video, data and voice communications to residential customers over fiber optic cable.

EC Fiber (Vermont)
Served as the principle engineer on the project. The project entails 22 towns in East Central Vermont forming a consortium to build their own Fiber to the Home network. The project budget is $66,000,000 and will be the largest public works project ever undertaken in Vermont.

ValleyNet (Vermont)
Served as the principle engineer on the project. The project encompassed the design and installation of 23-miles of aerial self-support fiber optic cable providing area homes and businesses with high speed broadband internet and comprehensive telephone service.

EDUCATION
1978 - Seton Hall University, South Orange, NJ - Accounting
1982 - DeVry Technical Institute, Woodbridge, NJ – Electrical Engineering Technology
1990 - Optical Networks International-Advanced Fiber Communications Technologies (certificate)

REGISTRATIONS / MEMBERSHIPS
SCTE – System Member
NJBJA – Member
NECA – Board Member
Society of American Military Engineers (SAME)
Kenneth McLaughlin  
Senior Vice President, Business Development

SUMMARY

Mr. McLaughlin is Senior Vice President of Business Development and holds over 24 years of experience in construction of communications infrastructure and CATV security networks. His experience also includes 10 years within the Competitive Access industry. Mr. McLaughlin's responsibilities have included the installation and maintenance of 2600 miles of distribution plant; in addition to, the construction and maintenance of a 160-mile SONET network in New Jersey. His experience has allowed him to utilize his skills to develop critical networking solutions for clients, focusing on advanced communications, interoperability, security of critical infrastructure and unified communications systems.

SELECTED EXPERIENCE

Rutgers RU-Net  
This project involved the design, build, and maintenance of Rutgers’ privately owned and advanced voice, data, and video infrastructure. The tasks involved in this project were to integrate the New Brunswick, Camden, and Newark campuses to provide faster internet and to link the classrooms, libraries, and residence halls allowing robust voice and data capabilities.

Cablevision Strategic Fiber  
Responsible for the design and construction of 500 miles of fiber optic plant in New York and New Jersey. This project linked all of Cablevision's transmit facilities with redundant capabilities.

MCI/WorldCom North Jersey Overbuild  
This project involved the overbuilding of a 100-mile jointly owned fiber optic system in the North Jersey area. The associated tasks included route feasibility studies, utility relocation engineering and material B.O.M.'s.

Madison, New Jersey (AT&T – "RoseNet") Fiber Project  
Responsibilities included overseeing the construction of 9 miles of fiber optic plant in the Borough to tie in all public facilities. Complete project management from initial design through project acceptance.

REGISTRATIONS/MEMBERSHIPS

State member of S.C.T.E.  
National Rights Of Way Association  
BICSI Corporate Member

EDUCATION

BS, Montclair State University, Montclair, New Jersey  
Certification, CALC  
Certification, Chuob
William A. Stark  
Vice President, Field Operations

SUMMARY
Mr. Stark has over 27 years’ experience in engineering, design, and construction of communications facilities with an emphasis on outside plant.

Additionally, he provides oversight of all field operations, including the management and direction of all field employees. Mr. Stark ensures that all resources are managed and coordinated in an efficient and professional manner on all projects, in order to perform work within the budget and ahead of schedule.

Recent work history includes project management, engineering of fiber optic networks and building laterals, in addition to, communications survey’s with route design.

SELECTED PROJECT EXPERIENCE

AT&T I.T.S. - Fiber interconnection
Completed survey and design for AT&T Local Services engineering project. This included designing diverse fiber optic lateral feeds to over 75 AT&T/Lucent facilities throughout New Jersey. Responsibilities included survey work, preparation of drawings, construction estimates, B.O.M.’s, and managing construction crews. Similar projects were also completed for Hyperion Telecommunications (Adelphia) and Lightpath (Cablevision).

Rutgers University - Telecommunications Survey
Managed field survey crews responsible for cataloging all existing OSP telecommunications facilities on six campuses at Rutgers University. Project included physical survey of all manholes, handholes, pull boxes and building demarcation points. Responsibilities included compiling all field data (sketches, digital photos, duct information), preparing as-built documentation, and submitting progress reports to University engineers.

Private Fiber Networks
Project managed the construction of approximately 455 miles of aerial & underground fiber optic plant for various municipal entities in New Jersey. Responsibilities included material procurement, customer interfacing, field crew management, and as-built submittals.

CLEC Support
Provides ongoing utility construction services to various communications suppliers in the Northeast region. This includes new capital build-outs, relocation work, daily maintenance and providing 24-7 emergency support.

EDUCATION
Cook College, Rutgers University - New Brunswick, New Jersey
Chris Lynch
Senior Account Manager, New England Division

SUMMARY
Chris Lynch has over 20-years of experience in high-tech communications technology. He has worked with structured cable, optical networking, and voice and data communications solutions. For the past 12-years, Chris Lynch has focused on the communications requirements of Tier 2 and 3 telcos and alternative communications providers. He is an acknowledged expert in the field of IPTV. Mr. Lynch’s roles have ranged from owning his own consulting firm to managing a sales force responsible for over $53 million in yearly sales.

Whether in managing his own territory or managing others – Mr. Lynch employs a solutions geared approach where the customer’s needs are paramount. His experience ranges from local small business deployments to Fortune 500 networks

SELECTED PROJECT EXPERIENCE

- Upgrading Sprint’s Overland Park, Kansas campus headquarters from an ATM based video network to MPEG2 IP live-video streaming network.

- Serving as AT&T SystemMax subject matter expert for Sprint North Supply’s national enterprise sales team in addition to managing a team of six covering 13 Northeast States.

- Design and deployment for an over 200-channel IPTV system for New Visions Communications in East Syracuse, New York.

- Integrator and deployment of an IP video system for the headquarters of State Street Financial in Boston, Massachusetts.

- Responsible for Business Development relationships between SES Americom’s IP Prime Division and Cisco, Nortel, Entone and others. SES is the largest private satellite company in the world

In addition to the above, Mr. Lynch has experience in the MSO market (Time Warner, Cablevision), carriers (AT&T, Verizon), broadcasters (ABC, CBS, CNN) and satellite providers (PanAmSat, BTV+, Hughes).
Client: Rutgers, The State University of New Jersey

Project: Rutgers University RUNet 2000 Telecommunications OSP Design
Location: Throughout New Jersey

Background

The State University of New Jersey, welcomes over 50,000 students every year. It is one of the nation’s leading universities with 7 campuses located in New Brunswick, Piscataway, Newark and Camden, New Jersey. In order to maintain their leading university status, they needed to create a comprehensive and advanced data, video, and voice communications infrastructure that would meet the challenges facing Rutgers in the Information Age.

Rutgers recognized the need to improve its communication infrastructure and network capabilities. Soon after, the university published a Strategic Plan entitled, A Vision For Excellence, which clearly specified that in order to achieve the goals stated within the document, a robust, reliable network infrastructure was deemed necessary. From this idea, RUNet 2000 was born.

Solution

To help move Rutgers towards their goals, Matrix Design Group, provided an engineering and design solution coupled with project management and construction services for the implementation of the Rutgers RUNet 2000 project, the largest project of its kind at an American university, to meet the communications needs of the university well into the next century.

The design included 100 miles of on-campus duct bank and overhead fiber optic backbone systems across six (6) main campuses. The backbone completion phase included 340,000 feet of underground conduits, 150 manholes, and 50 aerial poles. In addition to all Rutgers’ residence halls, the RUNet system was connected to all campus academic buildings, libraries, sports arenas, campus centers, student centers and recreation centers.

Utilizing advanced Global Positioning System (GPS) technology, Matrix prepared as-built mapping of the entire system. More than 750 buildings were located with associated database information embedded in the subsequent graphic elements. Detailed data dictionaries were designed based on client requirements to ensure continuity, system performance and functionality. All final mapping is geo-referenced into the appropriate coordinate system to create a university wide telecommunications GIS layer. Subsequent projects included connecting fiber optic cabling to the universities alternative energy windmills, electrical transmission points, and additional new construction buildings.

Matrix has helped Rutgers provide technology-based innovation in research and instructional programs, administrative procedures, and information systems through a robust, reliable network infrastructure capable of handling the needs of their faculty, staff and students.

Project Goals

Provide technology-based innovation in research and instructional programs, administrative procedures, and information systems

Build a robust, reliable network infrastructure capable of supporting client/server administrative systems

Assist in positioning Rutgers in the top quartile of research universities

Upgrade network to permit high-speed data transport, interactive video transmitting, and improved voice applications

Link Rutgers academic and residential buildings through an integrated data, voice and video network
Background

Having been continually overlooked in their quest for adequate broadband service by the incumbent service providers, 23 towns in east central Vermont banded together in 2008 to explore building a community owned fiber optic network. As the traditional carriers did not find it cost effective or profitable enough to provide high speed bandwidth in their towns, this group of communities decided to take control of the situation. Their cause has resonated throughout rural communities all over the country.

East central Vermont is made up of some of the most rural communities in the United States. These communities recognize that reliable broadband is more than just a matter of profitability; in some cases it’s about the very survival of their communities and the rural way of life. The collection of towns formed an organization, known as ECFiber, and through grass roots action in their respective communities, they sought out and received overwhelming community support to build and run their own Fiber To The Home Network (FTTH). When they needed the expertise to help them carry out the plan, they found it in Matrix Design Group.

Solution

Matrix Design Group began working with the ECFiber Governing Board, helping to identify the right network design to suit the needs of the community today and tomorrow. Matrix designed a robust network that would connect all 23 towns and all of the homes and businesses within the towns to the outside world. Additionally, Matrix provided capital budgeting oversight for the network plan, including preparation of the financial documents necessary to go to the public markets and managerial support at multiple meetings, both internally and externally.

When the public bond market collapsed, Matrix, without missing a step, redesigned the network to match the much more limited resources available to the project; resources that relied on local grass roots funding by the very people that would use the network. Matrix used its years of experience in designing, building, and operating complex fiber based networks to totally redesign the network to suit the very limited budgets. Although just as viable as the original design, the new design captured the essence of what Matrix is all about; designing and building to meet our client needs, within their budget. This new network, which is operational today, combines innovative thinking, solid engineering and cost effective construction techniques, to deliver world class FTTH service to rural communities in Vermont.

“Matrix has provided an invaluable service to the citizens of East Central Vermont. Our ambitious plan to take control of our future broadband needs was met by a company that stepped right up and made themselves an integral part of our team. We’re grateful for their guidance and contribution to our project. Without their truly innovative design, we may not be where we are today, delivering real broadband to areas of our State that may have never gotten it otherwise”

Loredo Sola,
Chairman, ECFiber
Client: Vermont Telecommunications Authority (VTA)

Project: “Middle-Mile” Fiber Optic Broadband Network
Location: Vermont

Background

The VTA, an independent agency of the State of Vermont, was created in 2007 for the purpose of expanding access to broadband and mobile telecommunication services for Vermont residents. As a small, rural state with rugged terrain, Vermont has difficulty attracting broadband Internet providers, who are often unable to build profitable business models for serving the state. The VTA’s goal was the development of a 773 “middle-mile” fiber-optic network in Southern, Central, and Northeastern Vermont. The project would connect over 340 community anchor institutions in the project area, encompassing seven of Vermont’s fourteen counties.

In 2011, the National Telecommunications and Information Administration (NTIA) awarded VTA with a $33.4 million dollar grant from the Broadband Technology Opportunities Program. This accomplishment allowed VTA to start soliciting Engineering and Design firms to design open fiber optic networks that would provide data transport services up to 1 Gbps to community anchor institutions, government agencies, and “last-mile” providers throughout the project area.

Solution

Matrix Design Group was selected as an engineering and design consultant to design 27.4 miles of fiber optic infrastructure from Hardwick to Islington. In addition to the design of the fiber optic network, Matrix provided additional support services including verification of pole line and underground routes, GIS data collection of pole stock and potential customer sites, preparation of make-ready applications, make-ready joint walk services, utility ride-out with all pole attachments, verification of utility make-ready estimates, material selection and budgeting, construction specifications for a draft RFQ, and optical fiber loss budget calculations.

With the help of Matrix, the VTA was able to offer wholesale data transport services to providers such as Internet Service Providers (ISP’s), telecommunications organizations and cellular companies. Matrix designed a network that provides 1 Gbps connections, allowing increased build-outs to additional community anchor institutions such as K-12 schools, libraries, colleges, state government offices, and public safety communications networks throughout the state of Vermont.

Results

The network now brings upgraded broadband and cellular service to areas of the state.

This “middle-mile” network gives educational institutions increased opportunities through media-rich on-line learning.

Brings improved patient care through the support of Electronic Health Records, including transfers of large medical imaging files.

Supports an increase in web-based interactions from state residents to state agencies and reduces state costs of travel and data center space through video conferencing and data center consolidation.

Gives the public access to super high-speed broadband service at public libraries and educational institutions.

matrixdg.com  866-792-9930
Project Description

This two year, 56-mile project from Newtown, PA to Newark, NJ crossed 14 bridges (including the Delaware, Raritan, Rahway, and Elizabeth Rivers), required review and permitting from 15 townships, 4 counties, and 2 states, crossed 14 railroads (including Conrail, NJ Transit, and Amtrak), and necessitated the review of 9 environmental and historic state agencies. The bulk of the permitting was completed within the first four months of the project. The final routing alignment utilized the NJ State Route 1 corridor to achieve its goal of linking the Washington D.C. backbone with the Connecticut backbone. Matrix Design Group was responsible for project management and administration, utility data collection and verification, conceptual/preliminary/and final running line design, directional drill design, ROW permitting, environmental investigation and permitting, bridge attachment design and permitting, rail crossing design and permitting, and the development of construction and final bid documents.

About Matrix Design Group

Serving all landscapes across the country, we specialize in fiber optic network deployments and complete broadband solutions. Our goal is to enable communities, cooperatives, municipalities, and utilities the ability to provide best-in-class broadband communications networks. From feasibility studies, budgeting and underground conduit and aerial cabling, to bridge crossings and outside plant construction, we provide everything from concept to completion.

Contact:

11 Melanie Lane, Unit 14
East Hanover, NJ 07936
matrixdg.com
866.792.9930
info@matrixdg.com
Calix Overview

To remain relevant, service providers must evolve their networks and service offerings at a pace unimaginable only a few years ago. Operators are faced with the complex task of transitioning from legacy monolithic systems into the software defined access rEvolution. As such, the following key architectural tenets must be part of this network transformation:

- Separation between hardware and software
- Stateful, fault containment
- Operational simplicity

Throughout this executive summary and solution overview, Calix will demonstrate these key tenets and how we can minimize disruption of legacy operational and service delivery models, while being ready for the disaggregation of network functions in the very near future.

The Calix solution enables Matrix Design Group to minimize CAPEX and ongoing OPEX as well as meet deployment timelines with a solution that is much simpler to manage, install and provision.

With over 19 years of real-world, standards-based fiber deployment experience, Calix delivers fiber solutions to over 1,300 communication service providers (CSP) worldwide, enabling ultra-fast, high-capacity fiber broadband solutions.

Calix’ fiber leadership begins with close customer alignment, coupled with a clear corporate vision and a long-term, strategic roadmap focus. With this approach, Calix has developed and delivered fiber innovations, designed to streamline and simplify service delivery.

Examples include:
- Remote ONT activation
- GPON/AE auto-detect,
- GPON ONTS ready for NGPON2 coexistence
- SaaS solutions for network management

It will become evident, that our CSP success-based approach will allow the Western Mass Towns that partner with Calix and Matrix Design Group to quickly adapt to regulatory changes, counter competitive threats, and capitalize on service delivery opportunities.
Calix has over 1300 fiber customers and of that, over 135 are deploying residential `symmetrical` Gigabit services with GPON. Studies have shown that GPON bandwidth won't be exceeded until after 2020. However, in anticipation of the need for more bandwidth, the FSAN, IEEE, chip and electronic vendor community have been working on next generation PON technology over the last several years. While IEEE has focused their efforts on 10G EPON, which is certainly a viable technology and is one that Calix brought to market in the first half of 2017, many cable operators have recently been embracing the virtues and benefits of GPON's lowest cost per Gigabit technology today, with the ability to move to 10G and multi-10G services as ONT costs align with typical ROI of residential, SOHO, SMB customers. Calix' product strategy and roadmap outlined in detail below, takes these costs into consideration and focuses on offering the lowest cost per Gigabit solution today with an easy progression to multi-Gigabit solutions in the future.

**PON Evolution**

Operators have been deploying GPON for nearly a decade. While downstream CAGR bandwidth projections will not tax GPON networks until well after 2020, preparations for migration to 10G and multi-10G are well underway. Operators can migrate with Calix to a single 10G XGS-PON GPON overlay or opt for NG-PON2 enabling up to eight 10G wavelengths on a single ODN. That's 90G of additional bandwidth across a fiber, without disrupting legacy deployments!

**Software Tools**

Compass is an award-winning suite of software applications that enable communications service providers to accelerate their business transformation. Compass simplifies the complex challenges of broadband service planning, activation, and maintenance through applications focused on key strategic functions for all service providers:

- Intuitive navigation and application launch pad via Command Center
- Connectivity, service activation, and device management at the customer premises
- Analysis of broadband traffic, usage patterns, and applications
- Wi-Fi network analysis

Compass equips you with the tools and information needed to optimize the communications experience for your subscribers, lower operating expenses, and increase revenue. Details specific to each module will be provided in the solutions section below.

**Proposed Calix Solutions Overview**

**Network proposal as designed**

In order to take full advantage of the standards based GPON network infrastructure that Matrix Design Group has designed, Calix proposes the use of the E7-2 Intelligent Access System. The
E7-2 supports GPON and Active Ethernet from the same chassis. This solution allows for a migration path to NG-PON2 for network migration strategies. The systems are designed to allow for strategic customer upgrades to NG-PON2 without a wholesale changeout of equipment or changes to the fiber design.

Continuing with the premise of building a highly scalable and cost effective network, the 844 ONT is proposed for the customer premise. This ONT provides 4 GbE ports and 2 POTS ports for the customer interface. With this configuration, the Towns of Western Mass can provide a Gigabit Experience for the customer along with traditional phone lines using existing customer devices.

Optical Line Terminals

Each network deployment is unique. Factors such as density, geography, and competitive landscape can drive operators to different deployment models: Headend, Cabinet and Node based OLTs.

Centralized OLT (Headend model)

- Optimal when fiber routes are “safe”, fiber is plentiful, distance is short
- Totally passive outside plant
- Suited for new deployments without existing fiber or power plant

E7-2 OLT supporting Headend based GPON and NG-PON2

It is critical for the access infrastructure to meet the ever increasing bandwidth demands today and long into the future. Calix has architected the E7-2 OLT System to evolve and scale with an expected life cycle of over 15 years. It supports the latest generation of deployable Ethernet standards to allow Matrix Design Group to deliver advanced IP applications. This approach ensures the seamless delivery of both residential and business services, while providing industry leading, standards-based third party equipment interoperability. This will help Matrix Design Group reduce the total cost of ownership and streamline end-to-end service delivery.
ONT

GigaCenter 844G and 854G

The Calix 844G and 854G GigaCenters are next generation residential premises service delivery platforms that extend the access network into the home and act as a strategic location for control of the gigabit experience. Supporting broadband connectivity within the home and managing subscriber voice, data and video services, The GigaCenter service interfaces include: integrated GPON port, carrier class wireless networking with 802.11ac Wi-Fi and four Gigabit Ethernet (GE) ports for IPTV video and data services, two integrated voice lines supporting carrier grade VoIP and network- based TDM voice circuits, a USB port for home networking services, and an option for RF video. With the introduction of 10G PON technologies, Calix will be introducing concurrent with OLT availably GigaCenter equivalents.

<table>
<thead>
<tr>
<th></th>
<th>844E</th>
<th>844G</th>
<th>844GE</th>
<th>854G</th>
</tr>
</thead>
<tbody>
<tr>
<td>POTS (FXS)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1G/100/1000 Ethernet</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2.4 GHz Wi-Fi</td>
<td>802.11n</td>
<td>802.11n</td>
<td>802.11n</td>
<td>802.11n</td>
</tr>
<tr>
<td>5 GHz Wi-Fi</td>
<td>802.11ac</td>
<td>802.11ac</td>
<td>802.11ac</td>
<td>802.11ac</td>
</tr>
<tr>
<td>RF</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1000MHz</td>
</tr>
<tr>
<td>Power and On/Off Switch</td>
<td>UPS or Adapter</td>
<td>UPS or Adapter</td>
<td>UPS or Adapter</td>
<td>UPS or Adapter</td>
</tr>
<tr>
<td>Dying Gasp</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

GigaPoint 801G

Calix’s GigaPoint 801G ONT, provides operators a simple and cost effective means of deploying a single GPON gigabit connection at the customer premise. While Calix believes that the ability of a service provider to manage all aspects of a customer’s network is paramount, it is acknowledged that many deployment scenarios will use a residential gateway that is separate from the fiber demarcation – the GigaPoint is the ideal ONT for these applications. With the introduction of 10G PON technologies, Calix will be introducing concurrent with OLT availably

<table>
<thead>
<tr>
<th></th>
<th>801G</th>
<th>803G</th>
</tr>
</thead>
<tbody>
<tr>
<td>POTS (FXS)</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>1G/100/1000 Ethernet</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Power and On/Off Switch</td>
<td>Adapter</td>
<td>Adapter</td>
</tr>
<tr>
<td>Dying Gasp</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
GigaCenter equivalents.

**GigaCenter 844E**

The 844E GigaCenter is a unique gateway solution that delivers advanced software features to unleash the gigabit experience throughout a subscriber’s home. The GigaCenter service delivery platform uses an Ethernet link at the subscriber’s premises to provide carrier-class Wi-Fi and Gigabit Ethernet interfaces for customer multi-media devices. The 844E GigaCenter enables residential subscribers to receive gigabit broadband data, IP video, and VoIP voice. Using the latest 802.11ac 5GHz technology incorporating 4x4 multi-user multiple-input and multiple-output (MU-MIMO) and beam-forming, the 844E GigaCenter allows service providers to extend the access network inside the home and establish a strategic location for the delivery and control of broadband services. A USB port is available for home networking with other Ethernet appliances. The 844E can also be used as a Wi-Fi network extender and can provide the same in-home visibility as other GigaCenters using Consumer Connect + outlined later in the document.

**700GE Outdoor ONT**

The 700GE Outdoor ONTs are designed for the industry-leading Calix C-Series, E-Series and B-Series platforms. Calix 700GE ONTs terminate a GPON or AE fiber link at the subscriber’s location and provide industry-standard interfaces for the customer premises equipment. The ONTs enable subscribers to receive broadband data, IP or RF video, and VOIP or TDM gateway voice on a single fiber.

**Compass**

The Compass application portfolio provides monitoring of network state, workflows for multi-layer service management, orchestration, automation and analytical capabilities from the cloud. The automation capabilities coupled with abilities to correlate information across network wide topology and reporting, Calix software allows users to easily manage and gain visibility into the network resources. The Calix cloud based application suite provides the robustness and scale with distributed database and multi-level clustering.
Calix' Compass Software Platform also provides cloud-native infrastructure services for all applications and includes:

- Normalized API layer with Open APIs
- Load Balancing and multi-level clustering
- Hot pluggable Apps
- High Availability
- Common information model
- Policy Management
- Automation

**Consumer Connect Plus**

Consumer Connect Plus focuses on optimizing the subscriber in-home experience. The primary capabilities include:

- Managing in-home devices which a service provider has deployed
- Gathering real-time and historical data on how the end-user is using the home network, particularly the Wi-Fi network.

Consumer Connect Plus provides an intuitive interface to apply bulk operations on GigaCenters. It also includes device auto-discovery and plug-n-play service management. Integrated with our cloud-based Compass service delivery ecosystem, Consumer Connect Plus would potentially provide Matrix Design Group with the intelligence and tools to simplify, manage, and monetize their subscribers' broadband experience. Consumer Connect Plus works with Calix' GigaFamily
of in-home networking devices or with third party devices like ONTs, cable modems, home routers or residential gateways.

When a new GigaCenter is installed at a customer premise, the subscriber can be commissioned using several configuration options including via the FSAN serial number, an intelligent app called Smart Activate or a registration ID can be entered to identify the subscriber in the management system and in the GigaCenter. Once the subscriber is configured, a simple representation of that subscriber is shown in the Consumer Connect Plus system. In this particular example, the subscriber has two devices configured, an 844E GigaCenter Gateway and an 844E GigaCenter WAP, as represented on the right hand side of the screen.

One of the high value added propositions of the Matrix Design Group and Calix proposed solution is the combination of Consumer Connect Plus with the GigaFamily products. Calix works closely with our chipset partners to not only ensure we are exposing the best features integrated into the chipsets but to enhance the user experience with advanced features driven through Consumer Connect Plus. Consumer Connect Plus covers the traditional TR-069 ACS functions that are available with any commercial ACS including software management, device management etc.

A majority of service calls are oriented around Wi-Fi performance in the home. Calix has taken great care to ensure the GigaCenter gives the best user experience possible, this is done through maximizing the hardware within the product and enhancing the Consumer Connect Plus software driving the solution.

Consumer Connect Plus user troubleshooting interface has simple "red light/green light" indicators that can show where there is a problem with the end devices. This provides the end user a quick view of network health of device's primary functional areas: LAN, WAN, wireless and wireless security. The same information can be see for any GigaCenter Gateway as well as any connected WAP as the WAP's are managed using STUN.

In addition to the industry leading and unparalleled diagnostics capabilities of Consumer Connect Plus, Calix offers the NetValet App (available in the Apple App Store as well as on Google Play) to empower the subscribers. NetValet self-care can enable a subscriber to quickly and simply address common in-home wi-fi and network trouble shooting.

**Flow Analyze Plus**
Flow Analyze Plus enables new levels of network visibility, allowing Service Providers to understand the applications running across their networks and proactively address service opportunities and issues.

With respect to troubleshooting, Flow Analyze Plus can assist a customer service representative by assessing the traffic characteristics associated with a customer. Applications, such as OTT video, could be negatively impacting a user’s experience without their knowledge and can often turn a trouble ticket into an opportunity to sell a higher tier of service. Flow Analyze “DVR” functionality also allows a representative to troubleshoot issues that have occurred in the past, further enhancing their ability to resolve trouble tickets quickly and efficiently.

**Benefits of Flow Analyze Plus**

- Identify new revenue opportunities
- Increase customer satisfaction through proactive troubleshooting
- Hosted solution with no infrastructure investment
- Monthly service subscription with no long term commitments

**Service Verify**

Service Verify is a cloud-based solution that provides service providers the tools to comprehensively validate MEF CE 2.0 Service Level Agreements (SLA) for their business subscribers. Service Verify automates data collection and analyses of key performance metrics from intelligent Ethernet access devices and it provides custom, real-time reporting that can be analyzed internally or shared externally with demanding business customers through a customizable portal.

**Benefits of Service Verify**

- Predictive Service Analytics
- Universal SLA management tool
- Customer Service Portal
- Instantaneous view of service health
Section C
Matrix Design Group History with the MBI

Matrix Design Group and our sister company Millennium Communications Group were founded over 20-years ago. Both companies are privately held with the same principal owners. Matrix can handle the engineering requirements of any fiber project, including the planning, permitting, design, and project management of the installation of our proposed fiber network on budget and ahead of schedule.

Millennium Communications Group handles the installation and electronics for fiber and technology projects. Combined our two companies can handle the “design” (Matrix) and “build” (Millennium) of any fiber project or as we like to say the ability to take any fiber project “from Concept to Completion.” The quality of our work is nationally recognized with our companies being named for three years running one of the Top 100 FTTH Companies in the United States by Broadband Communities Magazine.

During the past 20-years we've done projects such as building the fiber network for Rutgers University, data centers for ADP, network operations centers for Homeland Security and recently two multi-million dollar Smart Grids for Public Service of New Jersey. We have designed and built 10 FTTH Networks for rural New England towns (9 in Vermont and the Town of Leverett in MA) and are in the process of building 5 more (4 in Vermont and the Town of Petersham). Our top billing customers include AT&T, Level 3, and Verizon. These companies are the three largest Internet providers in the US and they choose to do business with us.

On two occasions Matrix Design Group has responded to MBI RFQ’s:

- On October 29, 2015 Matrix was informed by the MBI that Matrix was designated a qualified broadband service provider under Cable System Extension RFQ (RFQ No. 2015-MBI-3)
- On December 24, 2015 Matrix was informed that the MBI selected Matrix as one of four vendors prequalified to provide services under the MBI Pole Data Survey RFQ

There has been some confusion because even though Matrix was qualified as a broadband service provider and unanimously selected by the Boards of Selectmen and Broadband Committees of both the Towns of Hardwick and Montague – the award for those two towns went to Comcast instead. Department of Telecommunications and Cable Commissioner Karen Charles Peterson sided with Comcast but had the following quotes to justify her position:

"It seems clear based on the record that MBI never disqualified Matrix, but rather MBI staff merely found that Comcast’s grant proposal was stronger."

"Matrix has clearly shown a willingness to coordinate and work with communities to achieve a common goal, particularly with respect to Montague, Hardwick, Petersham, and the communities involved with Vermont’s EC Fiber network."

"I note that this recommendation is in no way meant to prevent, deter, or disqualify Matrix from providing broadband services in Hardwick, Montague, Petersham, or any other community in the Commonwealth of Massachusetts. In fact, Matrix’s plans in surrounding communities should be applauded."