ctc technology & energy

engineering & business consulting

March 26, 2021

Bill Zolper, Town Manager
Town of Dewey Beach, Delaware
Via e-mail: townmanager@townofdeweybeach.com

Subject: Qualifications for consulting on wireless facility siting and related issues

Dear Bill:

CTC Technology & Energy (CTC) is pleased to provide these qualifications for your review. We have 38 years of experience assisting local and state governments with their telecommunications engineering design and analysis needs, including significant work in the areas of wireless technologies, radio frequency (RF) engineering analysis, and wireless antenna siting for LTE and 5G.

Our engineers have decades of collective experience both with wireless technologies and issues related to utility pole attachments and rights-of-way. We have staff who formerly worked for the FCC and wireless carriers, as well as staff who have developed and implemented wireless review and permitting processes. CTC's engineers have submitted technical guidance to the FCC on proceedings related to rights-of-way issues and telecommunications facilities siting matters.

We manage the wireless facility siting application review processes and review hundreds of applications annually for public sector clients and support those clients in public meetings. We have developed and continuously improve processes that enable us to comply with shot clock requirements and scale up capacity to handle increases in application loads. These include our electronic portal; comprehensive application forms customized to each community for new and collocated sites and modifications; and a transparent process that enables (depending on the client's preferences) a view of each application's status to the City, the applicants, and the public.

Thank you for your call today and the opportunity to share information about us. Please do not hesitate to contact me with any questions.

Sincerely,

Andrew Afflerbach, Ph.D., P.E.
CEO/CTO | aafflerbach@ctcnet.us

Contents

1. About CTC

CTC is an established, financially stable, woman-owned consulting firm with a national client base, including the cities of Cambridge, Boston, Palo Alto, Cupertino, San Francisco, and New York City. We offer a unique combination of qualifications and capabilities in wireless and fiber engineering, Smart City planning, broadband business modeling, and network strategic planning.

Founded in 1983, we have a staff of 50 analysts, engineers, GIS specialists, technical writers, technicians, and support staff. Our headquarters office is in Kensington, Maryland, directly outside Washington, D.C. We have satellite offices in California, Illinois, Massachusetts, Minnesota, Montana, North Carolina, and Virginia.

We have strong but independent relationships with wireless technology vendors and are conversant with the wireless carrier small cell, DAS, and macro equipment as well as emerging millimeter-wave and other 5G technologies that will become increasingly dominant in the rights-of-way. To ensure that we can provide independent guidance, we are not affiliated with equipment manufacturers, cable operators, wireless providers, or tower companies.

We currently are supporting local and state government clients with wireless and fiber network strategic planning in the states of Alabama, Arizona, California, Delaware, Georgia, Indiana, Kentucky, Maryland, Massachusetts, New Mexico, North Carolina, Pennsylvania, Texas, Tennessee, Virginia, and Washington.

We were pioneers in developing comprehensive technical and aesthetic standards for wireless facility siting—even prior to the FCC's small cell Order—and continue to offer our clients innovative, strategic guidance on the range of issues related to small cell siting.

Our wireless technology expertise includes the following:

Developing technical and safety standards for wireless attachments

Our engineers develop and help enforce **technical standards to protect the public interest, public safety, public assets, and utility worker safety**, including through:

- Assessing whether proposed attachments increase congestion on a sidewalk or block motorists' views of traffic
- Ensuring that proposed installations meet ADA requirements and DOT rules that allocate right-of-way space for varying uses
- Verifying adherence with pole spacing requirements and—in the case of new tall towers—standards for soil and drainage

- Confirming clearances between new equipment and roads and buildings, and proper placement of power meters and shutoff devices
- Verifying compliance with FCC rules on RF emissions and related warning signage
- Testing RF signals to ensure non-interference with public safety, city, and utility wireless operations

We have developed technical standards for small cell siting in the rights-of-way on behalf of clients that own traffic, light, and utility poles, including the **City of Napa**, **CPS Energy** (San Antonio, Texas), **Huntsville (Alabama) Utilities**, the **City of Opelika, Alabama**, **Baltimore County, Maryland**, and a half-dozen municipal light plants in Massachusetts.

We have also worked alongside local government staff to develop **new and revised small cell ordinances** in Anne Arundel, Baltimore, Montgomery, and Prince George's counties in Maryland and many California cities.

Developing aesthetic standards and fee justifications for wireless attachments

In light of the FCC's wireless preemption Order limiting local agency authority in wireless siting and asset use, CTC's analysts develop strategies for technical compliance that address policymakers' desire for new deployment while **protecting public assets, interests, and mission-critical public infrastructure**.

For example, in response to the FCC's establishment of restricted fees for small cell applications, CTC's engineers performed a **cost analysis** of the City of Baltimore's small cell and distributed antenna system (DAS) application and review process. By documenting the various elements of the process, we established an accounting of actual costs that the City can use to justify the fees it charges applicants.

We have also developed **technical and aesthetic standards** that our local government clients can apply to wireless facility sitings in light of the FCC's new limitations. In 2019 we developed such standards for several municipal utilities in Massachusetts. Our work builds on our extensive experience in this area; for many years we have advised a dozen California cities (including Palo Alto and Sonoma) on **standards that minimize the visual impact of wireless facilities while improving mobile coverage**.

We have also written extensively on these matters, including the following guidance that we developed for our public sector clients:

- Ten Strategies to Protect State and Local Property After the FCC's Small Cell Preemption Order (https://bit.ly/2RI7N4I)

- The Three "Ps" of Managing Small Cell Applications: Process, Process, Process (https://bit.ly/35GusGD)
- Documenting the True—and High—Local Administrative Costs of Small Cell Siting (https://bit.ly/2MkxB7j)

Designing infrastructure and business plans for neutral-host infrastructure

We also **design neutral-host infrastructure and business plans** for localities and utilities seeking opportunities to support wireless carriers and expand wireless broadband.

For example, our engineers designed a neutral-host DAS to enable **Washington, D.C.**, to use its fiber network to distribute wireless signals, including within buildings where poor coverage led to public safety challenges. We also developed a program for installing commercial, public safety, and Wi-Fi wireless DAS networks.

We currently provide strategic and technical guidance to the City of San Antonio's Aviation Department on the design of a neutral-host DAS and Wi-Fi implementation in the **San Antonio International Airport**.

Developing wireless engineering plans and strategy

Our engineers and analysts advise public agencies across a range of tasks related to wireless facilities siting and planning. A few illustrative examples:

For the **City of San Francisco**, we evaluated the potential design and cost of 5G fixed and mobile deployment, including adequate fiber backhaul and use of street furniture. We are in the process of developing a citywide Smart Cities plan that incorporates City-deployed wireless infrastructure, City poles, and wireless infrastructure being deployed by the commercial wireless industry.

For the **Texas Department of Transportation (TxDOT)**, we developed a full strategic plan and guidance for wireless siting requirements, developing technical standards, establishing processes that included coordination with municipalities, and recommending appropriate fees—all intended to protect state interests while enabling efficient private use of TxDOT assets.

For **Montgomery County, Maryland**, we developed a comprehensive wireless siting process, which the National Association of Counties recognized as exemplary and the FCC's Intergovernmental Advisory Committee recognized as providing notable best practices.

Ensuring coordinated, efficient processes for wireless facility siting

We develop processes and standards that align public interests among land-owning agencies and among local governments and public utilities. For example, in **Huntsville, Alabama**, CTC helped the utility and city develop and harmonize complete processes for managing pole attachments

so that existing assets could be maximized, and so that wireless carriers would not install new poles just feet away from existing utility poles.

Evaluating and vetting wireless facility siting applications

Since the advent of the cellular industry, CTC has provided expert advisory services on the technical, strategic, and business aspects of wireless facilities siting. These services are as critical as ever, given that local and state authorities are being inundated with small cell wireless siting applications as the wireless industry densifies existing networks, prepares for 5G, and upgrades public safety networks.

CTC provides expert, independent guidance and staffing for public agencies seeking to protect their assets and the public interest while facilitating deployment of new services. CTC's wireless team has helped local governments, state agencies, public utilities, and nonprofits vet applications for thousands of towers, colocations, small cells, and distributed antenna system deployments.

Our expertise includes:

- Developing best practices in wireless siting to enable efficient deployment while protecting community interests
- Defining technical standards for wireless facilities that protect public assets and public safety
- Addressing technical challenges in siting, including ADA violations, radio frequency (RF) interference, and unsightly deployment
- Developing strategies to comply with state, federal, and local requirements and zoning considerations
- Vetting applications for zoning compliance, RF coverage, interference, and colocation opportunities
- Developing local processes and standards to enable deployment while protecting public interests and property
- Analyzing and justifying the cost of wireless review and permitting processes
- Participating in discussions with elected officials and the public regarding wireless infrastructure and applications by the wireless industry

Our engineers analyze siting applications and RF studies to evaluate the accuracy of applicant-claimed technical service objectives, the extent to which proposed wireless sites are necessary to fill gaps in coverage or capacity, and the significance of such gaps. Analysis typically includes:

- Vetting an applicant's application, including RF propagation studies or drive tests
- Identifying colocation options in the vicinity of a proposed site
- Considering options to minimize the visual or other community impact of a wireless facility, such as painting antennas to match a mounting location, requiring a stealth monopole design, or requiring that equipment meets local noise ordinances
- Visiting and reviewing sites to evaluate community impact
- Reviewing applications and requesting additional information as necessary
- Evaluating relevant reports, studies, public input, and other materials
- Presenting findings to planning departments, counsel, and elected bodies
- Preparing reports, maps, charts, documentation, or presentations to document findings and recommendations

We coordinate the wireless facility siting application and review processes for **Montgomery and Prince George's counties** in Maryland; **Fauquier and Louisa counties** in Virginia; and a dozen cities in California, including **Palo Alto, Napa, and Sonoma**.

Developing business and revenue strategy

We develop strategy to enable public utilities and localities to **maximize assets** to enable wireless service, to deploy new pole and fiber assets as necessary, to lease dark fiber for backhaul, and to realize associated revenues.

Developing Smart City strategies that benefit from cellular expansion and densification

As wireless carriers densify 4G networks with small cells and add infrastructure for 5G, there is opportunity for agencies to **leverage new infrastructure for public purposes**, such as installing public safety cameras, other kinds of sensors, and traffic controls.

In **Baltimore**, our engineers developed **small cell policies and standards that align with Smart City goals**. Our analysts developed a public-private partnership strategy for **Seattle** for deployment of wireless infrastructure and services. We are also working with **Boston** to implement Smart City initiatives in conjunction with provider network buildout.

Advising on public safety wireless

As the FirstNet and other public safety broadband networks are made available, states and localities face challenges related to vetting the adequacy of the service and developing business strategies for public safety broadband, including the degree to which FirstNet can serve public safety needs and potential migration plans. In suburban New York, we developed a **plan for public safety wireless network development and operations**. For **Kansas DOT**, we evaluated a **public-private partnership strategy** for land mobile radio and wireless broadband.

2. Key CTC Personnel

Chief Technology Officer Andrew Afflerbach, Ph.D., P.E., oversees all technical engagements. A licensed Professional Engineer, Andrew led CTC's technical work for the development of several significant recent projects, including the City of New York's broadband master plan, the City of San Francisco's smart pole strategic plan, the City of Baltimore's small cell and Smart City initiative, a City of Seattle wireless study, and the State of Texas Department of Transportation's strategic plan for wireless siting requirements.

Andrew advises local government clients on technical and strategic issues related to wireless facility siting in the public rights-of-way. He has developed aesthetic and technical guidelines for wireless facility siting and has written extensively on local governments' strategic options for addressing the FCC's wireless preemption Order. He has also submitted technical analyses to the FCC on issues related to small cell deployment.

He has also prepared guidance documents for local governments that provide comprehensive roadmaps for how localities can protect local interests while enabling expansion of mobile service. In addition, Andrew recently wrote "How Localities Can Improve Wireless Service for the Public While Addressing Citizen Concerns" (https://bit.ly/2ModepP).

President Joanne Hovis heads the firm's work in public broadband strategy, network business planning, market analysis, and policy. Joanne advises universities, cities, and states how to build strategy and opportunity for public–private partnerships in broadband. She led the CTC teams that developed first-of-their-kind public-private broadband collaborations for the cities of Tacoma, WA, Westminster, MD, and Lexington, KY; the states of Alabama, Delaware, and Kentucky; and the Urbana-Champaign Big Broadband consortium. Joanne also serves as CEO of the Coalition for Local Internet Choice and on the boards of Consumer Reports, the Fiber Broadband Association, and the Benton Institute for Broadband & Society.

Wireless Siting Team Manager and Vice President for Analytics Shawn Thompson is a recognized expert in wireless engineering, radio propagation, and issues related to wireless siting in the public rights-of-way and on private property. Shawn manages the CTC teams that provide ongoing wireless facility application review services to several large counties in Maryland and Virginia. He supported the State of Texas Department of Transportation on strategic planning and the development of standards for its wireless facility siting program. Shawn's expertise includes strategic approaches that local governments can take to address the FCC's preemption Order.

Shawn has overseen the design and implementation of more than 1,000 wireless networks nationwide, and, prior to joining CTC, advised wireless carriers such as AT&T, Sprint, and Verizon Wireless on indoor coverage and capacity planning. Shawn assisted the government of the

District of Columbia in developing a strategy for the use of small-cell technology, in which cellular carriers use poles and rooftops owned by municipalities to increase the density of their high-speed 4G LTE networks and deliver better service. Shawn helped the District move to the forefront of cellular deployment technology by developing a plan for standardizing equipment and space utilization for hundreds of proposed wireless facility sites. Shawn's plan will allow the District to maximize profits, efficiently reuse sites, and maintain sites more easily. His work will also benefit the area's cellular carriers and residents by paving the way for streamlined cooperation between the municipal government and the carriers.

In his previous role as the Associate Director of Wireless Solutions for Henkels & McCoy, Shawn oversaw the national build-out of wireless installation for Verizon, Sprint, and AT&T.

Principal Engineer Lee Afflerbach, P.E., is an electrical engineer who works extensively with local governments. Lee provides ongoing support to numerous municipal clients reviewing small cell applications and evaluating alternative small cell technology designs for deployment in their respective communities. He serves or has served as the project lead for CTC's team of engineers that examine deployment options for the cities of Rye and Scarsdale, New York, and the California cities of Arcadia, Burlingame, Dublin, Fremont, Hillsborough, Monterey, Napa, Palo Alto, Palos Verdes Estates, Piedmont, Rancho Palos Verdes, Rolling Hills, and Sonoma. These assignments include performing a technical review of wireless facility siting applications submitted to the cities, overseeing on-site signal verification measurements, negotiating technical options and issues with wireless carriers on the cities' behalf, and providing expert witness testimony as requested in legal proceedings.

Principal Engineer and Analyst Karen White has managed and provided technical and analytical services on numerous wireless projects at CTC and throughout her career, including the development of a statewide small cell wireless policy gap analysis, strategic plan, in-house and provider processes, provider agreements, and technical standards for the Texas Department of Transportation. She supports and has supported other wireless and broadband projects performing technology assessments, client requirements discovery, alternatives analysis, system design, system procurement, and implementation tasks for state and local governments, utilities, transportation, and other government and non-profit organizations.

As a member of SAFECOM, under the Department of Homeland Security's Cybersecurity and Infrastructure Security Agency (CISA), Karen represents the National Association of Telecommunications Officers and Advisors. She also is on the National Public Safety Technology Council's Executive Board and chairs the Technology and Broadband Committee.

Principal Analyst James Crane is a member of CTC's wireless siting team who supports multiple local government clients on a range of application processing, review, and reporting tasks.

Senior Engineer Nirav Gori, who has a master's degree in engineering, is a member of CTC's wireless siting team. He evaluates radio frequency (RF) electromagnetic energy (EME) reports for compliance with FCC standards; verifies RF coverage maps; and checks key elements of each wireless facility siting application he reviews, including operating frequencies, antenna types, component data sheets, and cell site drawings.

3. References

We invite you to contact the following references about the quality of our wireless facility engineering review services:

Montgomery County, Maryland
Marjorie L. Williams
Franchise Manager, Office of Cable and Communication Services
Department of Technology Services
(240) 777-3762, Marjorie.Williams@montgomerycountymd.gov
Dates services provided: 1996 to present

Prince George's County, Maryland
Michelle Lyons
Administrator of Boards and Commissions
Department of Permits, Inspections and Enforcement
(301) 883-5927, MDLyons@co.pg.md.us
Dates services provided: 2004 to present

Baltimore County, Maryland
Rob O'Connor
Chief Information Officer
(410) 887-2441, roconnor@baltimorecountymd.gov
Dates services provided: 2006 to present

Appendix A: Resumes of Key Personnel

Andrew Afflerbach, Ph.D., P.E. | CEO and Chief Technology Officer

Dr. Andrew Afflerbach specializes in the planning, designing, and implementation oversight of broadband communications networks, smart cities strategies, and public safety networks. His expertise includes state-of-the-art fiber and wireless technologies, the unique requirements of public safety networks, and the ways in which communications infrastructure enables smart and connected applications and programs for cities, states, and regions.

Andrew has planned and designed robust and resilient network strategies for dozens of clients, including state and local governments and public safety users. He has delivered strategic technical guidance on wired and wireless communications issues to cities, states, and national governments over more than 20 years. He has advised numerous cities and states, including New York City, San Francisco, Seattle, Atlanta, Washington, D.C., and Boston.

Applying the current state of the art—and considering the attributes of anticipated future technological advancements such as "5G"—Andrew has developed candidate wireless network designs to meet the requirements of clients including the cities of Atlanta, San Francisco, and Seattle. In a major American city, Andrew led the team that evaluated wireless broadband solutions, including a wireless spectrum roadmap, to complement potential wired solutions.

Andrew also advises local and state government agencies on issues related to wireless attachments in the public rights-of-way; he leads the CTC team that supports the Texas Department of Transportation (TxDOT) and many large counties on wireless attachment policies and procedures.

In addition to designing networks, Andrew testifies as an expert witness on broadband issues. And he is frequently consulted on critical communications policy issues through technical analyses submitted to the FCC and policymakers. He has prepared white papers on streamlining deployment of small cell infrastructure by improving wireless facilities siting policies.

As CTC's Chief Technology Officer, Andrew oversees all technical analysis and engineering work performed by the firm.

EMPLOYMENT HISTORY

1995–Present	CEO/Chief Technology Officer, CTC
	Previous positions: Director of Engineering, Principal Engineer, Senior Scientist

EDUCATION

Ph.D., Astronomy, University of Wisconsin–Madison, 1996
Master of Science, Astronomy, University of Wisconsin–Madison, 1993
Bachelor of Arts, Physics, Swarthmore College, 1991

PROFESSIONAL CERTIFICATIONS/LICENSES

Professional Engineer, states of California, Delaware, Georgia, Illinois, Maryland, and Virginia

SAMPLE PUBLICATIONS

See CTC's website: https://www.ctcnet.us/library/

Joanne S. Hovis | President

Joanne Hovis is a nationally recognized authority on broadband markets and on the evolving role of public–private partnerships in the provision of communications services to the public. For more than 20 years, she has overseen CTC's consulting services related to strategic planning, market analysis, business modeling, and financial analysis for localities, states, and tribal governments throughout the country.

Joanne leads the CTC teams that advise the states of Alabama, Connecticut, Nebraska, New Mexico, and New York; the cities of Atlanta, Boston, San Francisco, Seattle, and Washington, D.C.; and the statewide broadband networks in Colorado, Maryland, and Pennsylvania. She also leads CTC's advisory work regarding federal broadband funding programs such as E-Rate, ReConnect, the Connect America Fund, the Rural Digital Opportunity Fund, and the Healthcare Connect Fund.

Joanne has testified on multiple occasions before Congress on rural broadband, broadband public-private partnerships, and the digital divide, and has provided expert presentations to the Federal Communications Commission, the U.S. Conference of Mayors, the National League of Cities, and other national organizations.

Joanne is also CEO of the Coalition for Local Internet Choice (CLIC) and a member of the boards of directors of the Benton Institute for Broadband & Society, Consumer Reports, and the Fiber Broadband Association. She is a former president of the National Association of Telecommunications Officers and Advisors (NATOA).

Public–Private Partnership Planning and Negotiations

Joanne has spearheaded projects that explore a range of business models by which local and state governments can leverage their assets to build or expand fiber networks, and to incentivize private sector broadband expansion.

- Joanne has provided extensive business planning, market assessment, and strategic planning for the City and County of **San Francisco** over a dozen years. She played a key role in the project team that developed an innovative partnership strategy for deploying a ubiquitous fiber-to-the-premises network. In an earlier project that laid the groundwork for the city's current efforts, Joanne conducted an independent evaluation of the feasibility of San Francisco constructing and operating such a network.
- Joanne advises the State of **Alabama** Department of Economic and Community Affairs regarding broadband public-private partnerships and planning, and the Alabama Broadband Connectivity for Students program. She designed the State of **New Mexico** Department of Information Technology's strategy for grant funding of public-private partnerships in rural broadband. She has developed strategy for broadband public-private partnerships for the Departments of Transportation for the state of **Delaware, Nebraska, Texas, and New Mexico**.
- Joanne has been the strategic and business planning consultant to numerous smaller cities as they have planned and negotiated broadband public-private partnerships, including the **city of Tacoma, WA**; **Westminster, MD**; and the **Urbana-Champaign Big**

Broadband Coalition (University of Illinois and the cities of Champaign and Urbana). For these projects, she developed strategy to enable the communities to identify a private partner that would finance and operate fiber deployment and expansion. She evaluated potential partners' proposals, then helped negotiate win-win partnerships that reduce risk to both parties and ensure achievement of economic development and digital inclusion goals.

Business Planning and Feasibility Analysis

Joanne is sought nationwide as an expert in municipal broadband business models and planning. Among the projects she has led are the following CTC engagements:

- Joanne advised the **City of Atlanta** on strategic and tactical approaches it can take to plan, build, and operate its own fiber network to cost-effectively serve its internal needs, promote private sector broadband investment, and enable competition in the City's residential and business broadband markets. She assisted the City in its discussions with telecommunications providers about options for joint build and partnership.
- Joanne advised the **City of Seattle** regarding business planning strategies for a citywide fiber enterprise and facilitating equitable access to wireless broadband services. In her report on citywide fiber, she analyzed the public subsidies a network would require and delivered a full assessment of opportunities and risks. The report included an internal needs analysis, statistically significant market research, an assessment of competing services and technologies, and an evaluation of the business case and financial risks. Joanne led further analysis of the benefits of FTTP beyond the traditional balance sheet, including cost avoidance.
- Joanne advises the **State of New Mexico's Department of Information Technology** on broadband planning. She developed the state's broadband strategic plan and a guidebook for New Mexico's local governments on the business, financial, and strategic planning necessary to implement city- or county-owned broadband networks. The guidebook discusses strategies for exploring public-private partnerships to facilitate broadband expansion.
- Joanne supported the **State of Kansas Department of Commerce** on a needs assessment of the state's network infrastructure. She conducted major market surveys of core sectors across the state (residents, businesses, and community anchor institutions) to evaluate the current uses and needs of broadband infrastructure. She also developed a strategy for the evolution of the state-created broadband program that serves schools, hospitals, libraries, and higher education institutions.
- Joanne has advised officials in the **District of Columbia** government on a range of telecommunications and fiber optic projects for almost a decade. She worked with the Office of the Chief Technology Officer to create a business plan and strategy for building a municipal fiber optic network with a wireless overlay in the least-served wards of the city**.** She performed a business case and technology analysis for DC-Net, a fiber optic

telecommunications network that provides voice and data services for the District. She analyzed governmental, educational, and public safety uses of the network.

- Joanne devised a business strategy and wrote a business plan for **KINBER**, the statewide backbone and middle-mile fiber infrastructure focused on the higher education and healthcare sectors in Pennsylvania. One highlight of the KINBER strategy was developing an actionable plan to increase early cash flow.
- Joanne developed a broadband feasibility study for **Garrett County, Maryland**, with a focus on maximizing the benefits and use of the state's grant-funded fiber backbone. That initial analysis led to strategic planning and support for the county's successful Appalachian Regional Commission grant funding and a pioneering public-private partnership that has deployed TV White Spaces wireless service to unserved rural parts of the county.

Federal Funding and Grant Planning

Joanne's expertise includes the funding opportunities available to local, state, and tribal governments and public-private partnerships through the federal government and other sources. She has guided clients through project planning, application writing, and fund management. Her work on behalf of clients has included successful applications for funding from a range of agencies, including the FCC/USAC, Rural Utilities Service, National Telecommunications and Information Administration, the Appalachian Regional Commission, and the Department of Homeland Security.

Speaking and Advocacy

Joanne is in wide demand as a speaker and expert source on broadband deployment and public–private partnership issues. She has testified before the U.S. Congress on matters of broadband deployment and policy; has been interviewed by publications including *Business Week*, *The Washington Post*, *The New Yorker*, and *The Baltimore Sun*; and has been featured on C-SPAN's "The Communicators."

She has provided expert presentations to the Federal Communications Commission, the U.S. Conference of Mayors, the National League of Cities, the Broadband Communities Summit, Technology Policy Summit, the University of Illinois, Case Western Reserve University, the New America Foundation, and the Congressional Internet Caucus.

EDUCATION

***Juris Doctor*, with honors**, University of Chicago Law School, 1994

***Bachelor of Arts*, with distinction**, University of Wisconsin, Madison, 1990

ORGANIZATIONS

- Coalition for Local Internet Choice, CEO
- Benton Institute for Broadband & Society, Director
- Fiber Broadband Association, Director

- Consumer Reports, Director
- United States Unified Community Anchor Network, Task Force on Community Anchor Network Economic Models, Charter Member
- National Association of Telecommunications Officers and Advisors, Past President

PRIOR TO COMING TO CTC IN 1997

1996–1997 Litigation/Communications Attorney
Mintz, Levin, Cohn, Ferris, Glovsky, & Popeo P.C., Washington, D.C.

1994–1996 Litigation Attorney
Jenner & Block, Chicago

SELECTED PUBLICATIONS

- "Public Fiber, Private Service: A Shared-Risk Partnership Model for 21st Century Broadband Infrastructure," published by the Benton Institute for Broadband & Society, 2020 (forthcoming)
- "The Broadband Lifeline in a Pandemic: How Your Community Can Quickly Connect the Unconnected," CTC Technology & Energy, April 2020
- "Closing the Digital Divide: Broadband Infrastructure Solutions," Testimony Before the United States House of Representatives Committee on Energy and Commerce Subcommittee on Communications and Technology, January 2018
- "Leaping the Digital Divide: Encouraging Policies and Partnerships to Improve Broadband Access Across North Carolina," co-author, published by the North Carolina League of Municipalities, 2018
- "The Emerging World of Broadband Public–Private Partnerships: A Business Strategy and Legal Guide," co-author, published by the Benton Foundation, 2017
- "The Atomic Age of Data: Policies for the Internet of Things," contributor as participant at the Aspen Institute Conference on Communications Policy, 2015
- "The Art of the Possible: An Overview of Public Broadband Options," published by the New America Foundation, 2015
- "Better Communities through Better Broadband: A Coalition of Public and Private Interests Affirms the Need for Local Internet Choice," Benton Foundation Blog, 2015
- "The Killer App for Local Fiber Networks," *Broadband Communities* magazine, November/December 2014
- "Gigabit Communities: Technical Strategies for Facilitating Public or Private Broadband Construction in Your Community," 2014
- "How communities can facilitate fiber construction," Google Fiber Blog, 2014
- "Facilitating Broadband Construction," *Broadband Communities* magazine, January/February 2014

Lee Afflerbach, P.E. | Principal Engineer

Lee Afflerbach is an electrical engineer with 50 years of experience serving federal, state, and local government clients, including extensive work supporting California cities with RF analysis and reviews of wireless facility siting applications. Mr. Afflerbach's expertise covers a wide range of broadband communications technology. He has designed, overseen deployment of, and evaluated a wide range of wireless, coaxial cable, and fiber optic broadband networks for local and state government, public safety, education, and non-profit clients.

Commercial Wireless Broadband Technology

Lee provides ongoing support to numerous municipal clients evaluating alternative small cell technology designs for deployment in their respective communities. He serves or has served as the project lead for CTC's team of engineers that examine wireless deployment applications and options for Rye and Scarsdale, New York, and the California cities of Arcadia, Burlingame, Dublin, Fremont, Hillsborough, Monterey, Napa, Palo Alto, Palos Verdes Estates, Piedmont, Rancho Palos Verdes, and Sonoma. These assignments include performing a technical review of wireless facility siting applications submitted to the cities, overseeing on-site signal verification measurements, negotiating technical options and issues with wireless carriers on the cities' behalf, and providing expert witness testimony as requested in legal proceedings.

Lee currently is providing technical analysis services and expert witness testimony in support of clients' ongoing litigation in federal court with wireless carriers. These include the cities of Wilmington, DE, Hillsborough, CA, and Piedmont, CA; Pueblo County, CO; and North Buffalo Township, PA. He also supports communities with technical expertise as they examine options for settling disputes with wireless carrier related to wireless facility siting matters.

Lee also serves as CTC's project leader for managing the Delaware Department of Transportation's statewide, 20-tower, 4.9 GHz high-capacity point-to-multipoint broadband wireless network.

Broadband Network Engineering

Lee has planned and designed communications networks for numerous municipalities. These stand-alone broadband networks employ a range of wired and wireless technologies to provide video, voice, and data capability within and between municipal facilities.

Land Mobile Radio (LMR) System Design

Under funding provided by the Law Enforcement Assistance Administration (LEAA), Lee performed and managed communications design studies for federal, state, and local law enforcement agencies, including the FBI, Drug Enforcement Administration (DEA), New York State Police, and Georgia State Police.

EMPLOYMENT HISTORY (Excerpt)

1983 – present **Founder and Principal Engineer**, CTC Technology & Energy (CTC)
1971 – 1981 **Group Leader, MITRE Corporation**, McLean, VA and Frankfurt, Germany
1966 – 1969 **Staff Engineer**, Federal Communications Commission, Broadcast Bureau, Washington, D.C.

EDUCATION & LICENSES

Bachelor of Arts, Electrical Engineering, Drexel University, 1966

Licensed Professional Engineer — Delaware, District of Columbia, Maryland, and Washington

Shawn Thompson | Vice President for Analytics

Shawn Thompson is a recognized expert in wireless engineering, radio propagation, and issues related to wireless siting in the public rights-of-way and on private property. He has overseen the design and implementation of more than 1,000 distributed antenna systems nationwide, and has advised carriers such as Sprint, Verizon, and AT&T on indoor coverage and capacity issues.

Shawn manages the CTC teams that provide ongoing wireless facility siting application review services to Montgomery and Prince George's counites in Maryland, and Fauquier and Louisa counties in Virginia. He supported the State of Texas Department of Transportation (TxDOT) on strategic planning and the development of standards for its wireless facility siting program. Shawn's expertise includes strategic approaches that local governments can take to address the FCC's 2018 preemption Order.

Shawn led the CTC team that designed a neutral-host distributed antenna system (DAS) network to enable the government of the **District of Columbia** to use its citywide fiber to distribute wireless signals. He then worked with the District to develop a program for installing commercial, public safety, and Wi-Fi wireless systems in its key facilities. This $10 million, five-year program will improve wireless communications in as many as 60 city-owned buildings.

Additionally, Shawn assisted the District in developing a strategy for the use of small-cell technology, in which cellular carriers use poles and rooftops owned by municipalities to increase the density of their high-speed 4G LTE networks and deliver better service. This sector promises to be a growth area, as more and more carriers approach municipalities to negotiate terms of usage. Shawn helped the District move to the forefront of cellular deployment technology by developing a plan for standardizing equipment and space utilization for hundreds of proposed wireless facility sites. Shawn's plan will allow the city to maximize profits, reuse sites efficiently, and maintain sites more easily. His work will also benefit the area's cellular carriers and citizens by paving the way for streamlined cooperation between the municipal government and the carriers to maximize wireless facility deployments and create denser coverage.

Technical Background

Indoor Propagation Theory

Shawn was an early pioneer (2003–2005) in educating the industry against the use of coffee cup design (i.e., the idea that RF travels a uniform distance from a radiating point). Rather the partitions within buildings greatly affect the propagation patterns, and therefore RF power levels, antenna types, and intended density need to be considered in each building.

He collected data from multiple types of indoor environments to improve the published equations for indoor RF propagation. Specifically, he has made improvements to modeling RF propagation in environments such as industrial, retail, hospital, and airport venues.

Shawn has also furthered the understanding of antenna density and types within different types of environments. He has shown that the typical omni-directional antenna may not be appropriate

for many newer high-capacity wireless systems. Shawn has demonstrated through various stadium designs that precisely controlling the antenna beam-width patterns can have dramatic impact on throughput because of the antennas' sensitivity to noise and unwanted signals.

High-Capacity Design

Shawn has developed solutions for the ever-growing capacity needs in public venues such as stadiums, arenas, and airports. Working with manufacturers and carriers, he has participated in developing solutions that deliver high-speed data to users in these ultra-dense environments. In particular, Shawn's innovative sector-driven design approach using distributed antenna systems is driving a complete revamping of the existing systems in stadiums across the country. Among the stadiums on which Shawn worked are First Energy Stadium and Progressive Field in Cleveland; PNC Park in Pittsburgh; the Verizon Center in Washington, D.C.; and stadiums at the University of Montana and the University of Wyoming.

Program/Project Management

As an early leader in distributed antenna system design, Shawn collaborated with industry groups, wireless carriers, and manufacturers to develop several industry best practices. He assisted industry manufacturers in developing a grounding methodology that could be used as a template for the installation of DAS systems. The solution needed to be vetted and agreed upon by installation contractors, manufacturers, and carriers.

In 2012, working with Verizon Wireless on LTE DAS upgrades, Shawn developed a system through which Verizon could easily collect information across a region (usually several states) at existing sites, to determine a rough order of magnitude to upgrade these sites with 4G LTE service. This was executed in blocks of 100 projects. Also in 2012, he developed methodologies to use "The Last Planner" project management system across large DAS deployments.

Shawn also contributed to the understanding and practicality of passive intermodulation (PIM) testing within low-power RF antenna systems. He successfully negotiated compromise between construction-side concerns and carrier-demanded closeout policies by assembling leaders across various disciplines and developing a policy white paper.

EMPLOYMENT HISTORY

Henkels & McCoy 2011 – 2013
Associate Director, Wireless Solutions; Manager, Engineering and Design

In-Building-Wireless, *Co-Founder and CEO* 2004 – 2011

Applied Communications Technology, Inc., *Founder and President* 1999–2004

EDUCATION

B.S., Computer and Information Science, University of Maryland University College, 2016
M.S., Data Analytics, University of Maryland University College, 2018

Karen J. White | Principal Analyst and Project Manager

Karen White has more than 25 years of experience in municipal, commercial, and public safety telecommunications. Her background includes the planning, design, procurement, and implementation of wireless and wired broadband systems and small cells; public safety land mobile radio (LMR) communications systems; FirstNet systems and business case analysis; project management; and engineering management in the wired and wireless LMR, public safety wireless broadband, and municipal broadband markets. She also has extensive experience in communications software engineering management, requirements analysis, design, and development.

Karen has served as project manager, technical and policy advisor, and business analyst for many high-profile, multi-million-dollar communications systems projects for states, municipalities, and large transit clients including the States of Georgia, New Mexico, Texas, and Delaware, and the District of Columbia. These projects included technology assessments, client requirements discovery, alternatives analysis, system design, system procurement, and implementation tasks. Karen is very familiar with federal, state, and local policy and funding affecting broadband communications, including FCC orders and broadband support programs, and USDA, NTIA, EDA, CISA, and other federal and state funding programs.

As a member of SAFECOM, under the Department of Homeland Security's Cybersecurity and Infrastructure Security Agency (CISA), Karen represents the National Association of Telecommunications Officers and Advisors. She supports SAFECOM's mission to collaborate with emergency responders and elected officials to improve emergency communications interoperability. Karen has contributed to numerous SAFECOM products and has supported the direction of the committee. Karen is also an executive member of the National Public Safety Telecommunications Council as the Council's Technology and Broadband Committee's chair.

AREAS OF SPECIALIZATION

- Wireless and fiber networks
- Voice and data network design
- Strategic planning
- Needs assessment
- Solution development
- Technology evaluations (LTE, LMR)
- Small cells
- Fiber and wireless facility policy, design standards, and permit application processing
- Public safety voice and broadband networks including FirstNet
- Systems and software project management
- Radio system subscriber software design and development

CTC Technology & Energy 2016 – present

Project Manager and Principal Analyst

State of Georgia – Georgia Technology Authority and Department of (DOE) – K-12 Connectivity - Project Manager

- Primary point of contact for client throughout engagement; coordinate technical team to develop deliverables

- Develop and oversee execution of location identification program to find viable commercial carrier outdoor hotspots to support service to students throughout the state
- Issue tracking and resolution support for problems arising during the DOE's commercial carrier hotspot (WiFiRanger) deployment working with the school districts, carriers, and hotspot access program provider
- Oversee development of and contribute to fixed wireless network study
- In-depth research of potential spectrum, including CBRS, EBS, TV white space, and other unlicensed spectrum for fixed LTE wireless network use throughout the state and in particular counties
- Develop high-level data dashboard illustrating project status

State of New Mexico Department of Transportation – NMDOT Broadband Technical and Business Analysis - Project Manager and Principal Analyst/Engineer

- Primary point of contact for client throughout engagement; coordinate technical team to develop deliverables
- Oversee and contribute to development of a high-level statewide broadband network design to serve NMDOT operational needs
- Work closely with NMDOT to review broadband infrastructure provider proposals and develop negotiations points to potential engagement
- Develop process for NMDOT right-of-way (ROW) access permitting/agreements
- Develop ROW access permitting documentation including application form, design standards, and support for terms and conditions
- Develop mapping tools to capture existing assets and future desired assets to be connected by an NMDOT-owned operational network
- Participate in discussions with tribal representatives to outline tribe and pueblo broadband infrastructure needs

State of New Mexico Department of Information Technology (DoIT) – Statewide Strategic Broadband Plan - Project Manager and Principal Analyst

- Primary point of contact for client throughout engagement; coordinate technical team to develop deliverables
- Oversee and contribute to development of a high-level statewide broadband network models that would serve unserved locations throughout the state
- Oversee and contribute to the development of New Mexico's statewide strategic broadband plan
- In close concert with DoIT, develop successful $1.5 million federal Economic Development Administration grant application for technical assistance

Texas Department of Transportation (TxDOT) Small Wireless Facility Implementation – Project Manager and Principal Analyst

- Primary point of contact for client throughout engagement; coordinate legal/engineering/policy team to develop numerous deliverables and attend industry interface and other meetings with the client
- Conduct existing process and systems analysis and develop gap analysis between current state and desired future state
- Conduct interviews with carriers regarding needs, processes; collect and analyze attachment forecasts

- Advise client extensively on impact of FCC orders and other laws/regulations regarding small cells
- Research municipal and other state DOT processes including the relationship between municipalities and DOTs when DOT ROW is within municipal boundaries
- Support the development of design standards for wireless siting/small cell attachments on poles and other structures
- Develop revamped wireless siting lease/permit application processes for TxDOT internally and for applicants
- Support overhaul of Master Lease Agreement and Individual Site lease Agreements
- Cost analysis of application process and oversight requirements to establish a justifiable ROW rental fee basis
- Develop master plan

City of Boston Fiber Network Procurement and Implementation – Project Manager and Principal Analyst

- Primary point of contact for City, responsible for managing project resources and accountable for budget
- Manage collection of outside plant and inside plant site information for close to 200 sites
- Dark fiber IRU agreement review and contract negotiations support
- Design and oversee the development of a site information repository database documenting OSP and ISP data enabling the City to run quick reports on close to 200 sites
- Manage the procurement of a conduit construction vendor
- Support the implementation of a 30-year dark fiber IRU deployment for close to 200 sites
- Analyze City's fiber management operations and fiber resource management tools

District of Columbia Public Safety LTE Network/FirstNet Support – Project Manager and Principal Analyst

- Prepare report in close conjunction with the District to inform the Mayor's decision to opt in or opt out of the National Public Safety Broadband Network
- Oversee the conceptual design of a District-wide LTE radio access network (RAN) considering coverage, capacity and backhaul requirements
- Develop a financial model including both capital and operating expenses to determine the financial feasibility of the District owning, building and/or managing a District RAN
- Develop a Request for Information and Request for Proposals for an Alternative District Alternative RAN. Evaluate responses to inform the Mayor's decision
- Develop a FirstNet State Plan Portal evaluation matrix and evaluation plan/process
- Participate as a primary State Plan Portal evaluator and trusted adviser during FirstNet/AT&T consultations

State of Delaware Public Safety LTE Network/FirstNet Support – Principal Analyst

- Work closely with state public safety stakeholders to evaluate the FirstNet State Plan Portal
- Participate as a primary State Plan Portal evaluator and trusted adviser during FirstNet/AT&T consultations including several meetings with FirstNet and AT&T to discuss site deployment, policy, services, and costs
- Complete State and Local Grant Implementation Program (SLIGP) 2.0 grant application which required FirstNet-related program planning for 2 years including detailed budget breakdown and investment justifications

- Developed commercial carrier outdoor and in-building performance evaluation plan for assessing and comparing carriers that provide public safety services within the state
- Research current data sharing, interoperability, and other related policy processes; advise on and document new processes and policies

State of Kansas Statewide Interoperable Communications System Valuation Study – Principal Analyst

- Develop book value and commercial value of the 80+-site public safety network
- Work with team to develop long-term sustainable funding options and identify alternative management options
- Research and analyze state and federal statutory and regulatory constraints to sell, lease or transfer the management of the system in part or in whole
- Prepare in-depth report and support the presentation of findings and recommendations to the client

City of Atlanta Fiber Broadband Buildout Support – Project Manager and Principal Analyst

- Primary point of contact for City, responsible for managing project resources and accountable for budget
- Review current status of Citywide fiber buildout and begin strategic planning
- Review existing franchise agreements and assess potential modifications

City of Boulder, Colorado, Fiber Backbone and FTTP Engineering and Financial Studies – Project Manager

- Primary point of contact for City, responsible for managing project resources and accountable for budget
- Oversee the development of a system-level, optimized backbone and fiber-to-the-premises (FTTP) design including the selection of candidate hub and core locations, determination aerial vs. underground builds, consideration of the location of smart city and underserved locations, and the assessment of environmental impacts such as rock in the ground
- Oversee the cost analysis based on the engineering studies including updating unit pricing based on the expected prevalence of subsurface hard rock and on available data from recent bids and construction in the region
- Facilitate the analysis of the financial and policy aspects to support City decision making regarding next steps including laying out the benefits and challenges from both a financial standpoint and in light of the City's key policy goals of ubiquity, competition, equity, and control
- The City, based on our work on this project, continues to engage CTC in further financial analysis of different broadband deployment and operation options

Summit County, Colorado, Public Safety Land Mobile Radio (LMR) Upgrade – Project Manager and Business Analyst

- Primary point of contact for Summit County responsible for schedule, tasks, project costs and team
- Oversee coverage analysis comparing existing analog coverage with upgrading to P25 or joining the statewide Colorado Digital Trunked Radio System (DTRS)
- Business analyst responsible for collecting and evaluating pricing data for system upgrade
- The County will use this information to determine next steps for upgrading to a digital LMR network

Summit County, Colorado, Broadband Feasibility Study – Project Manager and Technical Lead

- Primary point of contact for Summit County responsible for schedule, tasks, project costs, and team
- Technical lead responsible for collecting, inventorying, and analyzing broadband and cellular carrier data
- Responsible for interviewing Summit County Town representatives and other County communications stakeholders
- Outreach to cellular carriers on behalf of the County to pursue a solution for major cellular coverage gaps within the County
- Prepared and reviewed responses to Requests for Information for FTTP and wireless solutions for the underserved areas
- Responsible for final report and presentations to Board of County Commissioners
- As a result of this project, the County is fully engaged with a commercial carrier to deploy additional sites within the County; in addition, this work has coordinated the Towns with respect to implementing fiber within the County and spring boarded other efforts

Onondaga County, New York, Public Safety Mobile Data System Upgrade – CTC Project Manager and Technical Lead

- Point of contact for prime contractor responsible for CTC schedule, tasks, project costs, and team
- Participated in stakeholder needs assessment and existing system evaluation
- Develop reports providing an analysis of public safety needs, documented data system and application requirements, and potential future options
- Provided FirstNet information valuable to the County and pertinent for future mobile data decisions based on extensive knowledge of FirstNet technical, operational, and financial components
- Engaged to develop a Request for Proposals and support the procurement and implementation of a replacement mobile data solution

El Paso County, Colorado, Broadband Strategic Plan – Principal Analyst

- Engaged to conduct a market assessment of the current availability of wireless services intended to identify deficit coverage areas and identify regions in which coverage does not meet acceptable levels of price or service reliability and identify current and planned efforts by incumbent carriers to address those issues
- Assessed public safety fiber communications needs through interviews with stakeholders

Universal Service Administrative Company (USAC) E-rate program – Principal Analyst

- Supporting the Knight Foundation and other library systems across the country, worked closely with libraries to define current and future broadband requirements
- Developed Requests for Proposals and supported the procurement or broadband services through the Universal Service Administrative Company (USAC) E-rate program

Additional responsibilities include:

- Engineering operations management for CTC's team of technical personnel
- Business development support for numerous proposals and sole source statements of work including pricing, level of effort, terms and conditions review, and interviews

PRIOR TO JOINING CTC IN 2016

Federal Engineering, Inc. 2007 – 2016
Executive Director
Chief Consultant/Business Development and Marketing Strategist
Senior Consultant/Project Manager

Major projects included the following—all of which were completed on time and within budget:

New York City Transit (NYCT) Bus Radio System – Project Manager

- Responsible for managing a large land mobile radio system project for the New York City Transit bus radio system replacement
- Managed a team of consultants in the design of a 20+-site voice and data radio system
- Participated in the engineering design of the voice and data system, as well as the generation of technical specifications for competitive system procurement

State of Minnesota Wireless Data Feasibility Study – Project Manager

- Led team to research and report on currently available mobile data system technologies; developed agency specification requirements for use in a future RFP
- Collected manufacturer specifications to accurately assess various mobile data solutions to include data throughput, capacity, bandwidth, and spectrum availability
- Evaluated several public safety and commercial mobile data technologies and characteristics
- Analyzed and developed specification criteria for use in future RFP requirements

State of Oregon Interoperability Showing – Technical Member

- Technical member of team that generated the required Interoperability Showing submitted to the FCC's Emergency Response Interoperability Center to justify Oregon's use of the 700 MHz broadband spectrum as a waiver recipient
- Participated in activities to develop the system architecture, list of applications, performance specifications, radio access network, interference coordination, testing, deployment, operations, administration, and maintenance of a statewide broadband LTE network

Routt County, Colorado, Radio Engineering Study – Project Manager and Engineer

- Managed radio engineering study to assess coverage needs for the County, which was a member of a shared statewide Digital Trunked Radio (DTR) network and was responsible for providing coverage needed beyond what statewide system provides
- Conducted project initiation, existing system data collection, and needs assessment meetings with system stakeholders
- Evaluated existing coverage; gap analysis of existing and needed coverage
- Developed recommendations and costs for coverage solutions including developing of an additional site, bi-directional amplifier(s), and a digital vehicular repeater system
- Provided written and oral report to the County

Additional responsibilities included:

- Management of high-performance location-diverse strategy and business development team responding to federal, state, local, and private sector solicitations. Responsible for the evaluation of government compliance requirements for projects.

- Intricately familiar with GSA, state, and local government bid processes, compliance requirements, and contracting that requires cross-functional coordination between government clients and consultants.
- Responsible for maintaining relationships with clients to ensure positive references and maintain client satisfaction throughout projects.
- Responsible for understanding unique structural, civil, and environmental requirements for communications site development on federal, state, local, and privately owned land. Work closely with environmental consulting firms to develop scopes of work and pricing to execute environmental compliance activities.

Motorola, Inc. (now Motorola Solutions) 1987 – 1999
Systems Engineering Manager
Systems Engineer
Software Engineering Manager/Project and Product Manager
Software Engineer

- Managed personnel, contract, revenue, expenditures, client interface, design, and implementation of multi-million dollar land mobile radio and data systems. All projects completed on time and under budget. Major projects included the following:

New York City Fire Department
- Managed the implementation of the software for a $1M pilot for an AVL/GIS application for the New York City Fire Department
- Participated on-site with the pilot performing tests and customer demonstrations

State of New Hampshire
- Participated in field Beta testing of the statewide P25 system
- Analyzed results to feed back to development teams

Township of East Brunswick, New Jersey
- Managed the procurement and implementation of the township's new CAD and driver's license look-up applications for both the field and the fixed end
- Managed all third-party application vendors involved with the project, including the oversight of system testing

Montgomery County, Pennsylvania
- Managed the design and implementation of the county's new CAD and driver's license look-up applications for both the field and the fixed end
- Managed all third-party application vendors involved with the project including the oversight of system testing

Additional responsibilities included:
- Managed profitable Wireless Communications Systems Engineering Team for Motorola's Eastern Division encompassing the entire East Coast; responsible for systems designs, proposal development, department budget, and performance assessments

- Key member of partner/Motorola system software integration team; negotiated contracts with partners, designed systems that included their products, and technically and fiscally managed the product integration into Motorola wireless data systems
- Responsible for teaming agreements and proposal response development with third-party public safety mobile data software developers
- Responsible for responding to mobile data portions of large and small system RFPs and sole-source statements of work
- Designed, developed, and tested software for next-generation wireless voice and data communications devices implementing over-the-air protocols, ergonomic controls, and internal processing
- Received patent on innovative approach to a wireless communications device operating system
- Designed automated software test environment for next-generation wireless device that saved Motorola hundreds of hours of hands-on repetitive testing
- Guided business development and engineering departments in process and quality metrics collection
- Responsible for reporting and improving quarterly quality metrics
- Developed award-wining systems design review and software testing processes
- Chosen as the Eastern Division's Systems Technology Champion by peers for engineering efforts and for the creation of a system design review process

EDUCATION

Bachelor of Science, Electrical and Computer Engineering
University of Miami, 1986, Cum Laude

Bachelor of Music, Music Engineering Technology
University of Miami, 1985

PATENT

- Patent #5,363,315 – "Method of Communications Between and Within Virtual Radio Interface Standard Layers"

ORGANIZATIONS

- SAFECOM – Department of Homeland Security
- National Association of Telecommunications Officers and Advisors
- National Public Safety Telecommunications Council (NPSTC)
    - Vice Chair, Broadband Emerging Technologies Working Group
    - Internet of Things Working Group
- Brain Tumor Association – Local Committee Member

James O. Crane | Communications and Public Safety Subject Matter Expert

James Crane is an accomplished communications professional, former law enforcement commander, and program manager with 25 years of experience in a variety of assignments, including 10 years at the command level and more than a decade leading communications planning and operations efforts. He has provided subject matter expertise on public safety projects for CTC clients including the District of Columbia, the State of Kansas, the State of Delaware, and Onondaga County, New York. He also coordinates CTC's wireless facilities siting engagements for Prince George's County, Maryland, and Louisa County, Virginia.

James served as Commander in the Washington, D.C., Metropolitan Police Department (MPD) and as a project and program manager on many sensitive and critical assignments, from managing the District of Columbia's Public Safety Answering Point (PSAP) to coordinating operations with the U.S. Secret Service and State Department.

He has also led many sophisticated regional communications initiatives, including as a member of the executive teams of the National Capital Region Law Enforcement Information Exchange, the Interoperability Communication Committee (2013 Chair), and the Capital Wireless Integration Network Executive Board.

Among other high-level assignments, James led the communications division and the Office of Police Communications for MPD, and was responsible for planning and management of major communications infrastructure and services projects. As head of a number of different divisions within MPD at various times, he supervised staff ranging in size from 75 to 375 officers and civilians. James was the first Director of MPD's Tactical Information Division (TID), which sought to bridge project management gaps between IT and operations.

PROFESSIONAL EXPERIENCE

CTC Technology & Energy **2013 to present**

Principal Analyst

Prince George's County, Maryland, and Louisa County, Virginia – Telecommunications Facilities Siting Committee Coordinator

- Coordinate applications for modifications, colocations, and new towers in client counties
- Lead interface with clients
- Approve and send final requests for information (RFI) needed during permit process regarding engineering review, coordination between land owning agencies and all other administrative and governance issues
- Prepare recommendation reports for client board's review and vote
- Attend committee meetings to advise and respond to any concerns raised by voting members
- Interface with applicants and public as needed

- Provide and conduct testimony as needed before legislative bodies and at public meetings
- Review applications and assess the potential impact of small wireless facilities l and distributed antenna system (DAS) installations in urban and suburban locations, including the public right-of-way

District of Columbia Public Safety LTE Network/FirstNet Support – SLIGP Support and Subject Matter Expert

- Conduct outreach to support SLIGP efforts and develop required reports for FirstNet
- Identify common data communications concerns among first responders
- Analyze FirstNet's potential in light of the needs of emergency support functions
- Evaluate potential impact of NG911 initiatives with the District's PSAP leadership
- Prepare and post FirstNet newsletters on the District's website
- Support the development of a report in close conjunction with the District to inform the Mayor's decision to opt in or opt out of the National Public Safety Broadband Network
- Contribute to the conceptual design of a District-wide LTE radio access network (RAN) considering coverage, capacity and backhaul requirements
- Contribute to the development of a financial model including both capital and operating expenses to determine the financial feasibility of the District owning, building and/or managing a District RAN
- Support the development of a *Request for Information for an Alternative District RAN.* Evaluate responses to inform the Mayor's decision
- Develop a FirstNet State Plan evaluation matrix and evaluation plan/process to analyze the FirstNet partner's plan for a RAN in the District

State of Delaware Public Safety LTE Network/FirstNet Support – SLIGP Support and Subject Matter Expert

- Maintain and update stakeholder/outreach participant lists, including extended primary and secondary users
- Provide in-person updates to stakeholders on network progress
- Develop web portal for the State Division of Communication to update stakeholders and obtain survey information
- Assist with updating the Statewide Communications Interoperability Plan (SCIP)
- Represent the State at APCO conferences
- Prepare outreach materials on public safety broadband issues

State of Kansas Statewide Interoperable Communications System Valuation Study

- Conduct needs assessment interviews with stakeholders to understand use and satisfaction with statewide network
- Support the development of the book value and commercial value of the 80+-site public safety network
- Work with team to develop long-term sustainable funding options and identify alternative management options

- Research and analyze state and federal statutory and regulatory constraints to sell, lease or transfer the management of the system in part or in whole
- Analyze financial impact state run LMR has on local first responder and PSAPs
- Prepare in-depth report and present findings and recommendations to the client

Onondaga County Mobile Data System Replacement Feasibility Study

- Conduct needs assessment interviews with stakeholders to understand use and satisfaction with current network
- Work with team and County to develop potential system replacement options
- Review PSAP operations and staffing regarding impact of mobile data needs by first responders
- Compare impact of commercial bandwidth throttling to public safety broadband options

Metropolitan Police Department, District of Columbia

Commander, Tactical Information Division	2010 to 2013
Commander, Special Operations Division	2007-2010
Director, Office of Police Communications	2004-2007
Director, Communications Division	2003-2004
Deputy Director, Communications Division	2002-2003
Captain, Fifth Patrol District	2000-2002
Lieutenant, Seventh Patrol District	1997-2000
Sergeant, Fifth Patrol District	1994-1997
Investigator, Homicide Branch	1994
Investigator, Repeat Offender Unit	1993-1994
Officer, Rapid Deployment Unit	1990-1993
Officer, Seventh Patrol District	1989-1990

Over the course of 25 years in MPD, James rose from patrol officer to commander of the Department's Tactical Information Division. Highlights include:

- Managed PSAP, which processed 1.8 million 9-1-1 and non-emergency calls per year, handled telephone reports from citizens, transcribed audio evidence, and conducted radio maintenance
- In partnership with Fire and Emergency Medical Services, developed the city's first Universal Call Taker program for 911
- Transitioned Police, Fire, and Medical call-taking responsibilities to new PSAP
- Coordinated with agency counterparts the transition of selected MPD facilities from commercial carrier to DC-Net Coordinated transition of 4200 member Police Department's radio system from analog to digital trunk
- Increased availability and speed of crime information to citizens via electronic alerts, paging, and social media
- Managed the processing of the Department's various crime tip programs including phone tips and text tips
- Managed Special Operations Division, which included units responsible for

Department's Emergency Response Team, Harbor Patrol, Air Support Unit, Horse Mounted Unit, Canine Patrol, Explosive Ordnance Disposal Unit, Motor Carrier Unit, and Major Crash Unit (tasked with traffic fatality investigations)
- Served as the first Director of the Tactical Information Division with a mission of bridging project management gaps between Information Technology and Public Safety Operations
- Served as Program Manager for CCTV monitoring and video retrieval, Acoustic Gunshot Sensors, Chemical Breath Testing Program, and Impaired Driving Enforcement
- Managed Real Time Crime Center, providing information and situational awareness to Police Department and District Officials
- Coordinated the planning of security and escort for the President and Vice President of the United States with the United States Secret Service
- Represented District of Columbia in testimony before U.S. Congress on law enforcement communications
- Coordinated escort and security for an average of 35 foreign dignitaries per month with the Department of State
- Coordinated MPD's operational role in National Special Security Events (NSSE) such as Presidential Inaugurations, State of the Union Address, 2008 Papal Visit, 2008 G20 Summit, 2010 Nuclear Security Summit, and IMF/World Bank Meetings
- Implemented MPD response to demonstrations and civil disturbance, including developing in-service training for these skills and tactics
- Developed and managed outdoor security at Verizon Center and Nationals Stadium; indoor and outdoor security at RFK Stadium
- Coordinated development of the White House Farmers Market with federal counterparts
- Conducted sensitive investigations for both personnel conduct and response related issues
- Implemented successful program with the Catholic University of America that improved community relations and reduced complaints of student behavior in neighborhoods
- Coordinated police response to an increase of demonstrations at private residences
- Served as chair for departmental disciplinary hearings

BOARD MEMBERSHIPS
- National Capital Region Law Enforcement Information Exchange (LinX) Executive Committee, 2005 to 2013
- DC Interoperability Communications Committee (2013 Chair), 2007 to 2013
- Capital Wireless Integration Network (CapWIN) Executive Board, 2004 to 2013
- MPDC Use of Force Review Board, 2007 to 2010
- MPDC Crash Review Board (Chair), 2007 to 2010
- DC Police and Firefighters Retirement and Relief Board, 2005 to 2013

Nirav Yogesh Gori | Wireless Engineer

As a member of CTC's wireless siting team, Nirav conducts detailed technical reviews of wireless facility siting applications submitted to CTC's local government clients. He evaluates applicants' radio frequency (RF) electromagnetic energy (EME) reports for compliance with FCC standards; verifies RF coverage maps; and checks key elements of each application, including operating frequencies, antenna types, component data sheets, and cell site drawings. He also designs wireless network models to enable feasibility analyses.

PRESENT PROFESSIONAL EXPERIENCE

CTC Technology & Energy – Kensington, MD **2019–Present**

Wireless Engineer

- Conduct detailed technical review of wireless siting applications submitted to CTC's local government clients by wireless carriers and infrastructure companies
- Evaluate applicants' radio frequency electromagnetic energy (RF-EME) reports for compliance with FCC standards
- Verify RF coverage map using Cloud RF
- Verify key elements in small wireless facility siting applications, including operating frequencies, antenna types, equipment data sheets, and cell site drawings
- Design LTE capacity and RF-EME calculators to optimize and reduce the application review time
- Design candidate wireless models and develop associated cost analyses for local governments

PREVIOUS PROFESSIONAL EXPERIENCE

Infinigy Solutions – Elkridge, MD **2018–2019**

RF Engineering Intern

- Generated RF EME compliance reports and NIER analysis reports for T-Mobile and AT&T cell sites nationwide using Roofview analysis tool
- Suggested appropriate signage and remediations to be taken to meet FCC compliance requirements
- Worked on AT&T WCS band and C-RAN small cell project, Verizon's Upstate project, T-Mobile L600/L700 band and Sprint 2.5Ghz band deployment using Massive MIMO Antennas
- Performed site visits and ROW surveys alongside carrier RF team for Mods or New Site Deployments
- Generated RF plumbing diagrams and QA/QC of cell site drawings by reviewing contents in RFDS

TECHNICAL PROJECTS (University of Maryland)

Indoor DAS design using iBwave **2018**

- Designed an inbuilding DAS solution for 3 story building for HSPA and LTE technology

- Developed three designs (SISO antennas, SISO pair for MIMO coverage, and MIMO antennas)
- Ensured that required target levels were met throughout the building using iBwave's prediction maps

TMA standalone sweeping using Anritsu **2018**

- Performed standalone sweep for return loss and gain measurement of TMA using Anritsu's OSL calibration

Remote electrical tilt for base station antenna using AISG **c**ontroller **2018**

- Successfully changed electrical tilt remotely for antenna connected to AISG controller via TMA using ATC Lit

RF planning and cell site design using Mentum Planet **2018**

- Deployed cellular sites for Washington D.C area and its suburbs using GSM 1900 and LTE FDD technology
- Eliminated the loopholes in the coverage by adjusting base station location, antenna's azimuth and downtilt

EDUCATION

Masters of Science, *Telecommunications*
University of Maryland, 2019

Bachelor of Engineering, *Electronics and Communication*
Dwarkadas J. Sanghvi College of Engineering, University of Mumbai, 2017