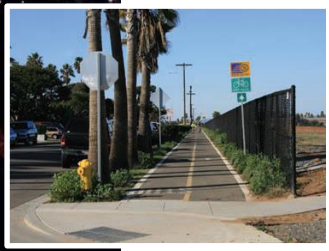
# OCEANSIDE 20/20

*The OMNI-Mesh Network*



OMNI-Mesh Network – The Mobile ICT Platform Atop Streetlights





U.S. Department of Transportation
Notice of Funding Opportunity Number
DTFH6116RA00002
"*Beyond Traffic: The Smart City Challenge*"

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## Exhibits, Tables and Letters of Support



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## Introduction

The United States Department of Transportation (USDOT) is challenging cities across America to innovatively think about and plan its "Smart City" future. The City of Oceanside has been methodically and independently moving towards its unique Smart City future. This Funding Opportunity will help Oceanside not only achieve its own aggressive Smart City goals, but by design, provide a technical and financing roadmap for other cities to follow. Oceanside has developed and implemented a financing model to systematically pay for "smart" infrastructure renewal. Oceanside's lead investment is replacing roadway lighting with LEDs, the lowest hanging energy savings opportunity for most cities across America, will serve as the backbone to enable its Smart City vision. The vision that Oceanside has embraced is comprehensive, integrating emerging Intelligent Transportation Systems (ITS) technologies with other city services through a highly secure, common Information and Communications Technology (ICT) platform, including water, police, fire, and it's growing sharing economy in order to develop its holistic connected city vision.

Oceanside has taken to heart and fully embraces the USDOT's stated vision:

> The USDOT's vision for the Smart City Challenge is to identify an urbanized area where advanced technologies are integrated into the aspects of a city and play a critical role in helping cities and their citizens address challenges in safety, mobility, sustainability, economic vitality, and address climate change.

As Oceanside "pays it forward" we are not just looking to stand up a technical ITS-ICT construct, but also create the business financing model that other cities can follow. We will demonstrate a viable mechanism whereby both energy and operational savings will pay for this "smart infrastructure." To date, Oceanside's LED streetlights and metered streetlight power distribution system have been paid entirely through a municipal lease, with no out-of-pocket monies coming from the City's General Fund. We have identified several national banks and other funding sources that embrace the Oceanside vision of this funding strategy and are willing to compete to finance this next phase of ICT and ITS investment. The next step in Oceanside's financial planning is to establish an Enterprise fund, whereby future cost savings, as well as the revenues generated from our planned ICT infrastructure will be captured and reinvested into the expansion of Oceanside's mobile ICT platform, the **O**ceanside **M**unicipal **N**etwork **I**nfrastructure (OMNI) Mesh Network.

### Oceanside's Transportation Plan

Oceanside adopted its General Plan Circulation Element in 2012. This plan addresses:

- ✓ Enhancing the City's corridors for all modes of transportation;
- ✓ Increasing bicycle and pedestrian connections, routes and facilities;
- ✓ Refining the City's traffic calming program to promote safer streets for motorists, pedestrians, and bicyclists;

- ✓ Identifying and incorporating Intelligent Transportation System (ITS) technology for the City;
- ✓ Increasing support of Transportation Demand Management programs; and
- ✓ Improving the efficiency of the existing transportation system.

A primary goal of the plan calls for "complete streets" enabling compatible and shared use by all forms of transportation, including vehicles, bicycles and pedestrians. A key element of the plan describes the City's vision for enhancing mobility choices through cost-effective deployment of Intelligent Transportation Systems (ITS). A targeted goal of the City's ITS system is to improve Level Of Service (LOS), measured in wait times at signaled and un-signaled intersections, across the entire city.

The City, according to the 2010 census had 167,083 citizens. As a resort community featuring the longest public pier along the West Coast of the United States, Oceanside can experience a peak daily population of nearly 300,000 on busy holiday weekends, with the majority of the peak population visiting Oceanside's nearly five miles of beaches via a mix of transportation modes. Level Of Service is a key metric the City tracks as a key to enhancing the experience of living and playing in Oceanside.

Oceanside's Transportation is complemented by The Oceanside Transit Center (OTC), located in the heart of the urban downtown area. The Transit Center is among the busiest multi-modal transportation hubs in San Diego County, annually serving more than 1.2 million commuters, connecting San Diego, Orange, Riverside, and Los Angeles Counties. Operated by the North County Transit District (NTCD), the center brings visitors by rail, light rail and bus, complementing service provided by Amtrak and Metrolink rail service. There is also a mix of public parking, both paid and free. During these peaks, downtown urban density around the pier and beaches transforms Oceanside into a highly dense urban city. The two agencies, Oceanside and NCTD, strategically collaborate to assure plan alignment.

## Oceanside's Intelligent Transportation System (ITS) Plan Elements

The goals governing Oceanside's ITS Plan are:

**Goal 1**: Encourage and support the use of Intelligent Transportation System technologies to increase the efficiency of the transportation network.

**Goal 2**: Support the use of ITS technologies as a cost-effective alternative to improve the transportation network.

These goals are achieved through meeting the following objectives:

1. Improve the safety, security, and movement of goods, people, and services for all modes of transportation by using advanced technologies, coordinated management techniques, and by providing real-time traveler information.
2. Improve air quality and reduce greenhouse gas emissions through traffic signal optimization and the use of advanced signal control techniques.

3. Ensure compliance with regional ITS architecture and National ITS standards where feasible to promote interoperability and information exchange with other agencies in the region.
4. Work cooperatively with regional ITS and related operations efforts to enhance regional and local response to incidents and events impacting the City.
5. Collect data for public dissemination and/or analysis by the City traffic engineers.

### Oceanside's Long Term Plans

Oceanside's long term plans are currently governed by the 2030 Regional Transportation Plan (RTP), as published by the San Diego Council of Governments (SANDAG). Additional planning documents include the 2050 RTP, describes enhanced mobility options desired by 2050, and the Riding to 2050, the Regional Bicycle Plan.

## Smart City Development Strategy – The OMNI-Mesh Network

Oceanside fully appreciates and understands the strategic transportation focus of the Notice of Funding Opportunity (NOFO.) With that said, with this proposal, we are taking a strategically different approach to our response. We are proposing a two-pronged approach:

1. Design, build and demonstrate the deployment of a citywide mesh-enabled Wi-Fi ICT platform, The OMNI-Mesh Network, strategically designed with a cyber security layer that is complaint with the most stringent Federal Information Processing Standards (FIPS) cyber security levels. This issue is important since most technology companies in their rush to market overlook the fact that Transportation is a specified segment of Critical Infrastructure in the existing 2002 Homeland Security Act legislation which triggers with ITS integration.
2. Design, build and demonstrate the integration of advanced traffic flow monitoring sensors as part of the ICT streetlight platform, in the targeted areas (See proposed map of designated areas) to continuously and dynamically monitor the flow of traffic. This is the foundation layer for enabling advanced ITS capabilities, as well as other city services.

What is unique with our proposal is that we are proposing to place the mobile telecommunications component of our ICT platform atop city-owned streetlights. Distributed and metered power with 2-way communication every 100-200 feet across the entire city. We are strategically developing this platform, among other reasons, to minimize or eliminate the burgeoning urban clutter of radios and devices now starting to proliferate atop public infrastructure. And this urban clutter problem will grow unless we take a different approach. We have already commenced with this integration through the linking of our metered streetlight control system with our ITS system via common city-owned fiber optic cabling. The City has a policy of utilizing its fiber optic cable to support as many city functions as practical.

### Why a two-pronged approach?

The chief reason for our two-pronged approach is simple. A truly Smart City needs a common operating platform to both deploy advanced ITS and non-ITS capabilities, and pay for these

capabilities. A cyber-secure ICT infrastructure needs to be not just in place, but designed from the ground up to be enable many applications in addition to ITS applications. It is the monetization of these operational and energy efficiency savings that will, over time, pay for the build-out of the citywide ICT operational platform that will enable emerging ITS and other non-ITS applications.


While the general focus is on transportation, the USDOT's challenge has identified the need to integrate the entire city. With that said, Internet of Things (IoT) devices, including vehicles, will eventually connect to the ICT platform and interact with sensor data. These devices will need more than just a secure environment. In our view of the future, the ICT platform will serve both ITS requirements and a host of other city and public services. Sensor data needs to support automation to unlock efficiencies that can be turned into cost savings in every connected environment. Therefore Oceanside is strategically focused on building a highly secure ICT operational platform to enable both ITS systems and non-ITS systems.

## Urban Clutter – a Growing Menace

Urban clutter, or the ad hoc proliferation of devices in public spaces, left unchecked, is fast becoming a major municipal policy and planning issue. In San Diego County alone, we are seeing unsightly telecomm equipment being installed being installed on streetlights in several cities where telecomm carriers are attempting to address network traffic weaknesses ahead of the new metered streetlight rate about to go into effect.

They are staking out their turf as this IoT market heats up. Moreover, Southern California Edison (SCE), one of the nation's largest public utilities, is planning to expand their deployment of more than 50,000 radios to over 250,000 radios in the next 5-7 years and they are targeting streetlights as their prime installation location. SCE is just one of dozens of utilities across America planning on installing private radio networks cluttering cityscapes as they proceed. This is currently happening relatively unchecked across America. With this new USDOT push, this problem will only be compounded unless a new strategic approach, such as proposed here, is implemented.

*Remember the Good 'ol Days?*

Oceanside is tackling this emerging trend head on by designing and installing Oceanside's OMNI-Mesh Wi-Fi ICT data highway for everyone, including the City's ITS backhaul, cellular carriers, utilities, the city itself, as well as for other public and private use. Streetlights will have attached devices. With that said, our integrated strategy is designed to minimize clutter by combining backhaul duty for multiple services through one common platform.

## Cyber Security Must Be Built into the ICT Platform from the Beginning

Again, the 2002 Homeland Security Act stipulates that ICT platforms, which ITS systems rely upon, must be FIPS-compliant. Absent this architectural systems design requirement, ITS integration and growth may face major systemic and legal risk ramifications. Accelerated ITS deployment delivery across the entire smart city ecosystem may otherwise be in jeopardy of having to be replaced with a true FIPS-compliant system. When infrastructure starts to become "smart" and connected, something legal happens – that infrastructure now becomes "critical infrastructure," which has a special federal definition based on the Homeland Security Act. This act designates the cybersecurity standard that must be deployed on infrastructure when it is designated "critical infrastructure." This covers transportation systems, energy and smart grid systems, IT services and government facilities. Therefore, the ICT systems needs to be FIPS-compliant from the outset because this is the only way to avoid this potential systemic risk. Cybersecurity experts use the term: "Security Must Be baked in from the Beginning." As a result, we are recommending the US DOT elevate Cyber Security as a technical priority.

Simply put, if a FIPS-compliant ICT architecture is not implemented from the beginning, deployed ITC assets will not be properly secured. When this happens, the entire ITS and ICT platforms will be compromised. This is a potential systemic risk that the national Internet of Things (IoT) transportation sector appears to be is facing, unless action is taken now. Expanded use of a mobile ICT platform as it relates to integration into an overall Smart City architecture further compounds the problem. This policy issue might be served through formal collaboration among the USDOT, Department of Energy, Department of Commerce, Department of Homeland Security, and the Department of Defense to a) agree this is an issue

that must be addressed from the outset and b) agree to a Cyber Security strategy which help cities grow into interconnected smart cities.

## Oceanside's Core ICT Platform – Smart Streetlights?

Designing a smart city requires a holistic view of the city as a living organism, with its roadways seen as the lifeblood or arteries connecting the city. As Oceanside adds sensors and grow its Smart City organism, what we are really doing is building the neural network connecting all of the City's IoT operations. When we start adding ITS elements, we are literally adding "limbs and fingers." Those limbs and fingers need a cyber-secure and robust foundation whose very architecture enables automation through machine-to-machine interface.

As it turns out, streetlights are uniquely poised to provide the mobile ICT connectivity because:

1. Streetlights can now provide distributed and metered power everywhere, providing energy or food to the city's new limbs and organs.
2. Streetlights are spaced 100-300 feet apart, touching every corner of the city, delivering light as a service. The streetlight typically resides about 30 feet in the air, ideal for transmitting and receiving mobile data. They enable the installation of a mobile data operations platform that can handle both established carriers' small cell data and Wi-Fi for public use. In addition, extending Wi-Fi mesh across the entire city can create a potentially significant revenue opportunity by accommodating carrier needs to offload data-intensive traffic from existing cellular networks.
3. The rights-of-way are already established, accelerating deployment schedules.
4. Oceanside already own its streetlights, and therefore are direct controls of this increasingly valuable asset.

With the above as a framework, Oceanside is well down the road towards building its vision of a smart city. The city is currently focused on first enabling its ICT operating platform so when ITS technologies become commercially viable we will have a natural environment to plug into. Oceanside's forward-leaning investments include:

1. Conversion of 7,661 streetlights to LED on city-owned streetlights across the entire City through an investment of $3.8 million.
2. Installation of the first generation 2-way wireless lighting controls system atop every streetlight, incorporating an approved utility-grade meter in each streetlight through an investment of $1.4 million.
3. Fiber optic cabling across the city to connect existing ITS infrastructure through an investment of $1.0 million.
4. Traffic Management Center investment of $1.6 million.
5. The connection of the City's streetlight controls system with the City's ITS system through a common fiber optic backhaul. This design effort is now underway.

## Distributed Power and Metering – a Breakthrough Moment

Embarking on the development of an ICT platform utilizing "smart" streetlights a natural evolution, recognizing the real estate value of streetlights installed in publicly-permitted rights-

of-way. Though the general concept has been around for more than a dozen years, the concept was ahead of its time due to technology limitations. With the proliferation of LEDs atop municipal streetlights over the past ten years and the emergence of metered adaptive controlled dimming, the groundwork has been set for this phase of development. Specifically, "smart meters" now exist within the majority of adaptive controls products from Philips, GE and Acuity, among others. And Oceanside has installed and commissioned 7,661 meters to date.

Why is this important? Because when utilities accept smart meter data from municipal streetlights and are paid for the energy used, the relationship between the utility and the municipality changes – for the better. Cities can now freely utilize metered power delivered to streetlights for other city services without having to seek special permission from utilities to connect to an existing power source. Streetlights are generally not metered, and therefore, non-conforming loads are typically prohibited without a formal "per location" agreement between the utility and municipality. In this new future, cities can add ITS sensors, micro cells, Wi-Fi radios, other powered sensors, EV charging stations, banner lights (seasonally popular) etc. without this onerous utility application process.

Finally, the local utility, San Diego Gas & Electric (SDG&E), began investigating the feasibility of metered streetlights more than two years ago, with the result being the filing in 2015 of one of the nation's first metered streetlight tariffs. This tariff is slated for implementation in 2016. For the past several years, numerous cities within the greater San Diego area have been pre-positioning themselves to create this policy tariff framework just to enable this smart city platform, including Oceanside. What this means is that the region is poised to build their regional smart city visions around this construct of metered power distributed to every corner of the city atop 30 foot high streetlights.

## Technical Approach

In this section we will present our technical approach to achieving our strategy, starting with a recap of the progress made to date.

### Foundation Investments Made

The City of Oceanside has been strategically laying the groundwork to build its ICT platform, independently of the USDOT's efforts, for several years. To date, the City has invested in the following:

1. Intelligent Transportation Systems (ITS)
    a. Central Signal Management System (CSMS)
    b. 150 signal intersections, with 140 intersections ITS-enabled to facilitate signal synchronization.
    c. 38 CCTV cameras at ITS-enabled intersections. 20 more CCTVs planned
    d. Traffic Management Center
    e. Emergency Vehicle Response Preemption System
    f. Driver Feedback Signs. Approximately 15

2. Streetlights
    a. LED lights installed across the entire city atop 7,661 streetlights
    b. Investment of $3.8 million.
    c. Networked Dimming System linking all 7,661 roadway streetlights.

    **Note:** This element called out in the City's master transportation plan
3. ICT Platform
    a. 23 miles of City-owned Fiber Optic cabling currently connecting 140 intersections.
    b. Distributed utility-grade metered power grid atop the 7,661 streetlights.
    Oceanside chose the GE Light Grid platform for this application.
    c. Investment of $1.2 million (Light Grid) plus $1.0 million for FO.

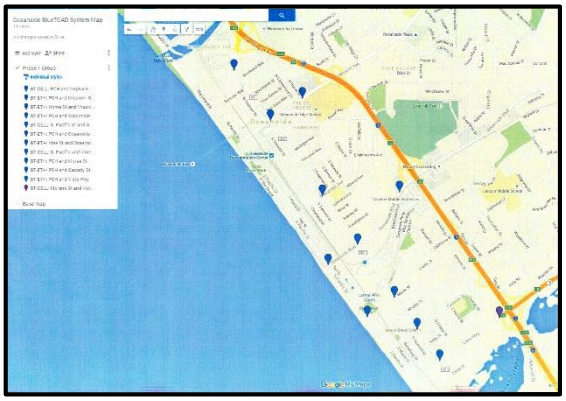

Oceanside Traffic Management Center (TMC)

## Immediate Next Phase of Development

The next phase of development involves the integration of the backhaul networks for both the existing ITS platform and the emerging ICT platform. Integration engineering is currently underway to utilize existing city FO cabling to operate both the distributed metered power system atop streetlights and existing ITS infrastructure.

## 2016 Plans

Oceanside has an aggressive Fiber Optic expansion plan. In 2016 installation of an additional four miles of FO are planned. Also, in 2016 a pilot project is being implemented across the City's proposed test area to evaluate TrafficCast's BlueTOAD, a device that counts vehicles by monitoring Blue Tooth devices found on drivers, passengers and within vehicles. This represents the City's next step in integrating traffic sensors beyond the current use of roadway pucks.


Map of Oceanside's Initial BlueTOAD Deployment

Once the ICS Platform is established, the City will begin expanding the installation of traffic monitoring sensors to build out the dynamic traffic monitoring system. Early field tests are about to commence with the evaluation of BlueTOAD devices to count blue-tooth enabled vehicles.

Should Oceanside be the successful City, we plan to integrate the BlueTOAD data as a real-time data source to our dynamic traffic monitoring system, complemented by other to-be-identified technologies, including sensors that can see vehicular Wi-Fi, and cameras that can distinguish between vehicle types and pedestrians.

## 2017 and Beyond

Oceanside has ambitions plans to expand both the ITS infrastructure and ICT infrastructure with FIPS compliance as a central strategy. FIPS will be required because streetlights will eventually be used for Smart Grid applications, delivery of city services, support emergency response, and shared with the public. This will trigger streetlights being designated "Critical Infrastructure," which has federal regulatory definition. Furthermore, the City works closely with the local transit authority, NCTD, and the regional traffic planning authority, San Diego Association of Governments (SANDAG), to be consistent with regional objectives. Long term plans call for:

1. Changeable Message Signs
2. Transit Signal Priority, providing buses priority access to maintain schedules
3. Encourage citizens to adopt electric vehicles through public education in partnership with SDG&E;
4. Expanded installation of charging stations, including e-bikes.
5. Decarbonization of City's electrical grid. The City is starting to explore Community Choice Aggregation to facilitate the purchase of clean power. In addition, the City is expanding the installation of solar power. In 2014 installing about one mW of solar generation capacity alone was installed at the City's waste water treatment plant, complementing the installation of a methane-fueled co-generation facility, recycling waste methane gas.
6. 511 Public Traffic Monitoring System, by phone or Internet.
7. Smart Parking Systems to enhance tourism.
8. Enable autonomous, Vehicle-To-Vehicle (VTV) and Vehicle-To-Infrastructure (VTI) communication with its mobile ICT platform to utilize the dynamic traffic flow monitoring system
9. Design and Installation of a terrestrial based three dimensional GPS system, (3D Terrestrial GPS), introducing the z value (elevation) to the traditional x, y coordinate satellite-based GPS system. These beacons will be placed atop streetlights, solving the urban canyon effect when high rise buildings block satellite GPS signals. Adding the z coordinate can also provide more accurate location of IoT devices and vehicles. This can enable a new three-dimensional way of tracking and supporting the guidance of moving objects, preparing the way for expanded use of, for example, drone package delivery. This also has National Security implications in the event of a star-wars type attack on US GPS satellites. A terrestrial positioning system can serve as an emergency backup, allowing GPS devices to continue to operate should satellites be destroyed.
10. Utilization of an Enterprise Funding Strategy to organically grow the ICT platform across the City, integrating FO and Wi-Fi mesh ICT elements everywhere.

As we implement the ICT platform, we will begin integrating new ITS technologies.

## The Mobile Information and Communications Technology (ICT) Platform

Oceanside is moving forward with plans to invest in this new mobile ICT platform, The OMNI-Mesh Network. Oceanside's plans call for The OMNI-Mesh Network to support the following:

1. Efficient integration of sensors along all city streets to dynamically monitor traffic flow everywhere, not just at intersections.
2. City communications services, including fire, police, operations and maintenance, etc. (cost sharing opportunity)
3. Water and Gas Advanced Metering Infrastructure (AMI) (cost sharing opportunity)
4. Delivery of Wi-Fi service to targeted low income neighborhoods (public service
5. Sharing of Wi-Fi capacity with telecomm carriers (revenue generating opportunity)
6. Advanced Parking systems – identification of available parking spots by citizens, reducing time looking for parking in congested downtown areas.
7. Use of Public Wi-Fi to enable the sharing economy.
8. This is just a short list of services and capabilities that can utilize streetlights. We have a longer roadmap of 45 functions and services that benefit from connected smart streetlights.

Oceanside plans to pursue the design and installation of a mesh Wi-Fi communications platform using the unlicensed 5 GHz spectrum. This platform will be able to connect city services everywhere, with the backhaul linked to the City's burgeoning fiber optic network currently connecting the City's ITS signaling system. The "mesh" component of the system will efficiently link streetlights together, with the eventual data signal being ported back to the City's operations center via fiber optic cable. We will be investigating as part of our plan, whether individual devices connecting to the mesh Wi-Fi at individual streetlights will be "tethered" through a 2.4 GHz star-topology approach for connecting mobile end devices.

## Why Mesh Wi-Fi?

Perhaps the most strategic reason to utilize mesh Wi-Fi is because of latency, which is the time delay created when data is shared or moved about. In a growing world of IoT integration, this is a really big issue as sensors positioned atop streetlights need to support many applications in a real-time automation environment. Carrier cellular networks cannot overcome this latency issue because they are closed systems. Milliseconds matter, especially in large, Smart City networks. We will follow the Wi-Fi Alliance Passport 2.0 / 3.0 standards as our starting point.

## System Architecture and Implementation Footprint

Shown on the following pages are:

1. Exhibit 1, a high level System Architecture schematic
2. Exhibit 2, a technical schematic of the proposed mesh Wi-Fi ICT platform.
3. A map of the city, depicting existing ICT and ITS installation, including the Traffic Management Center. Also shows the planned first phase of deployment area surrounding the beaches, the pier and the urban downtown shopping district.

These illustrations, when taken together, identify how Oceanside will build out its ICT platform atop streetlights. It starts to become quite evident when one studies the citywide map of the streetlight network the ideal nature of sensors everywhere will act as the "nerve endings" to detect and communicate information back to the Analytics platform.

## Exhibit 1
## System Architecture Schematic

Below is a high level graphic describing the core elements of Oceanside's planned Smart City platform. The centerpiece of the platform is the integrated data highway of fiber optic cabling and the mobile ICT platform. New applications, especially applications that automate things, can now be safely added, integrating cell phone apps as the means for public interaction and use. This framework is the platform for delivering services in the new IoT economy. The next Uber, Lyft, Google or Facebook will likely emerge from this technology environment.

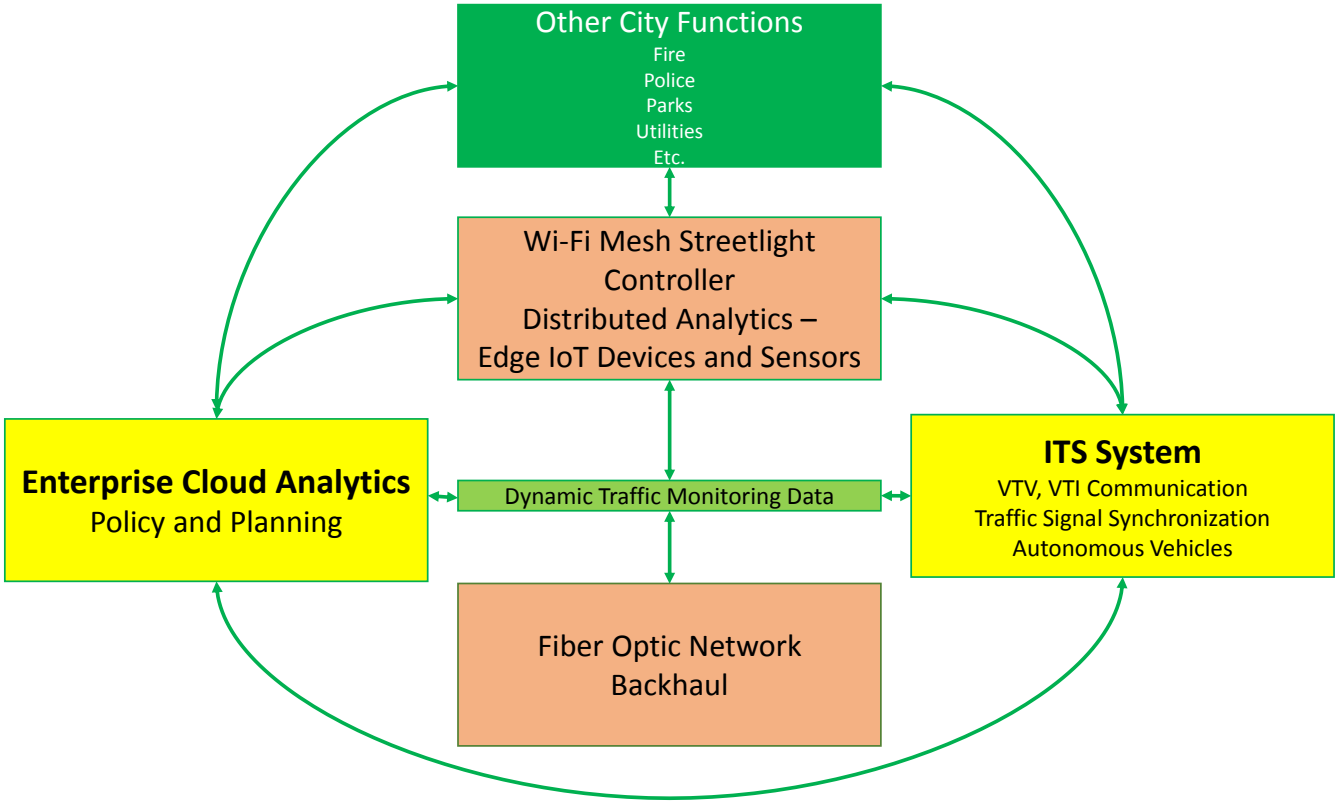


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Exhibit 2

Streetlight Architecture

Below is an illustration of the Wi-Fi mesh network atop streetlights. Each "node" physically resides atop the streetlight.

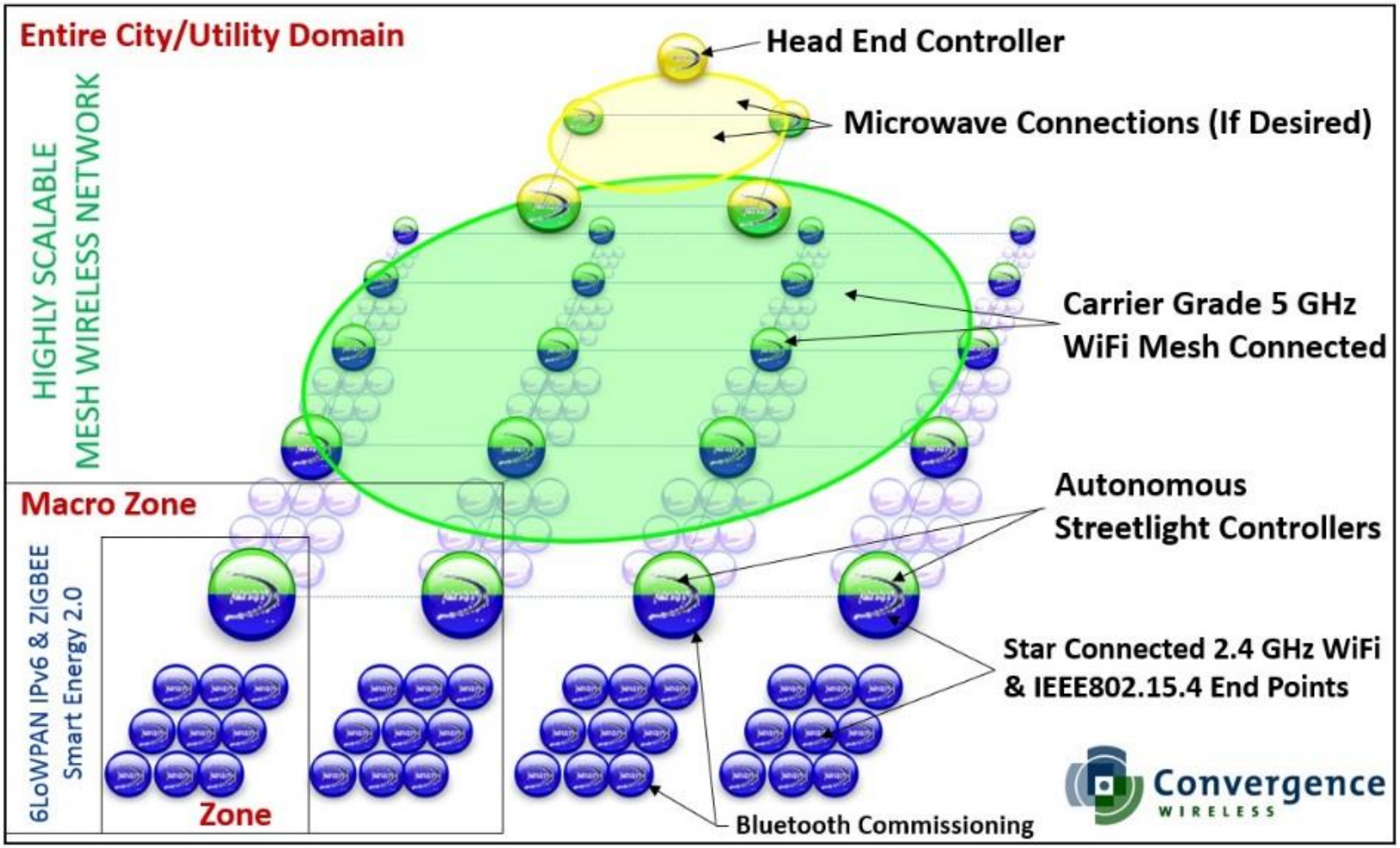

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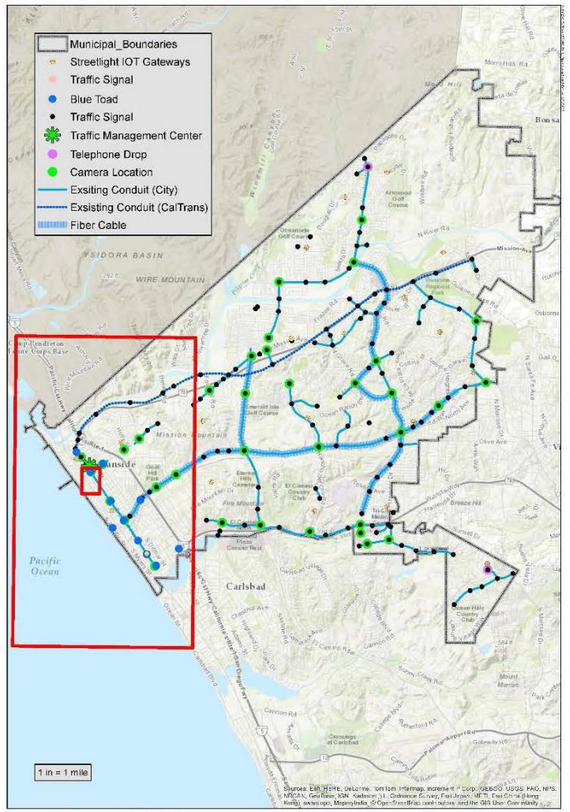
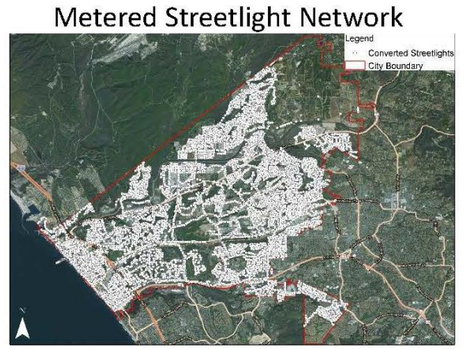
Exhibit 3

Target Development Area

Below is a map of Oceanside showing the location of all 7,661 currently operational roadway lights with distributed metered power. The target zone for implementing the Oceanside ICT and ITS demonstration project is outlined in green in the inset image. It 100% overlaps the planned BlueTOAD pilot project currently underway. Once the City's Mobile ICT platform is successfully deployed in the urban downtown target development zone, long term plans call for the roll-out citywide atop the remaining streetlights. This expansion will be funded through ICT system revenue generation and leveraging city business efficiency gains.








OMNI-Mesh Network
USDOT Deployment Boundary

## Data Analytics

The power of the ICT / ITS integration becomes fully realized when the system is operational and the Analytics engine is integrated. There are two components to analytics in the Oceanside model:

1. Field Automation Analytics. Resides on devices and streetlight controllers. Reads local sensors, automating field devices.
2. Enterprise Analytics. Resides in the cloud, capturing macro data for deep system analysis, and the vehicle for providing access to publicly available analytics data to encourage 3rd party developers to build new businesses.

Together these analytics tools provide the means for the City to:

1. Improve lives by giving citizens insights that can help them decide whether to use private or public transport.
2. Improve city services by enabling emergency vehicles to get to their destination faster by knowing in advance if a road is closed or traffic detoured.
3. Lower costs to businesses because they can schedule travel and other logistics during offpeak times.
4. Improve people's experience at public events or tourist sites by providing spectators smart phone apps that can help them quickly find the most convenient parking.


Quality of life is enhanced as stress related to traffic congestion falls. With this powerful toolkit, traffic planners can now think about dynamic traffic signal control, with a core metric now measurable – vehicle idling hours while stuck in traffic. Optimum travel times can be now be continuously compared to current travel times, with signals dynamically changing durations to minimize congestion and traffic signal idling. This directly translates to reduced greenhouse gas

emissions. We envision a system that will learn from itself, constantly refining the traffic signal algorithms directing signal controllers driven by constantly monitored traffic flow.

When Vehicle to Vehicle (VTV) and Vehicle to Infrastructure (VTI) technology becomes ubiquitous as standards are adopted and technology advances, the ICT platform will enable a new generation of automation whereby the vehicle speed may be regulated so it never comes to a complete stop while in route to its destination, the ultimate GHG reduction goal. In the end, it is the Data Analytics that enable the seamless integration of multiple city functions as depicted in this graphic provided by IBM, providing command and control, as well as situational awareness of the entire city field of operations.

## Standards-based Architecture – A Strategic View

Taking a Standards-based architecture approach is a bit more complicated once the FIPS-based "critical infrastructure" strategy is applied. To address differing security requirements of different systems (Traffic, Police, Utilities, Public, etc.) sharing a standards based common platform ICT model, we need to integrate more than just the USDOT's emerging ITS standards governing VTI communications. We also need to consider the Smart Grid cyber security standards as defined by the US Department of Energy and National Institute of Standards and Technology (NIST). For example, we see a major opportunity to integrate the backhaul communications requirements of utility companies connecting to a common ICT platform. Connecting Smart Meters and Smart Grid assets located within cities will eliminate or dramatically reduce unsightly urban clutter on streetlights. As a result, we are recommending a cross-functional workshop be convened with appropriate participation among the following federal agencies:

- ✓ U.S. Department of Transportation –ITS requirements
- ✓ U.S. Department of Commerce – NIST requirements
- ✓ U.S. Department of Energy – Smart Grid Requirements
- ✓ U.S. Department of Defense – command and control requirements to support advances in formal Consequence Management involving U.S. communities adjacent to military bases.
- ✓ Homeland Security

An example of why this matters illustrated is demonstrated within the plans of Southern California Edison (SCE), one of the nation's largest electrical utilities, with a 50,000 square mile service territory. They currently own about 50,000 radios linking their assets (substations, transmission lines, power distribution vaults, etc. These two-way communications devices automate switching to assist with restoring power in the event of an outage. Their plans call for expansion of this radio backhaul system to grow to over 250,000 radios within the next five years. And they have strategically targeted the use of streetlights to attach these radios. The use of these radios will eventually, if not already, fall within the purview of the Smart Grid cyber security standards as these standards are implemented. Left unchecked, unsightly urban clutter will ensue. This also represents a revenue / cost-sharing opportunity for the city as Oceanside provisions capacity of the ICT platform to the local utility, allowing utility radios to talk to the ICT platform.

### Additional System Requirements – E-Commerce and 3rd Party Developers

Oceanside, building on its Smart City infrastructure investments to date, plans to open up the ICT platform to 3rd party developers creating the opportunity for new applications by business start-ups and established technology companies to "Invent in Oceanside!" We envision a future where emerging technologies, not just transportation technologies, can use the City's ICT platform to invent. The City plans to organically grow sharing and service economy businesses, two of the fastest growing business sectors. To enable 3rd part developer thrive, the metered field controllers atop streetlights, will deploy Standard Too Kit and API calls, with the appropriate cyber security protocols in place to assure only authorized personnel can deploy atop the ICT platform.

## Program Management Approach

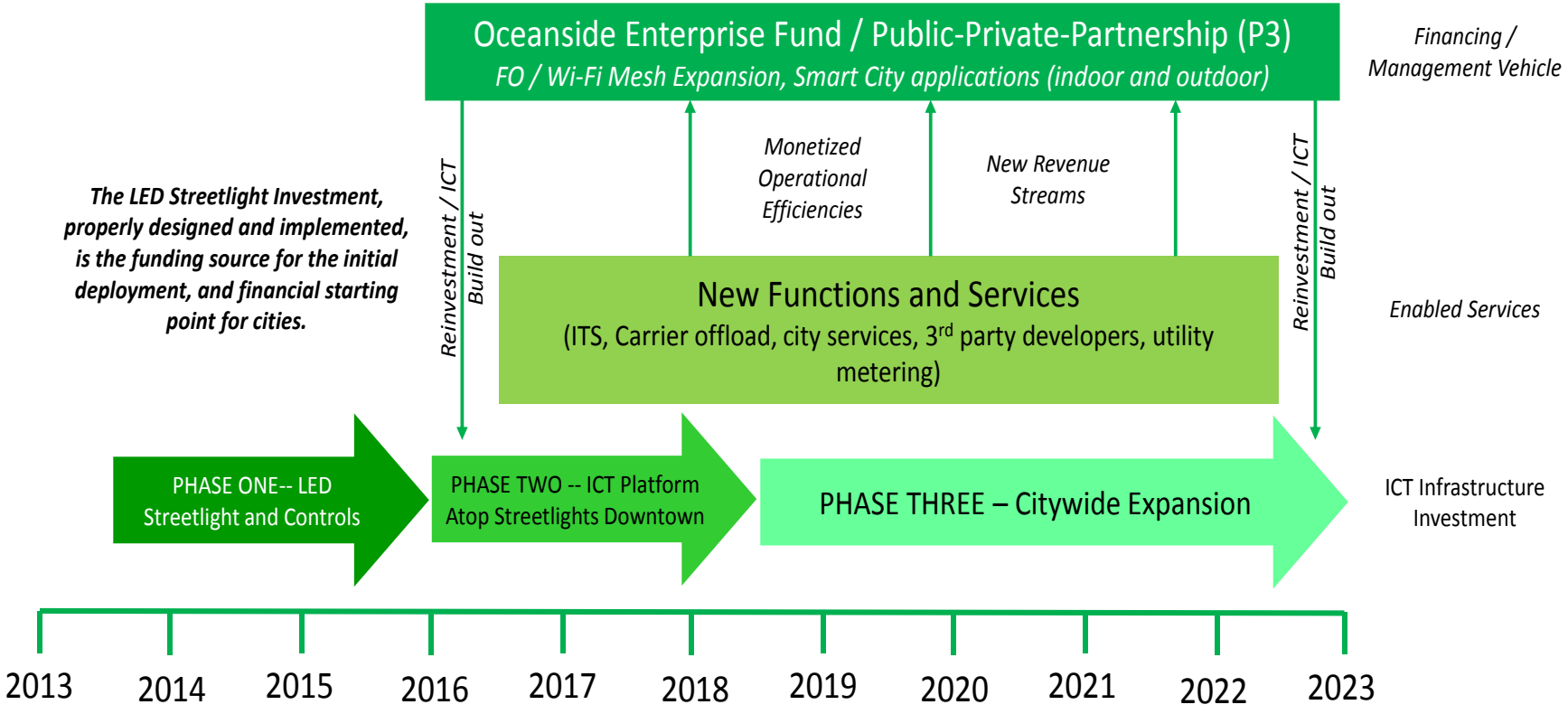
Program Management will be led by the City. It starts with a clear Statement of Work, as well as Goals and Objectives as described in this proposal. It includes a work plan, an organizational structure, and a funding mechanism to assure all work is complete. Below is Oceanside's Program Management Plan to carry out the vision described with this paper. It starts with a clear understanding of how the program will be organized.

### The Oceanside Business Model – Paying It Forward

Oceanside, like most cities, started down its Smart City path without available funds. California's energy efficiency policy environment timing was just right. City after city in the San Diego region has converted to LEDs atop streetlights. And each city was able to finance the LED investment with ZERO money out of pocket. Oceanside went one step further, investing in the metered streetlight control network at the initial LED deployment. The energy dollar savings were so great that the City did not have to come out of pocket to pay for its first ICT lighting controls platform. Now, with the advent of the new metered streetlight rate, Oceanside will now be free to repurpose streetlights to expand the ITS footprint while supporting integration of other city services, then invite 3rd party developers to work in Oceanside, while offering Wi-Fi bandwidth to the telecomm carriers to offload growing Smart Phone traffic. As a result of these developments, Oceanside now envisions the implementation of a special Enterprise fund, whereby new revenues are tapped and operational efficiencies unlocked, the monetization of these benefits will pay for the network expansion.

Exhibit 4 below depicts Enterprise Fund and its relationship to all the program elements. The timescale shows how the early investments made in streetlights is parlayed into ICT expansion.

Exhibit 4
Relationship between Funding / Management Mechanism, ICT Deployment and Service



## The Oceanside Partners - A Public Private Partnership (P3)

While Oceanside is motivated, owns and /or controls the streetlights and related rights of ways, and has demonstrated commitment to Smart City development through its forward leaning investments in streetlights, it cannot go it alone. And most important it owns and / or controls the streetlights within public rights-of-way. To build its future, Oceanside has sought support from the private sector. Today, Oceanside is actively working with the following technology and implementation channel partners to enable its vision:

1. IBM. Cloud Analytics. City analytics and services deliver business efficiencies.
2. Intel Corporation. Latest IoT chipsets.
3. Convergence Wireless – Mesh Streetlight Controllers, Fiber Optic backhaul, Technical Architecture and integration design. Convergence's wireless technology currently approved for use in GSA buildings across the United States.
4. Intellastar – embedded analytics
5. Ultra 3eTi. US DOD Wi-Fi Telecommunications Security Expertise.
6. Southern Contracting. LED streetlight architect and program manager.

The core team is unique in that it fully understands and has implemented FIPS-based cyber-secure networks. They have all previously worked together, in one form or another, on directly relevant projects. Each of these firms have met with, and/or indicated a formal willingness to support, the City of Oceanside. One or more of above firms will participate in the formation of a P3 to design, build, operate and maintain the ICT platform, protecting the City from technology obsolescence. Below is a deeper look at each committed team member.

### IBM

IBM's Industry Smarter Solutions Team (ISST) their Intelligent Transportation Systems (ITS) team are collaborating with both Convergence Wireless, Inc. to use their Broadband Wireless Streetlights (BWS) offering and Intellastar's real-time control and embedded analytics to increase the sensing and actuation granularity by leveraging the ubiquity of light infrastructure existing power drops and the BWS offering's ability to become the "Smart City Backbone." This will enable not just the Department of Transportation's Framework to utilize this unified communications wireless "fat pipe" wireless network, but numerous other stakeholders as well, all using their own separate VPN tunnels taking advantage of the true lock & key based authentication and encryption based cyber security.

### Intel Corporation

Intel Corporation is supplying their new Internet of Things (IoT) modules to the Convergence Wireless Dual Radio Wi-Fi Streetlight System. This Intel chipset is comprised of processors capable of performing automated image and analytics processing with sensor data collected from every streetlight. The entire team will be working closely with the City of Oceanside on an innovative implementation of the USDOT Framework, which can then be scaled across the nation.

## Convergence Wireless

Convergence Wireless, Inc. (CWI) has the earliest patents for leveraging the existing lighting infrastructure (both indoor and outdoor) to enable the lowest cost and most ubiquitous Internet of Things (IoT) and Industrial Internet of Things (IoT) solutions in the market. CWI is able to accomplish this very bold statement because they take advantage of the existing and paid for power drops that the lighting infrastructure represents to a network. Power drops that are literally everywhere because of the need for lighting in everyday activities. They first control and monitor the lighting infrastructure itself to deliver energy savings and electric grid peak demand automatic load shedding incentive capture from electric utilities, quickly paying for the technology cost and installation cost before reaching out to even more lucrative heretofore manual processes automation in operational and maintenance areas that IoT and IoT delivers.

## Intellastar

Intellastar is the embedded analytics technology provider to Convergence Wireless Corporation. Thus, the end nodes will have their own real-time controls capability, embedded analytics with real-time clock running entire schedules, sensing data gathering and even on board camera visual analytics the automate visual information so Control Center Personnel can focus on what matters because automated analytics will create alarm conditions automatically with the camera based graphics. A portion of the Intellastar Analytics Engine will reside on the server side of the system and feed the real-time analytics data into the IBM USDOT Framework Implementation cloud analytics servers.

## Ultra Electronics, 3eTi®

Ultra Electronics, 3eTI® (3eTi) is a leading provider of military-grade secure communications that enable critical systems security, infrastructure security, and facilities management for the defense, government, utilities and industrial markets worldwide. Since its founding in 1997, 3eTI has been deeply involved in creating highly secure wireless solutions for US DoD agencies and designed and deployed the world's first FIPS 140-2 validated Wi-Fi Access Points as well as the first Common Criteria certified Wi-Fi. Our secure 802.11 and 802.15.4 wireless networks are the industry's first to attain independent validation and certification and are used by the most stringent customers, including the US military. 3eTi is also experienced with ISO/IEC 27001 for Information Security Management Systems (ISMS), ISO 15408 (Common Criteria) and the NIST Risk Management Framework (RMF).

As the cyber security partner for this Smart Cities program, 3eTi will not only oversee the security validation and certification process, but will also ensure that the system has a robust cyber security implementation. This will be accomplished through ensuring that the overall ICT system achieves FIPS 140-2 validation for cryptographic operations, adheres to cyber-security standards such as ISO 27001 (Information Security Management System), ISO 15408 (Common Criteria) and the NIST Risk Management Framework (RMF). 3eTI will manage the entire security certification process and coordinate with government and 3rd party accredited

laboratories in order to insure that the ICT design meets stringent cyber-security standards and a robust cyber-security profile.

### Southern Contracting

Southern Contracting is the local electrical general contractor with the "boots" on the ground. Southern designed, installed and commissioned the entire streetlights metering network and is assisting the City develop its Smart City plan described here. Southern organized a formal research program among the cities of San Diego and Chula Vista, SDG&E (local utility), and the California Lighting Technology Center (CLTC) to vet the first generation of metered lighting controls, leading to the nation's first smart meter streetlight tariff. Southern also designed, installed and commissioned the city of San Diego's 3,000 streetlight controls network spanning the downtown urban area of the nation's 8th largest city. Southern will assist Oceanside to lead the development and implementation of the proposed program and the P3 partnership.

### Envisioned Regional Agency Partnerships

Beyond this capable team, Oceanside is entering into and/or seeking to enter into partnership arrangements with:

1. The San Diego Association of Governments (SANDAG), the regional traffic planning agency
2. North County Transit Authority (NCTD), the local transit authority. Headquartered in Oceanside, NCTD manages the light rail (SPRINTER), train (COASTER), bus (BREEZE) and last-mile (LIFT AND FLEX) transportation network serving North San Diego County. NCTD has also executed interoperability agreements with BNSF Railway, Southern California Regional Rail Authority (SCRRA) METROLINK commuter service, AMTRACK and Pacific Sun Railroad.
3. University of California San Diego (UCSD). UCSD has been conducting primary and applied research for the past several years on the design and deployment of sensors atop streetlights under the banner of the Sentinel Program.
4. Caltrans. Statewide transportation authority. We want to explore and develop the ICT technology platform to eventually integrate Caltrans-controlled signaled intersections into the ICT platform, supporting system-wide signal synchronization.
5. US DOD, Camp Pendleton. We plan to explore and integrate common communications protocols in support of Consequence Management requirements.

The City has already opened preliminary discussions with each of these agencies and will solidify their support as the City proceeds.

### Partnership Governance

The City envisions the P3 to be structured within the City's provisions to oversee this strategic plan, and assure goals and objectives are met. Appropriate City representatives will govern the enterprise effort. This will assure the funds are prioritized toward the City's Smart City Infrastructure implementation.

## Requested Grant Application Information

Presented on the following pages are detailed responses to the series of questions posed in the NOFO.

### Oceanside's Alignment with the Characteristics and Vision Elements of a Smart City

#### Population Characteristics

Oceanside should be considered an ideal candidate because of how well we align with the Smart City characteristics described in the NOFO. Our 2010 census population of about 167,086 falls a bit short of the population guideline. However, it is worth noting that Oceanside is a resort destination, and with major events on holidays or weekends, the population within the downtown target development zone can swell by more than 100,000. In addition, Camp Pendleton, the Marine training base, shares a common border and is home to more than 30,000 permanent residents. Oceanside thinks and acts like a much larger mid-sized American city described in this NOFO. In addition, Oceanside's demographics are among the most diverse in California, more reflective of the nation as a whole when compared to other similar-sized cities.

Table 1
Oceanside 2010 Census Population

| | Male | Female | Total |
|---|---|---|---|
| **TOTAL** | **82,424** | **84,662** | **167,086** |
| White | 54,048 | 54,972 | 109,020 |
| Hispanic or Latino | 29,844 | 30,103 | 59,947 |
| Some Other Race | 12,909 | 12,977 | 25,886 |
| Asian | 4,661 | 6,420 | 11,081 |
| Two or More Races | 4,866 | 4,831 | 9,697 |
| Black or African American | 4,178 | 3,695 | 7,873 |
| Native Hawaiian Pacific Islander | 1,047 | 1,097 | 2,144 |
| American Indian | 715 | 670 | 1,385 |
| Three or more races | 444 | 430 | 874 |
| Native Hawaiian | 128 | 133 | 261 |

#### Other Relative Smart City Attributes

1. **Urban Density.** Oceanside is the 18th most densely populated city in the nation, with 3,978.2 residents per square mile. Oceanside represents 6% of the overall population of the greater urbanized San Diego area.
2. **Existing Public Transport System**. The Oceanside Transit Center (OTC) is one of the busiest transit centers in San Diego County, with more than 1.2 million annual passengers boarding trains and buses. OTC connects transit services between San Diego, Orange, Los Angeles and Riverside counties.

The North County Transportation District (NCTD) is headquartered in downtown Oceanside near the OTC and oversees to a robust network which provides more than 12.5 million passenger trips per year in North San Diego County. NCTD renders services which include the BREEZE bus, the SPRINTER light rail, the COASTER commuter train, the FLEX demand response, and the LIFT paratransit service. The City of Oceanside is a League of American Cyclists Bronze Level Bicycle-Friendly Community. The head of the Coastal Rail Bike Trail starts in Oceanside and is augmented by the fact that the Coaster, the Sprinter, and the Breeze all allow bicycle transport. The City also has an extensive 3-level bicycle network connecting the City guided by the City's bicycle mobility plan.

3. **Conducive Environment**. Oceanside has invested more than $6 million in fiber optic cabling, advanced LED streetlights and streetlight metering system and is in the process of integrating the ITS and streetlight networks with a common backhaul. The City is well on its way to enabling its Smart City future. In addition, the local utility, SDG&E, is about to implement one of the nation's first metered streetlight tariffs, supporting the acceleration of Smart City technologies and deployments.
4. **Continuity of Committed Leadership**. The City Council, City Manager, Chief Engineer, and various departments, including IT, Transportation, Police, Fire and Utility Services, are fully committed to Oceanside's Smart City future.
5. **Sharing Economy**. Oceanside's very ICT platform is being been strategically designed to enable 3rd part development. The City's leadership intends to start discussions this year to attract new business that will thrive in Oceanside, fast becoming a leading connected city. Linkages with Social Media, consumer apps utilizing traffic flow data, and smart city programs designed to engage the public are all in early formulation stages.
6. **Shared Data**. As with Oceanside's plans to help stand up sharing economy business constructs, Oceanside is fully committed to making the data collected through the ICT platform available to the public (public at large, other agencies, 3rd part developers, itself through its Enterprise Cloud Platform) to acceleration of its Smart City ambitions. Appropriate provisions will be made to protect privacy through data de-identification, and restricted access to distributed cloud data driving machine-to-machine interfaces.

## Vision Elements

Below is a review of the USDOT Vision Elements and how Oceanside aligns.

### Technology Elements

1. **Urban automation** is the heart of the ICT platform. Designed by proven automation experts with a focus on meeting FIPS-compliant cyber-security standards.
2. **Connected Vehicles** cannot function safely without being connected to a truly secure ICT platform. Oceanside is leaning forward with this proposal to identify and solve this strategic conundrum. The ICT platform needs be share data among many stakeholders, including Traffic and Transportation management.
3. **Intelligent Sensor-based infrastructure** is at the heart of our mesh Wi-Fi enabled ICT platform, eliminating or minimizing latency in support of automation best practices.

## Smart City Elements

1. **Architecture and Standards**. The ICT platform is being architected with not just the USDOT standards in mind, but also other stakeholders, including NIST, US DOD and US DOE.
2. **Low-cost resilient technology**. The ICT platform is using commercial Wi-Fi Alliance 2.0 / 3.0 standards to assure widespread acceptance.
3. **Smart Land Use**. In 2009, the City of Oceanside adopted the Coast Highway Vision and Strategic Plan. This plan serves as a blueprint for the revitalization and enhancement of the Coast Highway corridor between Harbor Drive in the north and Buena Vista Lagoon in the south. The Vision and Strategic Plan includes several recommendations to transform Coast Highway from an auto-oriented thoroughfare into a "complete street" that serves all modes of transportation from automobiles to pedestrians to bicyclists and transit vehicles.

   The City of Oceanside is now embarking on an effort to study and begin the design process for the street enhancements and changes proposed as part of the Vision and Strategic Plan. This effort, called the Coast Highway Corridor Study, will assess existing and future transportation conditions along the corridor and on surrounding streets in order to identify the preferred approach to implementing the recommendations contained in the Coast Highway Vision and Strategic Plan.

   The study effort will focus on assessing projects that are consistent with the Vision and Strategic Plan and address the needs of the community through:

   - ✓ Improving pedestrian and bicycle infrastructure with a focus on safety and comfort, enhancing access to transit.
   - ✓ Modifying the roadway with improvements such as roundabouts to improve traffic flow.
   - ✓ Improving parking access to businesses along the corridor.
   - ✓ Encouraging economic development through improvements in mobility and the public streetscape.

   The ICT platform will be a key tool used by city traffic planners to enable these goals. Traffic patterns will be characterized using the dynamic sensor-enabled ICT platform. Furthermore, the City is now able to make informed decision about new streetlight dimming plans with even more energy savings to come by overlaying dimmable streetlights GIS layer with the City zone map GIS layer. Integrating traffic pattern analysis to the ICT platform will enable even more advanced analytical analysis and planning.

## Innovative Approaches to Urban Transportation Elements

1. **Urban Analytics**. The ICT platform is being architected from the ground up with a distributed, two-layered analytics architecture. This provides the framework for field automation and support of the automation requirements of connected vehicles, while feeding the analytics engine residing in the Cloud. Cloud analytics provides separation

of machine-to-machine automation security elements, data access by agencies and the public, and support of 3rd part development of new technology and shared economy businesses.

2. **Urban Delivery and Logistics**. Oceanside will be exploring the design and deployment of a terrestrial 3D GPS component, using streetlights as GPS beacons to enable delivery automation.
3. **Strategic Business and Partnership Models**. Oceanside, through its planned P3 and Enterprise Fund approach, has been committed from the beginning to both find a working business model to enable its future, but also provide an example for other cities to follow. Oceanside has learned how to withdraw from the Bank of Energy Efficiency and monetize energy savings to pay for its first wave of Smart City systems like streetlights. Combining the value proposition inherent in public mesh Wi-Fi with this new P3/Enterprise Fund business model, Oceanside welcomes the opportunity to share lessons learned with other cities.
4. **Smart Grid Roadway Electrification**. All these capabilities are being provided for, by design, within the ICT architecture. In fact, expansion of the Smart Grid will find major economies of scale by piggybacking onto this Smart Streetlight construct as Smart Meters and planned radio deployments to connect utility infrastructure in support of a more secure and resilient grid are achieved through a co-op agreement between the local utilities and the City.
5. **Connected Involved Citizens**. Oceanside will be exploring and developing policies from the outset to not only engage its citizenry, but also provide subsidized access to low income neighborhoods so no family or child is left behind. The Home Login Page will feature local businesses and city news.

## Twelve Vision Element Alignment

Below is a detailed analysis of how Oceanside's plans align with the twelve vision elements.

1. **Urban Automation**. As described above, this is the heart of the planned ICT platform. Designed by automation and cyber-security experts from the ground up to support low-latency automation everywhere across the City.
2. **Connected Vehicles (VTI)**. The ICT platform designed to securely scale the deployment of VTI interaction around automation design principles. The common ICT platform shares duty with many other stakeholders as well, including fire, police, utilities, and telecomm carriers.
3. **Intelligent, Sensor-based infrastructure**. The basis of the ICT Platform, addressing the requirements of sensors to operate in a real-time automation environment.
4. **Urban Analytics**. System will deploy distributed analytics, analytics at the edge to support automation, and analytics at the enterprise level to support policy and planning, as well as support of identifying and incentivizing the development of new services.
5. **User-focused mobility services and choices**. Integration with NCTD's transit system, of rail, light rail, bus, bike and last mile transport, providing apps that will offer mobility

choices balancing convenience, travel time and cost. For example The City is just starting to explore e-bike charging stations around the downtown area, and a consumer app that shows both the location of an open charging station, but also links to nearby businesses as a way of encouraging expanded e-bike usage. starting

6. **Urban Delivery and logistics**. Oceanside's plans to support the investigation and development of a 3D terrestrial GPS system atop streetlights will support new package delivery modes when combined with the dynamic traffic data platform.
7. **Strategic Business Models and Partnering opportunities**. The business model framework consists of a combination of an Enterprise Fund and a P3 to bring the ICT platform to life.
8. **Smart Grid, Roadway electrification and Electric Vehicles.** Smart Grid integration is one of many revenue / cost sharing opportunities to fund the expansion of the ICT. Utilities will be able to connect their Smart Grid assets through the common ICT platform. Charging stations can connect their meter and charging transaction to the Wi-Fin mesh, providing not just a fueling transaction, but the connected vehicle can monitor the best available route to shopping destinations, homes, EV charging stations, etc.
9. **Connected, involved citizens**. Citizen involvement will be assured as the public will have access to the Wi-Fi system with the log-in page generating revenue through banner ads and while providing Public Service announcements.
10. **Architectural Standards**. The City will be working closely with the development team to emerging USDOT standards, NIST FIPS standards, and USDOE Smart Grid standards.
11. **Low-cost ICT**. Enhanced revenue directed through an Enterprise fund approach will assure low cost access to the platform by everyone through a co-opting strategy of a shared ICT platform connecting government, businesses and citizens.
12. **Smart Land Use.** As new businesses and services are implemented, deployments will be designed with the City's zoning map as a backdrop to understand the impact on the community. Spatial awareness is key when using existing rights-of-way.

The three highest priority element, Urban Automation, Connected Vehicles and Intelligent Sensor-Based Infrastructure are addressed head on with our ICT platform, The OMNI-Mesh Network. Urban Automation is addressed through the system architecture being designed by automation experts, not just network architects. Connected vehicle security will be addressed through the integration of our FIPS-compliance design strategy with emerging USDOT VTI standards. The application of Wi-Fi Alliance Passport 2.0 / 3.0 standards to the design of our mesh Wi-Fi-based OMNI-Mesh Network will assure low latency integration of sensors atop streetlights across the City to the most current standards, further supporting cross-functional usage of OMNI-Mesh beyond ITS applications.

## Technical, Policy and institutional Risks

There are several technical, policy and institutional risk associated with our plan. Here are the key risks we have identified.

1. **Tariff Risks**. Metered Streetlight Utility Energy Tariffs in infancy state. There needs to be a concerted organized effort to expand metered streetlights. Current flat rate tariffs restrict what cities can do with their streetlights.
2. **Streetlight Control**. Streetlight ownership is not universal. Cities need to buy their streetlights, and then convert to LED as their Smart City starting roadmap starting point. This process can take up to two years when a city decides to move forward.
3. **Timing Risk**. Integration with emerging USDOT VTI standards will be constrained by the actual USDOT timetable. Preliminary data structures need to be assessed / integrated.
4. **Security**. The USDOT needs to assure that the ICT platform is secure to the highest FIPS standards. Streetlights are the natural place to ubiquitously install traffic monitoring sensors, and will soon be formally classified as "Critical Infrastructure," along with other elements of the Smart Grid. The USDOT needs to take a forward-leaning position on this to minimize 1) security breach risk, and 2) the risk of independent data / communication silos cluttering cityscapes with radios and devices.
5. **Implementation Risk**. A common, sensor-enabled ICT platform IS the most economical way to share data among agencies and the public to enable automation, IoT based applications to thrive in the emerging new world economy.

Additional risks include, construction risks, operations and maintenance (O&M) risks, entitlement risks, environmental risks and analytics risks. The City will develop a formal Risk Mitigating plan to address each.

## City Transportation System

The City of Oceanside, situated adjacent to Camp Pendleton, is located in North San Diego County along the I5 corridor connecting San Diego with Los Angeles. The City's roadways include:

1. Interstate Five (I5) -- 4 miles.
2. Highway 78 Freeway (SR-78) -- 7 miles
3. Highway 76 Expressway (SR-76) -- 10 miles
4. Roadway Arterials -- 114 miles

In addition, Oceanside is home to the headquarters of NCTD and the OTC, a multi-modal center linking buses, light rail, trains, taxis and bicycles to inland and coastal municipal transportation networks. Amtrak and Metrolink also use the transit center, linking Oceanside with the rest of California and the United States. The City has two electric vehicle charging locations located around the City, including 14 charging stations at the OTC and one at Mossy Nissan, Oceanside. Long term plans call for expansion as EVs become more popular. The City's transportation plan calls for initiation of an educational program to encourage EV adoption.

## City Data Collected

The City Transportation Management Center (TMC) serves as a central data collection center where real-time information is gathered from many sources such as CCTV cameras and traffic signals via Citywide a fiber optic network, a 16-panel video wall, and 38 CCTV cameras at key

signalized intersections. The data received at the TMC enables the City traffic engineers to monitor and optimize traffic in real-time to ensure a fast, intelligent and coordinated response is made to improve traffic operations on the circulation system. This information and the associated response measures are managed through a software application know as an Advanced Traffic Management System (ATMS). The TMC allows traffic engineers to monitor and adjust traffic signal plans during special events, as well as implement real-time transportation management measures at incident locations.

Phase II of the TMC is currently underway, which consists expanding the existing fiber optic backbone along Coast Highway, Oceanside Boulevard, El Camino Real, and College Boulevard, adding more CCTV cameras at signalized intersections, and enhancing collection and provision of traveler information (with the use of changeable message signs and inter-jurisdictional traveler information sharing on a regional level known as the 511 Program) during daily and peak traffic periods and/or emergency situations. Additionally, the implementation of BlueTOAD technology currently being integrated into the City's TMC which directly determines travel time, speeds, and origin-destination at select locations by matching Bluetooth signals from passing vehicles.

### Cross-Functional Integration with Other City Services

It is Oceanside's strategic intent to use the Mesh-Wi-Fi enabled mobile ICT system to support all city services. One of the key goals of the City's ITS / ICT technical approach is to enable the dynamic collection of data through a sensor-based network atop streetlights. This data will be directly linked to the ITS system to support automated adaptive signaling, enhancing Level Of Service (LOS) targets. This data will drive the advanced deployment of adaptive signal control, while providing data to support long term transportation plans consistent with land use plans. Furthermore, the mesh Wi-Fi will support other city services by design.

### Existing Policies, Ordinances and Enacted Legislation

Oceanside has a formal policy that the information gathered is made available to the public. Specific to the City's ITS platform, a written policy is in place to ensure compliance with regional ITS architecture and National ITS standards where feasible to promote interoperability and information exchange with other agencies in the region. A key goal of the ICT platform is to enable access to citizens as well, enhancing their work, play and living experience in Oceanside. This will be enabled through formal encouragement of new businesses and technologies to grow and thrive in Oceanside enabled through our mesh WI-FI enabled network that will support new mobility businesses. We envision new ride sharing services to take advantage of gathered data, connecting riders with vehicles to travel to leisure, shopping and work destinations.

### Public Private Partnership (P3) Governance

Oceanside is starting to formally explore the development of a Public-Private Partnership (P3) to implement, operate and maintain the ICT platform. The detailed terms are yet to be worked out, with the goal to define cost sharing, annual budgeting, revenue sharing, and the co-

development of new 3rd party applications and city services to enhance the Oceanside experience. Through revenue sharing, the P3 partners will be incentivized to invest while taking on the O&M risk as well as technology obsolescence risk. A key element of the P3 will be to define what information is available to whom and when, with measures to protect privacy through appropriate system user de-identification techniques.

## Cyber-Security Certification

Beyond the integration of USDOT, NIST and Smart Grid Standards described earlier, there is one more standard that needs to be addressed – cyber-security. Our planned ICT platform will comply with the below emerging standard because in this new IoT world, streetlights will be classified as "Critical Infrastructure." Recognizing that the national and economic security of the United States depends on the reliable functioning of critical infrastructure, the President issued Executive Order (EO) 13636 in February 2013, Improving Critical Infrastructure Cybersecurity. The Order directed NIST to work with stakeholders to develop a voluntary framework – based on existing standards, guidelines, and practices - for reducing cyber risks to critical infrastructure. The Cybersecurity Enhancement Act of 2014 reinforced NIST's Executive Order 13636 role, which built upon the 2002 Homeland Security Act. The entire system will be tested for adherence to the National Institutes of Standards and Technology's (NIST) Cyber Security Framework, which was released in February 2013, with complete testing being performed at NIST's top cyber security contractor's real-world lab located in Knoxville, TN, Enernex, Incorporated. The NIST Cyber Security Framework includes adherence the United States Federal Information Processing Standards (FIPS) 56a, 140 (all 4 levels), 180 (all versions), 186 (all versions), 197 (all versions), 198 (all versions) 200 (all versions), 201 (all versions), 800-21, 800-38a and 800-57. We will secure the highest formal FIPS 140-2 compliance certification as a result of this Executive Order.

## Program Performance Metrics

A core measureable goal of the ITS system as it utilizes the collected dynamic traffic data, will be to improve Level Of Service (LOS) at all signaled and non-signaled intersections. The City's Traffic Plan has specific targets defined today based on intersection type and time of day. What is being measured is the impact of traffic congestion on the daily lives of Oceanside citizens and visitors. Key metrics will plan to measure includes:

1. Idling wait times
2. Average speed along arteries and corridors
3. Greenhouse Gas Emissions reduction calculation based on vehicle type and idling time (before and after comparison)
4. LOS Improvements when compared to baseline targets.

Right now we are projecting a 10% reduction in Greenhouse Gas (GHG) emissions, 15% reduction in vehicle stops, and an 8% reduction in fuel use.

### Capacity to Take on the Project

Oceanside has the complete capacity to take on a project of this magnitude. When combined with the attached letters of support from our agency and private partners, this proposal demonstrates the executive and partnership commitment. By partnering with industry partners including IBM and Intel, we have the breadth of commitment necessary to deliver results. Our infrastructure has been strategically developed to prepare for exactly the very Smart City vision articulated by the USDOT. Finally, we have successfully installed more than $10 million in "smart" infrastructure improvement projects strategically designed to prepare just for this moment, demonstrating our management ability to achieve our plan. Oceanside has strategically committed to move forward and we welcome support from the USDOT to help realize our vision.

### Leveraging Federal Resources

A core element of the Oceanside plan is to develop the Business Model for other cities to emulate. Central to this plan is to identify the first revenue sources, including carrier and utility network sharing, and develop / implement these first co-op offtake agreements. We will then use this revenue to underwrite the investment expansion with third party banking funds by monetizing these value streams. We plan to explore leveraging this model to build out a portion of the development downtown, extending and/reducing the investment made by the USDOT.

## Summary

The USDOT is seeking the following outcomes to be achieved.

- ✓ **Improve Safety** – By using advanced technologies, including connected vehicle technologies, to reduce the number of collisions, fatalities, and injuries.
- ✓ **Enhance Mobility** – By providing real-time traveler information and emerging mobility services to improve personal mobility for all citizens.
- ✓ **Address Climate Change** – By implementing advanced technologies / policies supporting a more sustainable relationship between transportation and the environment through fuel use and emissions reductions.

Oceanside's OMNI-Mesh Network directly addresses each:

1. **Safety**: Improved police and fire coordination and response times through enhanced communication and knowledge of fastest, most routes.
2. **Enhanced Mobility**: Supporting local and regional traffic planning agencies develop better plans and services while enabling a new generation of entrepreneurs invent the next big sharing economy. "Invented in Oceanside!"
3. **Climate Change**. Dynamic traffic monitoring enabling VTI communications linking sensors with big analytics to enable new algorithms to monitor then regulate traffic flow, improving Level Of Service (LOS). This leads to reduced idling / GHG reductions.

### Advanced Vehicle-To-Vehicle Demonstration Plan

Oceanside has clearly taken a different approach to supporting the USDOT and the nation with this proposal. Should we become one of the five finalist cities, we will actively engage with

USDOT partners and seek out transportation companies looking to demonstrate their technologies in Oceanside utilizing the OMNI-Mesh Network, like bus collision safety technology, in partnership with Oceanside and the NTCD.

In closing, a key premise of our approach is that these new technologies, like bus collision safety, will be better supported when the OMNI Mesh Network is in place. This cyber-secure ICT platform will also provide the networked environment enabling the placement and deployment of real-time traffic sensors. Central to the technical approach of our plan is the expanded integration of traffic sensors midblock and at or near non-signaled intersections to create a dynamic real-time model of the City's traffic flow. This traffic flow database is consistent with the USDOT's larger plans to integrate VTI technology, while providing the very data necessary to develop more accurate algorithms governing signal synchronization citywide.

We are already installing BlueTOAD devices as part of the first phase of development in the targeted downtown development zone. As part of this USDOT opportunity, we will be approaching additional traffic monitoring technology companies to complement the BlueTOAD technology (Vehicle / Passenger Blue Tooth Detection) to more accurately characterize vehicle type, vehicle direction, vehicle count and vehicle velocity. We will also explore how we can monitor and characterize pedestrian traffic within our dense urban target development zone.

We will develop our detailed program plan, budget and schedules integrating everything described in this proposal while simultaneously adding VTI capabilities consistent with current local and regional transportation plans. This will support two key goals: 1) Integration of emerging USDOT ITS standards governing VTI and VTV communications, and 2) Demonstrate the very technologies that the USDOT is seeking to promote.

Starting with a secure ICT platform designed from the ground up for mobile and FO Smart City connectivity, Oceanside is a ready,-willing and able partner to enable a truly 21st Century Smart City architecture to share with the United States and the global community of cities.