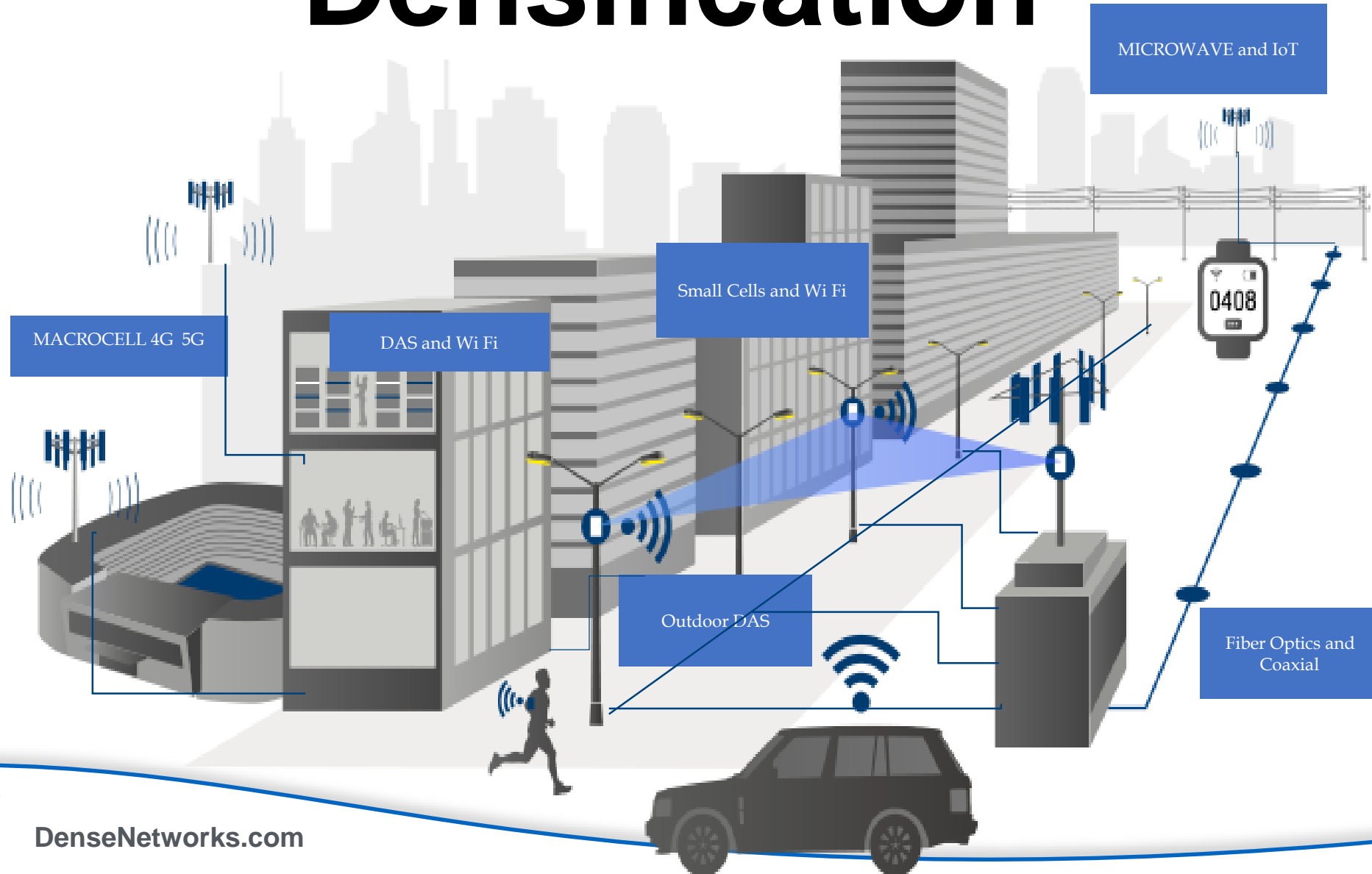


Densification



CITY OF CORAL GABLES INFORMATION TECHNOLOGY DEPARTMENT RESILIENT SMART CITY - ENGINEERING, DESIGN AND COMPLEXITY CHALLENGES

The infographic illustrates the Smart City Ecosystem, structured as follows:

- Top Header:** smart city logo, CORAL GABLES THE CITY BEAUTIFUL logo with tagline "A World Class City with a Hometown Feel", and SMART DISTRICT PROJECTS logo.
- Strategic Pillars:** STRATEGIC PLANNING – INNOVATION, CONTINUOUS IMPROVEMENT, CUSTOMER SERVICE – QUALITY OF LIFE.
- Smart City Ecosystem:** A central layer with the theme "COLLABORATION, PARTNERSHIP, INTELLIGENCE / CUSTOMERS, STAKEHOLDERS AND TECHNOLOGY". It includes categories: PEOPLE, BUSINESSES, ORGANIZATIONS, THINGS, and I.T. SYSTEMS.
- Smart City Hub:** A layer with the theme "VALUE, TRANSPARENCY, OPEN DATA AND ANALYTICS, ACTIONABLE INFORMATION, EFFICIENCIES, CITIZEN ENGAGEMENT, MOBILITY, ACCESSIBILITY, INCLUSION, CROWDSOURCING, COLLABORATION". It contains:
 - DATA MARKETPLACE (OPEN DATA PORTALS, IoT DASHBOARDS, GIS PORTALS)
 - APP STORE
 - TRANSPARENCY PORTALS (CITIZEN ENGAGEMENT)
 - CRIME INTELLIGENCE CENTER
 - ENTERPRISE SYSTEMS + eGOV
- Data Platforms:** A layer with the theme "DATA AGGREGATION, INTEGRATION AND CORRELATION / BUSINESS INTELLIGENCE AND ANALYTICS BACKEND". It includes: PUBLIC & PRIVATE CLOUDS & DATACENTERS, BIG DATA AGGREGATION & ANALYTICS, ARTIFICIAL INTELLIGENCE & MACHINE LEARNING, VIDEO ANALYTICS, OPEN DATA & APIS, and HORIZONTAL & VERTICAL INTEGRATION.
- Internet of Things:** A layer with the theme "REAL-TIME URBAN AND ENVIRONMENTAL VISIBILITY / PHYSICAL INTERFACING". It includes: SMART LIGHTS, TRAFFIC & PARKING SENSORS, PUBLIC SAFETY SMART EQUIPMENT, ENVIRONMENTAL SENSORS & ACTUATORS, SMART DEVICES, SMART KIDDES & DIGITAL SIGNAGE, and ROBOTICS & SMART VEHICLES.
- High Speed Communications and Resilience:** A layer with the theme "ROBUST, RESILIENT SMART CITY NETWORK FOUNDATION". It includes: RESILIENT NETWORK (IEEE Winner of 2012), FIBER OPTICS, WIRELESS BACKBONE, METROPOLITAN ETHERNET, PUBLIC & PRIVATE WI-FI NETWORKS, SATELLITE & CELLULAR COMMUNICATIONS, and SMART ENERGY RESILIENCE.
- Footer:** CORAL GABLES THE CITY BEAUTIFUL logo, QR code, website (www.CoralGables.com), social media (Facebook.com/cityofcoralgables, @CityCoralGables), and contact information (Coral Gables City Hall • 405 Biltmore Way, Coral Gables FL 33134 • 305-446-6800).

THERE ARE RESILIENCY CHALLENGES RELATED TO THE COMPLEXITY AND DIVERSITY IN THE DESIGN OF THE SMART CITY INFRASTRUCTURE STACK AND SERVICE PORTFOLIO.

RESILIENCE AND HIGH-AVAILABILITY HAVE TO BE AN INTEGRAL PART OF THE ENGINEERING AND DESIGN PROCESS, NOT AN AFTER-THOUGHT.

A COMPREHENSIVE STRATEGY TO MAINTAIN CRITICAL SERVICES WHILE COMPLYING WITH HIGH-AVAILABILITY POLICIES AND REQUIREMENTS.

ICT SYSTEMS AND SERVICES HAVE TO BE A STRATEGIC AND INTEGRAL PART OF THE ORGANIZATION'S CEMP AND COOP PLANS.

CITY OF CORAL GABLES
INFORMATION TECHNOLOGY DEPARTMENT
SMART CITY NETWORK FOUNDATION

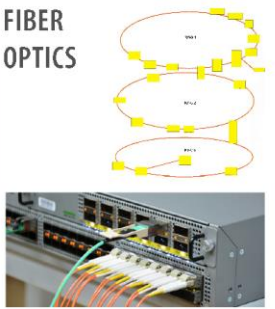
HIGH SPEED COMMUNICATIONS AND RESILIENCE

ROBUST, RESILIENT SMART CITY NETWORK FOUNDATION

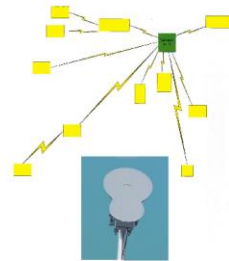
RESILIENT NETWORK



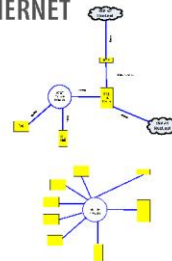
FIBER OPTICS



WIRELESS BACKBONE



METROPOLITAN ETHERNET



PUBLIC & PRIVATE WI-FI NETWORKS



SATELLITE & CELLULAR COMMUNICATIONS



SMART ENERGY RESILIENCE



OUR NETWORK INFRASTRUCTURE AND SERVICES MUST BE SECURE, ROBUST AND RESILIENT TO SURVIVE HURRICANES, POWER OUTAGES, CYBER-THREATS AND OTHER DISASTERS WHILE KEEPING EMERGENCY SERVICES AND CRITICAL COMMUNICATIONS ON (911, FIRST RESPONDERS, MISSION-CRITICAL SERVICES, ETC.)

Post-Sandy Federal & Industry Actions

2016 Wireless Resiliency Coop. Framework

- Roaming; Mutual aid; Local government; Consumer readiness; Consumer information; Disaster Information Reporting System (DIRS)

July 2018 Omnibus Bill

- **Securing Access to Networks in Disasters (SANDy Act)** - FCC to report feasibility of using Wi-Fi / Internet for increased 9-1-1 access.
- **Access for service providers during federally declared emergencies** - Provide wireline or mobile phone, Internet, radio or TV broadcasting, cable service, or direct broadcast satellite service, with tower owners and operators

November 2018 FCC BDAC

- Disaster Response & Recovery Working Group

Initiatives for Resiliency



- Broadband Deployment Advisory Committee (BDAC)
 - Disaster Response and Resiliency Working Group
 - Industry Standards and Infrastructure
 - Mutual Aid, Support and Reporting
 - Policy and Regulations
- Alliance for Telecommunications Industry Solutions (ATIS)
 - Network Reliability Steering Committee
 - Industry Best Practices and Checklists
 - Disaster Information Reporting System (DIRS) with FCC



- Many Others
 - FEMA ESF #2, FirstNet, CTIA, TIA, WIA, Safer Building Coalition....
 - 2016 Wireless Industry Cooperative Framework



Smart Cities need smart infrastructure



Smart
Grid

Energy Efficiency

EPB in Chattanooga built out a fiber network to reliably manage its energy and electrical systems



Smart
Health

Healthier Cities

Hiawatha Broadband in Minnesota piloting project to use its fiber as a platform for home monitoring of patients with dementia



Sensor
Network

Civic IoT

US Ignite and cities around the U.S. (and the world) are developing a smart city app store predicated on big bandwidth



Smart
Mobility

Safer Streets

Verizon and the City of Boston are using sensors and advanced traffic signal controls to measure traffic, improve safety



City
Wi-Fi

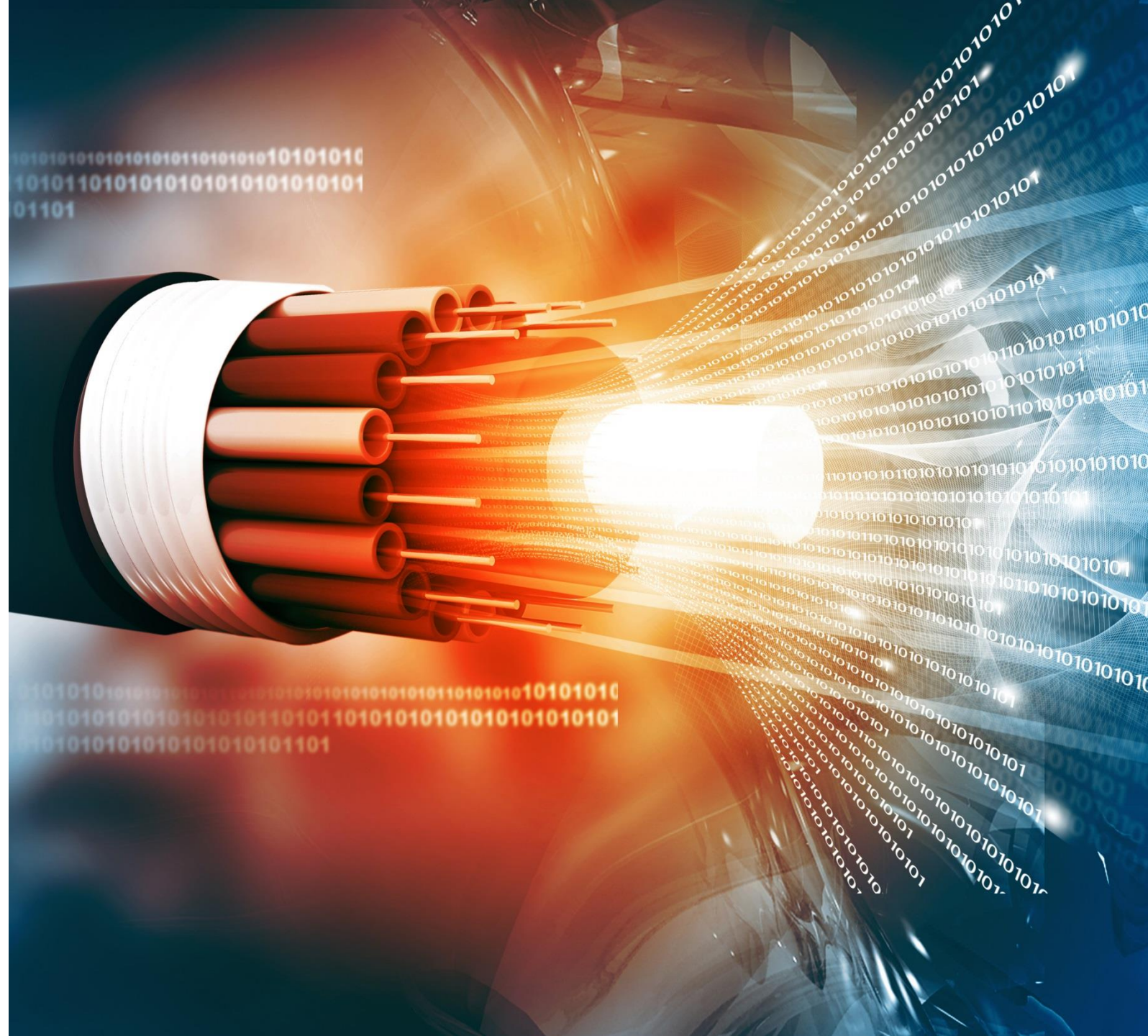
Connected Community

Santa Monica City Net provides fiber-supported Wi-Fi to its residents in public places



Fiber Optics

- Fiber Optic Links
 - greater bandwidth,
 - longer distance
 - more signal immunity
- Resistance
 - temperature fluctuations,
 - severe weather conditions
 - moisture
- Lifespan Over 100 Years
- Replace Outdated Solutions
 - Copper and twisted pair transmission
 - Traffic signal loop sensors
- 5G/ Small Cell



THE IMPORTANCE OF NEUTRAL DIGITAL INFRASTRUCTURE

In Mexico, there is a great need for neutral digital infrastructure that will support 5G, IoT and the development of Smart Cities.

The only solution for Mexico to improve broadband penetration is the development of Private Public partnerships allowing the deployment of neutral shared digital infrastructure in return for right of way access and IoT services.



Hurricane IRMA – Early September 2017

- In FL **3,973 of 14,730** out (27.4%) with 6 counties >50%, 2 counties >80%.
- In PR & USVI **497 of 1,850** (26.9%) out with
 - St Johns 9/10 out
 - St Thomas 44/57 out
 - St Croix 9/40 out



Florida:

Percent Cell Sites Out-of-Service By County

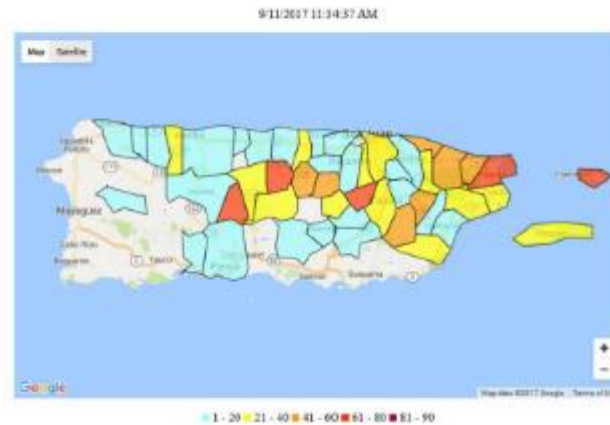


Alabama, Florida, and Georgia:

Percent Cell Sites Out-of-Service By County

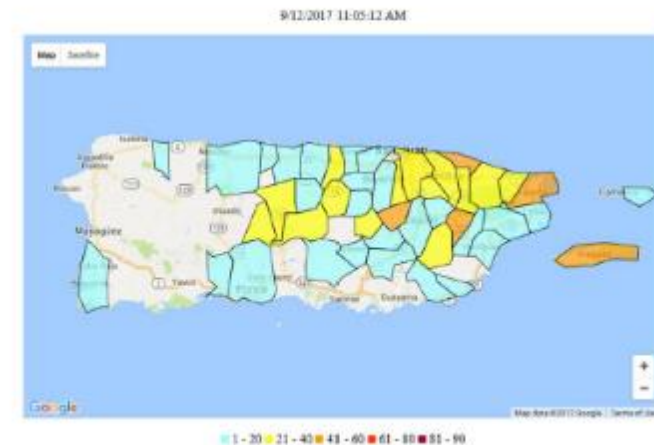


Percent Cell Sites Out-of-Service By County



Puerto Rico:

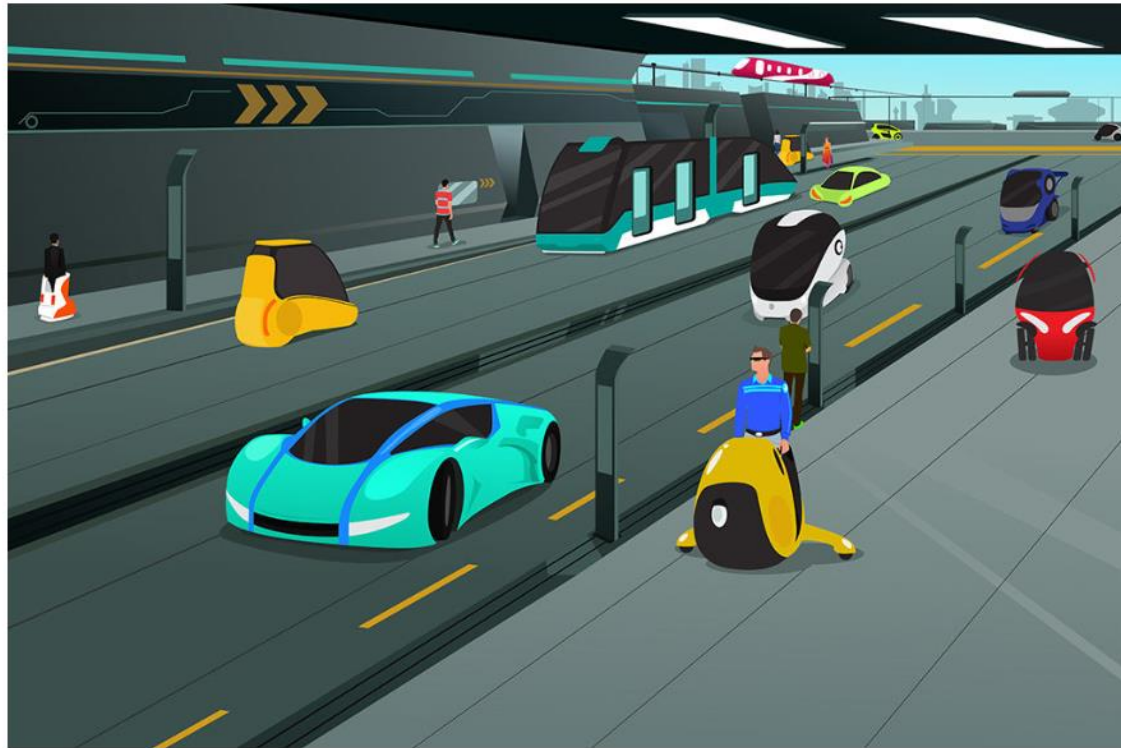
Percent Cell Sites Out-of-Service By County



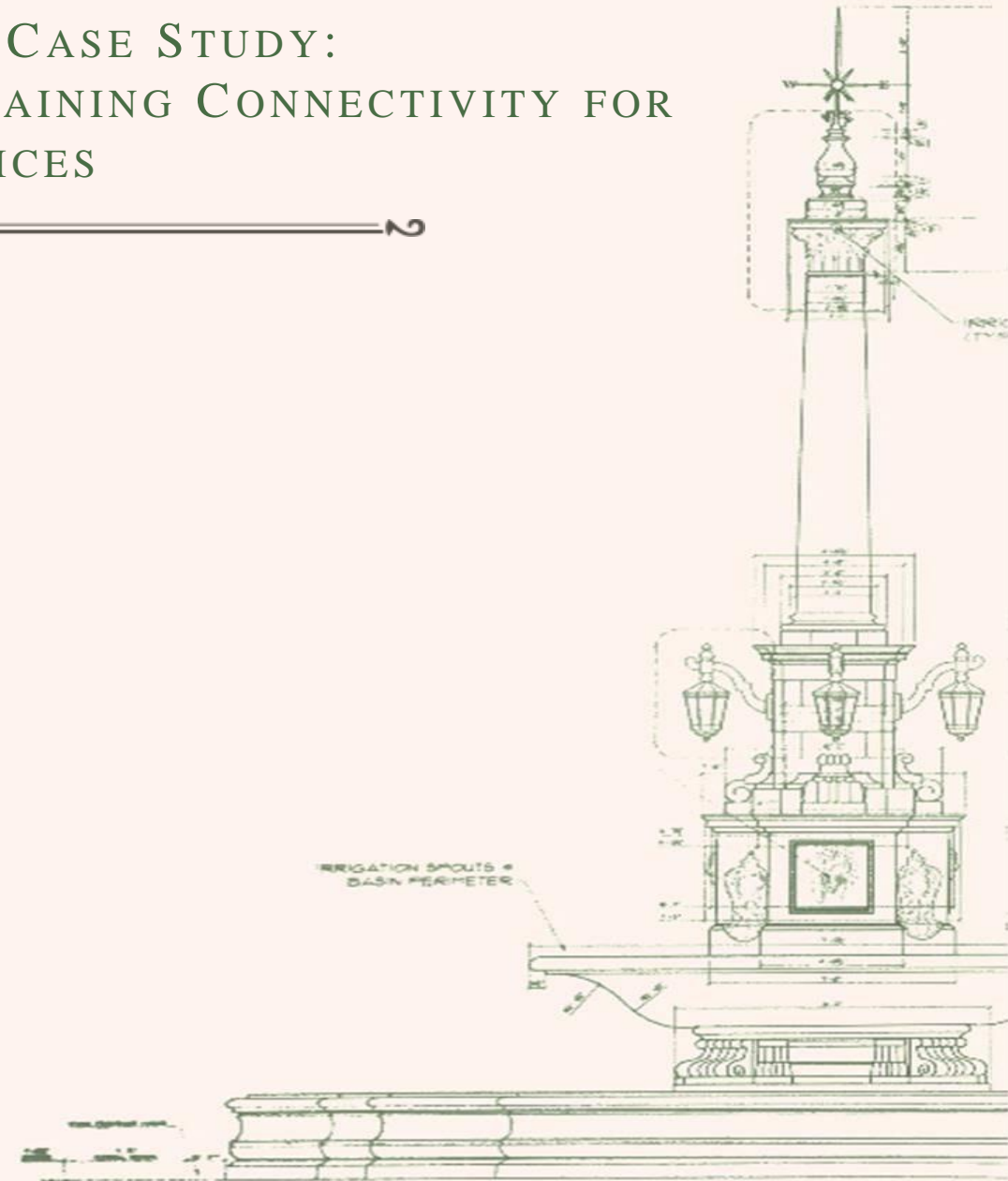
CORAL GABLES RESILIENCY CASE STUDY: SURVIVING HURRICANE IRMA AND MAINTAINING CONNECTIVITY FOR EMERGENCY SERVICES

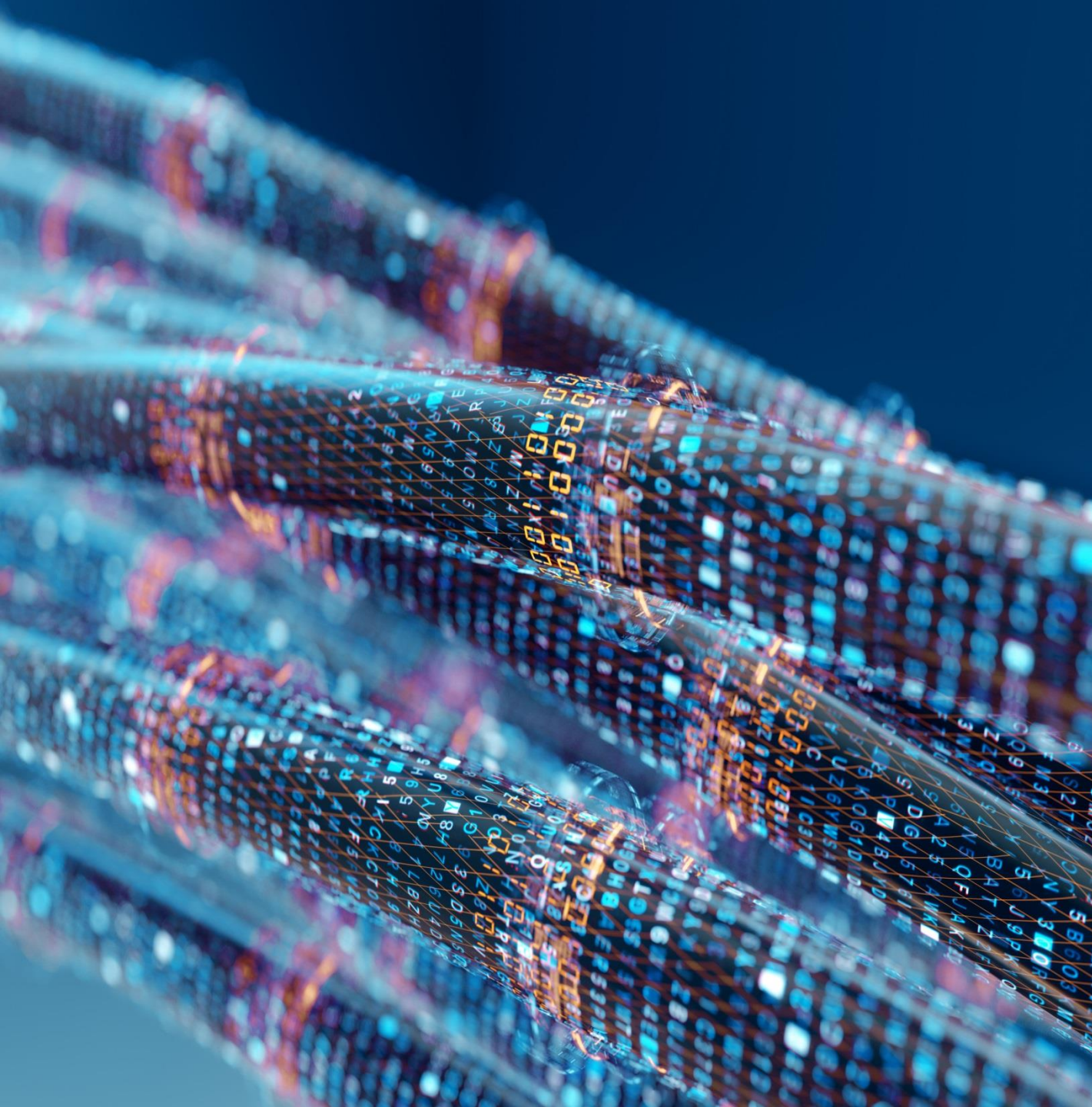


BeyondStandards
IEEE STANDARDS ASSOCIATION



Connected Through a Disaster





Bandwidth

- Limitless Capability
- High Bandwidth Crucial
- Ubiquitous Speeds
- High Speeds Create Seamless Interaction

Smart Cities invest in smart infrastructure like fiber

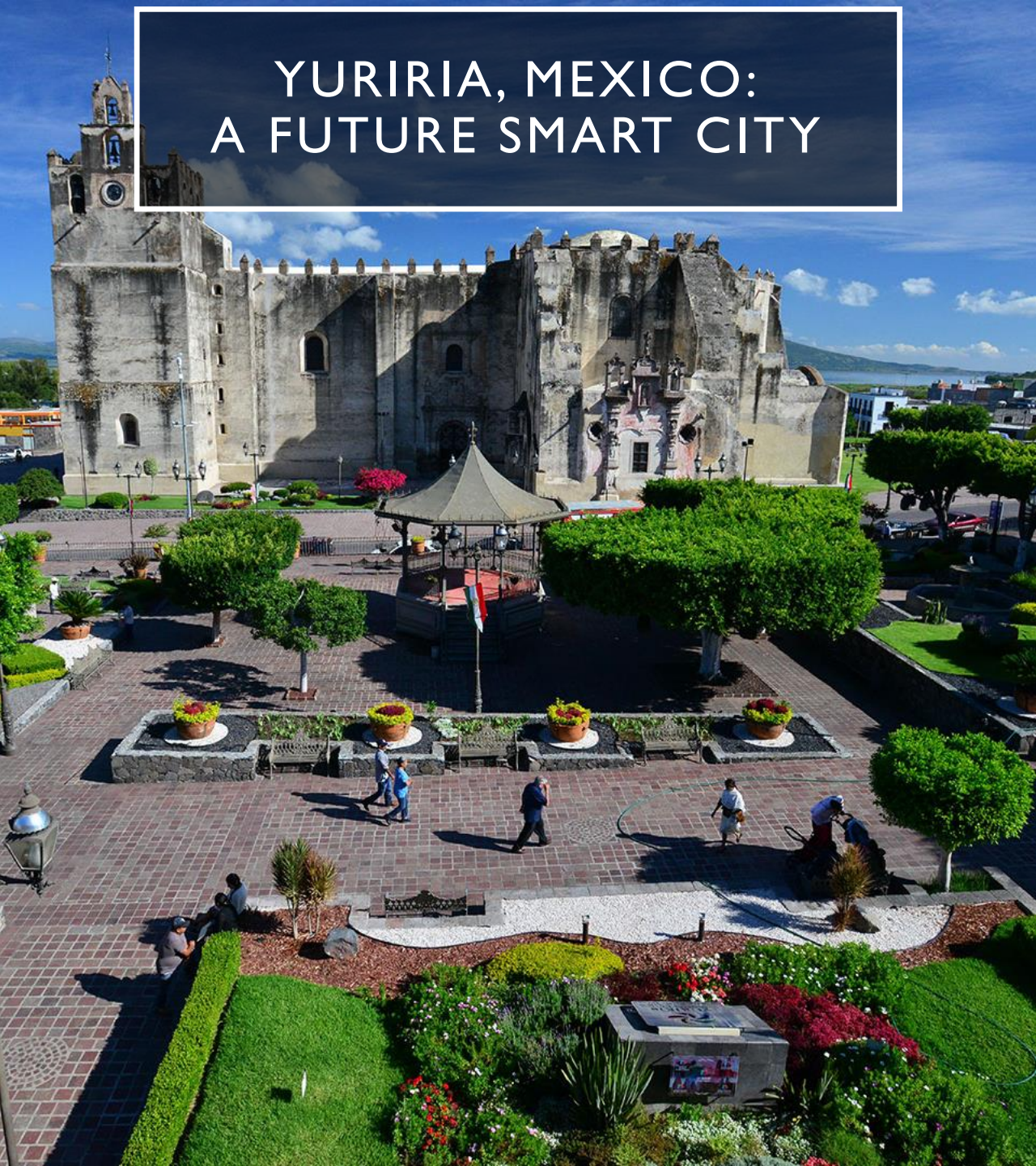
According to 2018 research from RVA, LLC:

Fiber Cities are more likely to be Smart Cities

- Cities with fiber have, on average, **37% more deployed small cells** and just **over 35% more smart city applications**
- **33% of cities without fiber** report small cell activity, versus **60% of cities with fiber** to the residence.



YURIRIA, MEXICO: A FUTURE SMART CITY



- **Neutral Dark Fiber**

- The backbone of a Smart City is the deployment of shared neutral dark fiber infrastructure that can be utilized by the public and private sectors. AWIS neutral dark fiber solutions are designed and deployed to meet the increasing demand for higher bandwidth of existing and next generation networks.

- **Towers**

- AWIS offers a turn key service to the public and private sectors by identifying key locations for greenfield tower sites, following the necessary procedure for site acquisition and permitting, delivering build-to-suite towers and property management of existing public and private real estate infrastructure.

- **Small Cells**

- Our dedicated Small Cell solutions offers a less expensive, flexible and comprehensive network solution that can be used in conjunction with other digital infrastructure. Through our private/public partnerships we can ensure Small Cell site compliance, meeting local requirements and preserving aesthetic, environmental and historical surroundings.

- **Neutral Edge Computing**

- As digital content and demand for streaming services continues to increase, the AWIS Neutral Edge Micro Data Centers solutions will provide Smart Cities, carriers and content providers improved latency and lower backhaul costs for its services through efficient and strategic placement.

Hurricane Maria – Late September 2017

- In PR **2,470 of 2,671** cell sites out (92.5%) with 100% in majority of counties/municipalities
- IN USVI
 - St John 6/9 (66.7%)
 - St Thomas 26/55 (47.3%)
 - St Croix 33/42 (78.6%)

In the fall of 2017:

- Over 5,700 cell sites impacting over 10 million people
- Plus the California wildfires (failures & responders)

Phases impacted across all hazards:

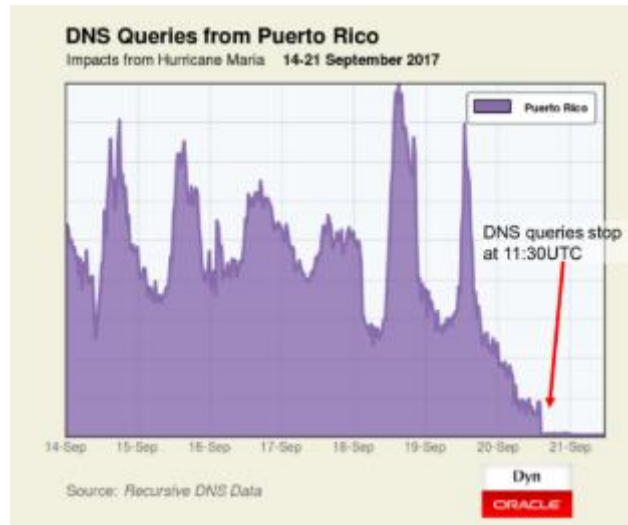
→ Preparation

→ **Immediate Response**

→ **Response**

→ **Restoration**

→ Recovery

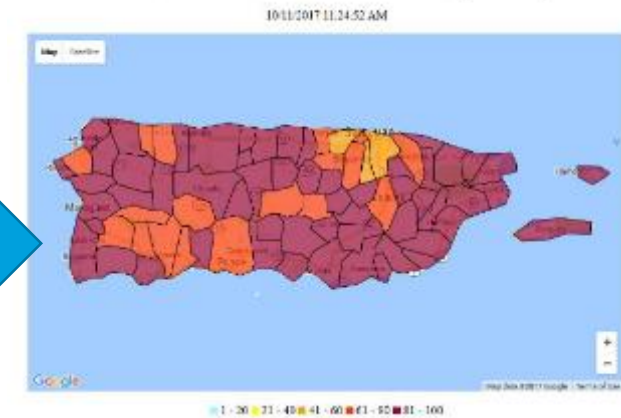


Percent Cell Sites Out-of-Service By County

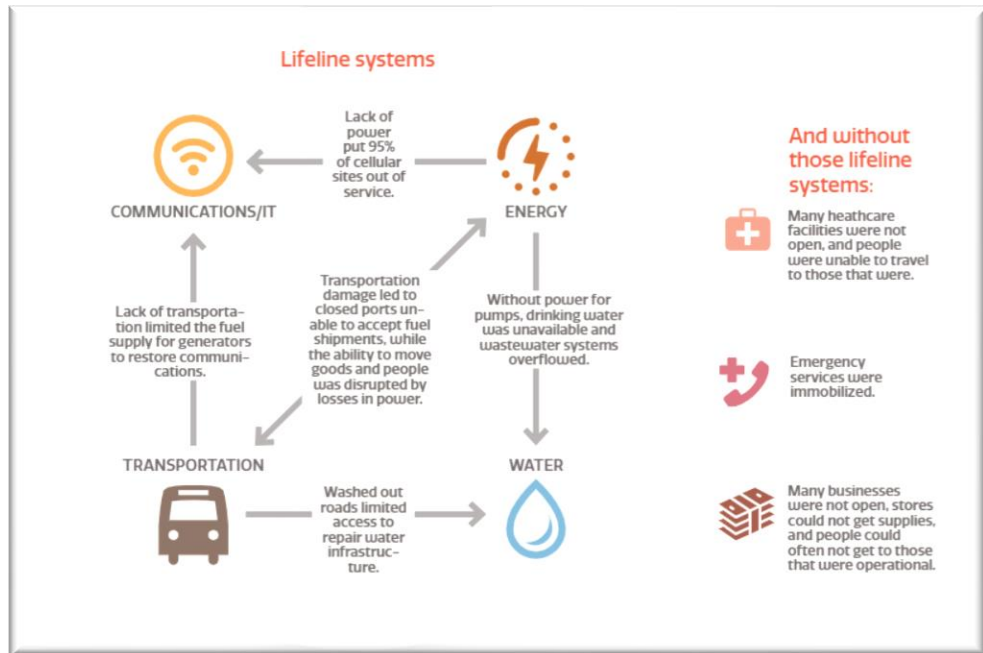


One Week Later

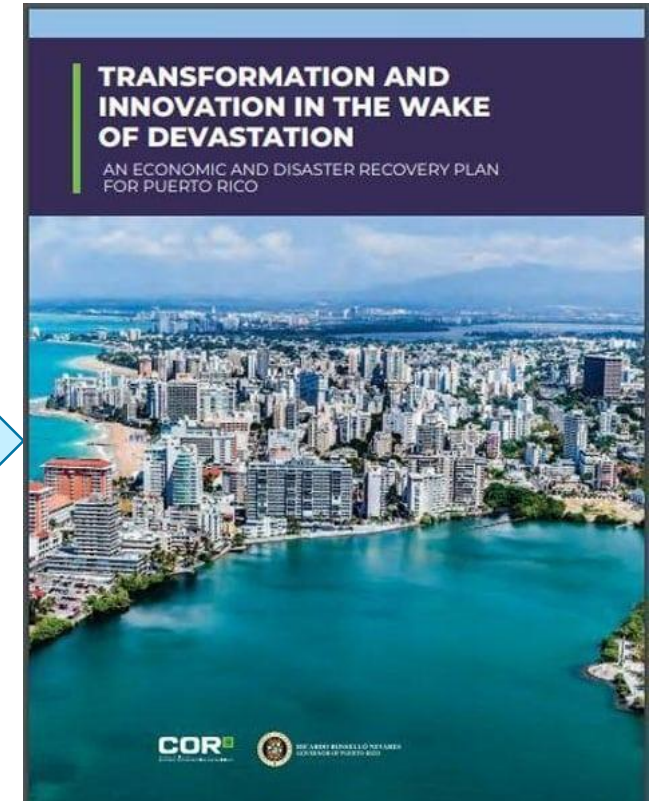
Percent Cell Sites Out-of-Service By County



PR Recovery Plan



- Communications infrastructure identified as critical lifeline system
- Dependency on power, power and personnel access
- PR recovery plan of July 2018 identifies over 30 courses of action (CoA) to rebuild communications
- At same time support economic transformation and innovation for PR

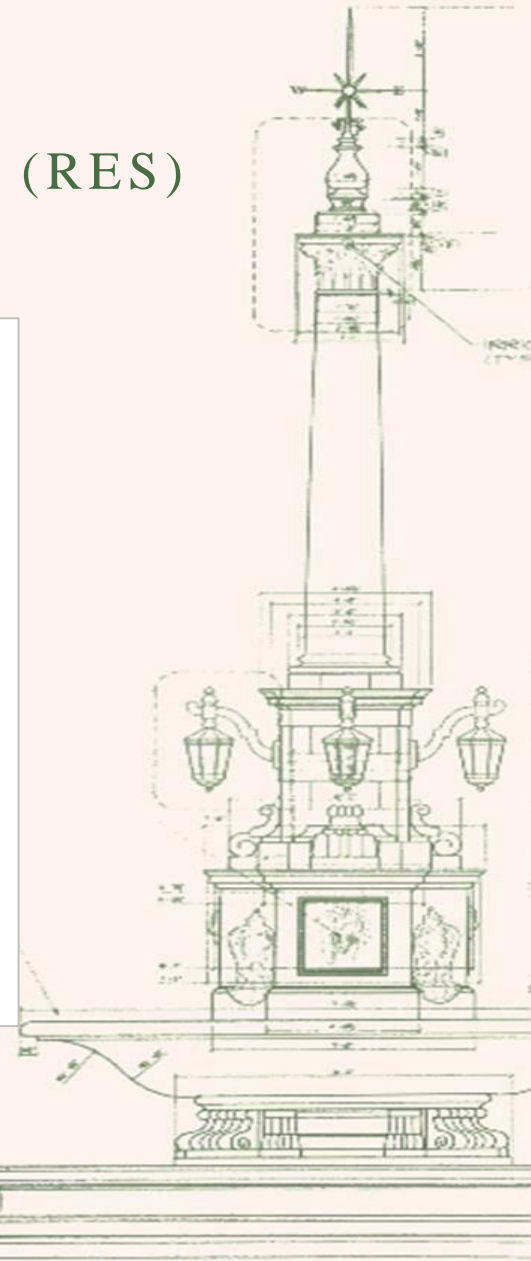
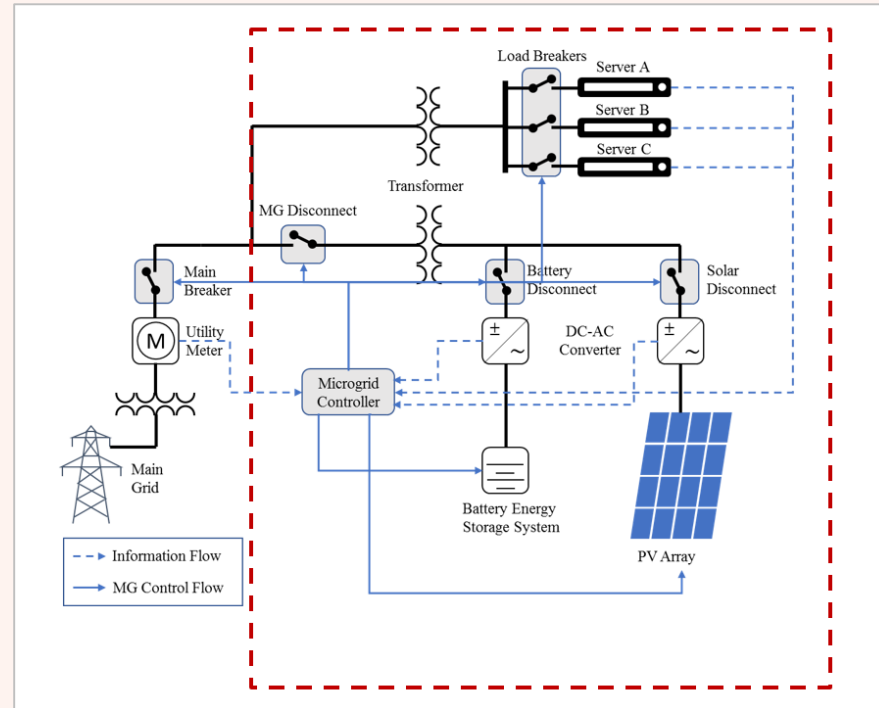


<http://www.p3.pr.gov/assets/pr-draft-recovery-plan-for-comment-july-9-2018.pdf>

Feedback from “VIPR”

- We became too reliant on one form of communication
- Single point of failure with backhaul, power and core network
- We have to educate and practice doing without...Plan B

CORAL GABLES RESILIENCY CASE STUDY: DESIGNING A SMART MICRO-GRID RESILIENT ENERGY SYSTEM (RES)

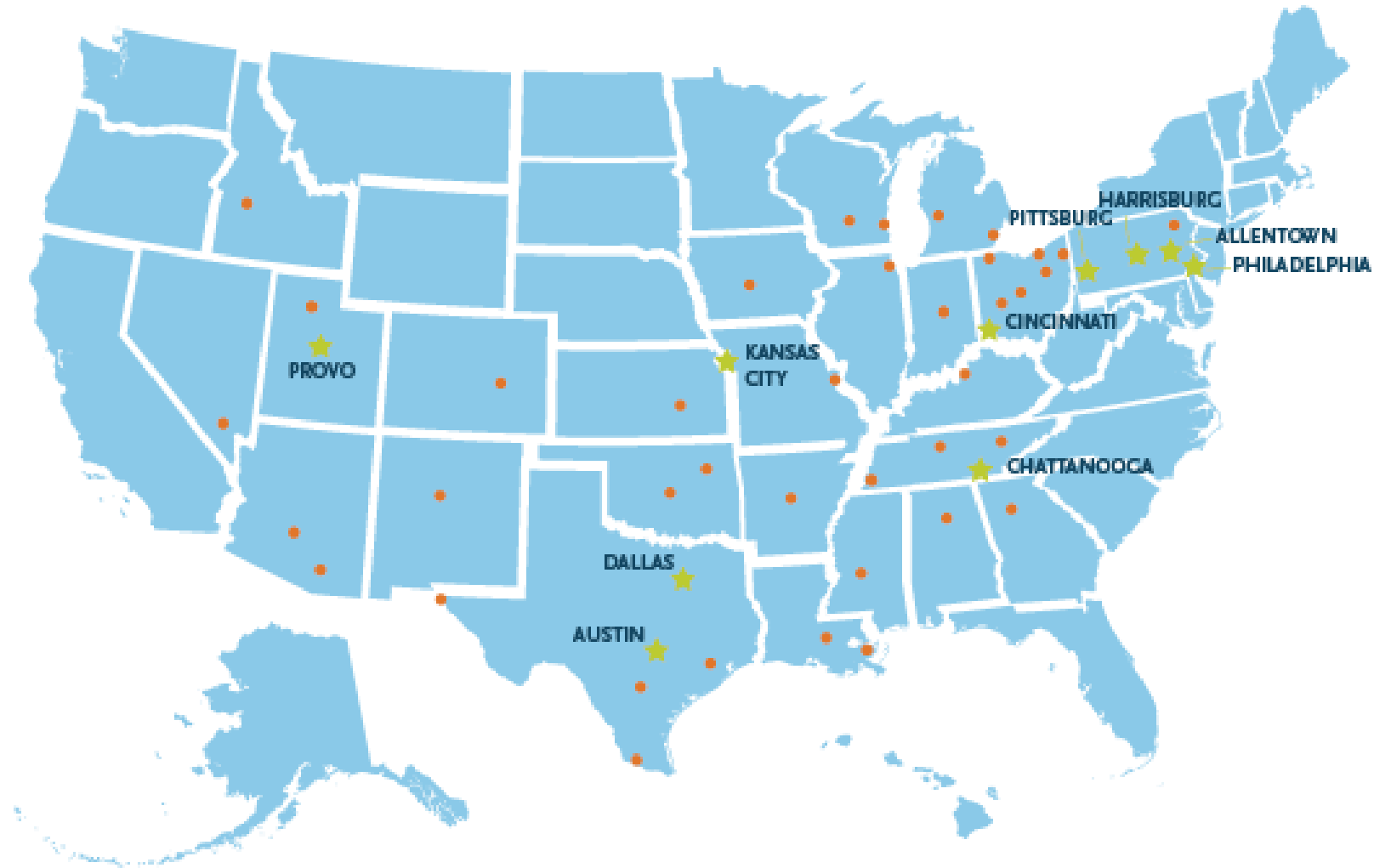


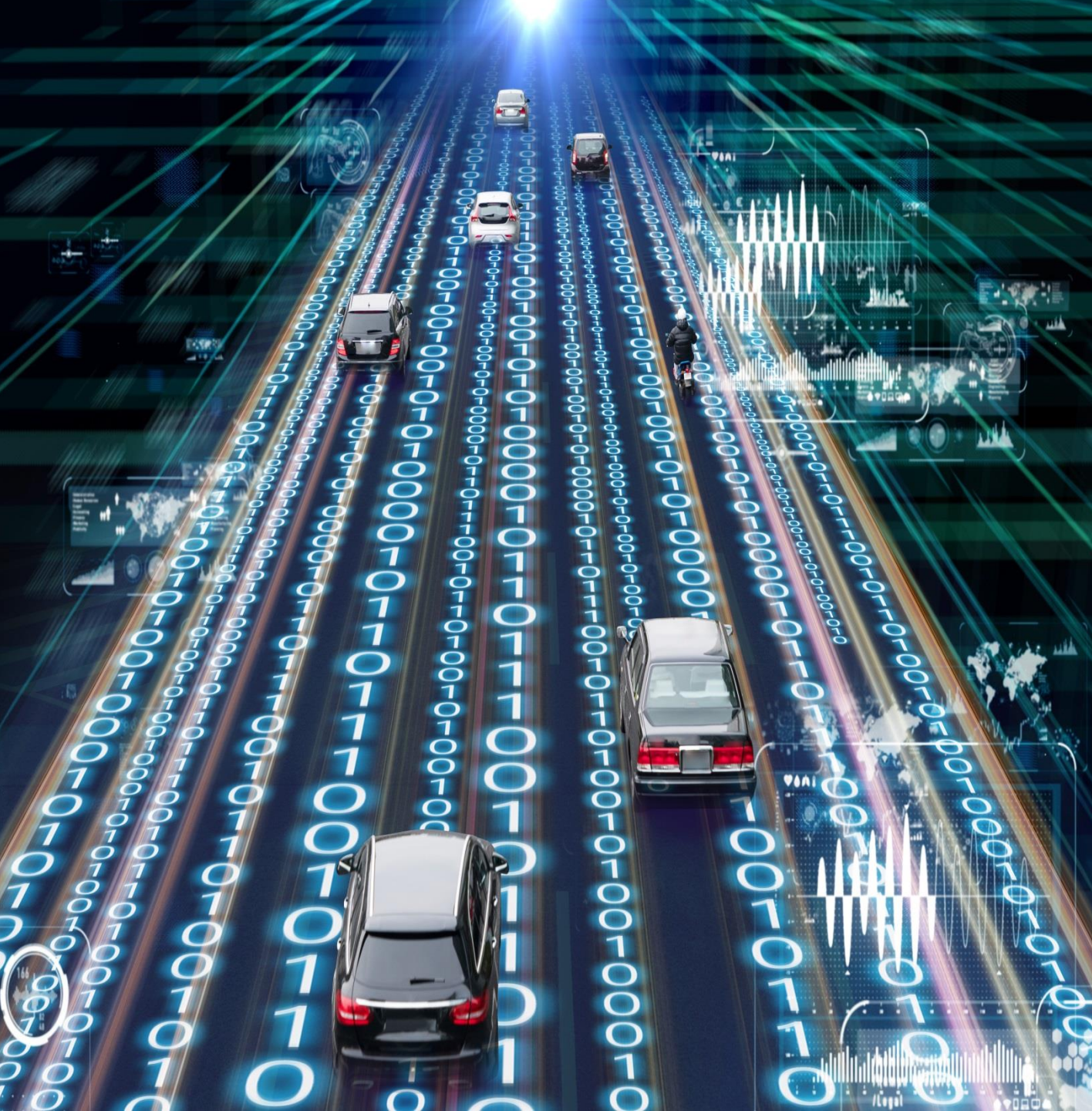
Economic Development: Fiber's Killer App

Ten Year Gross Metropolitan Product:
64% Better For FTTH Cities

Ten Year Job Impact:
72% Better For FTTH Cities

Better Year New Business Formation:
46% Better For FTTH Cities





Intelligent Transportation Systems

- Smart Street Lighting
- High-resolution cameras
- Smart Traffic Signals and Signs
 - Interaction with vehicles
 - Communications from the infrastructure to vehicles
- Variable Message Signs
 - Amber Alerts
 - Accident Warnings
 - Speed Limit Changes
 - Delay Times
 - ETA's
 - Law Enforcement Alert Notifications



Office Buildings

Industrial

Suburbs

Public Areas

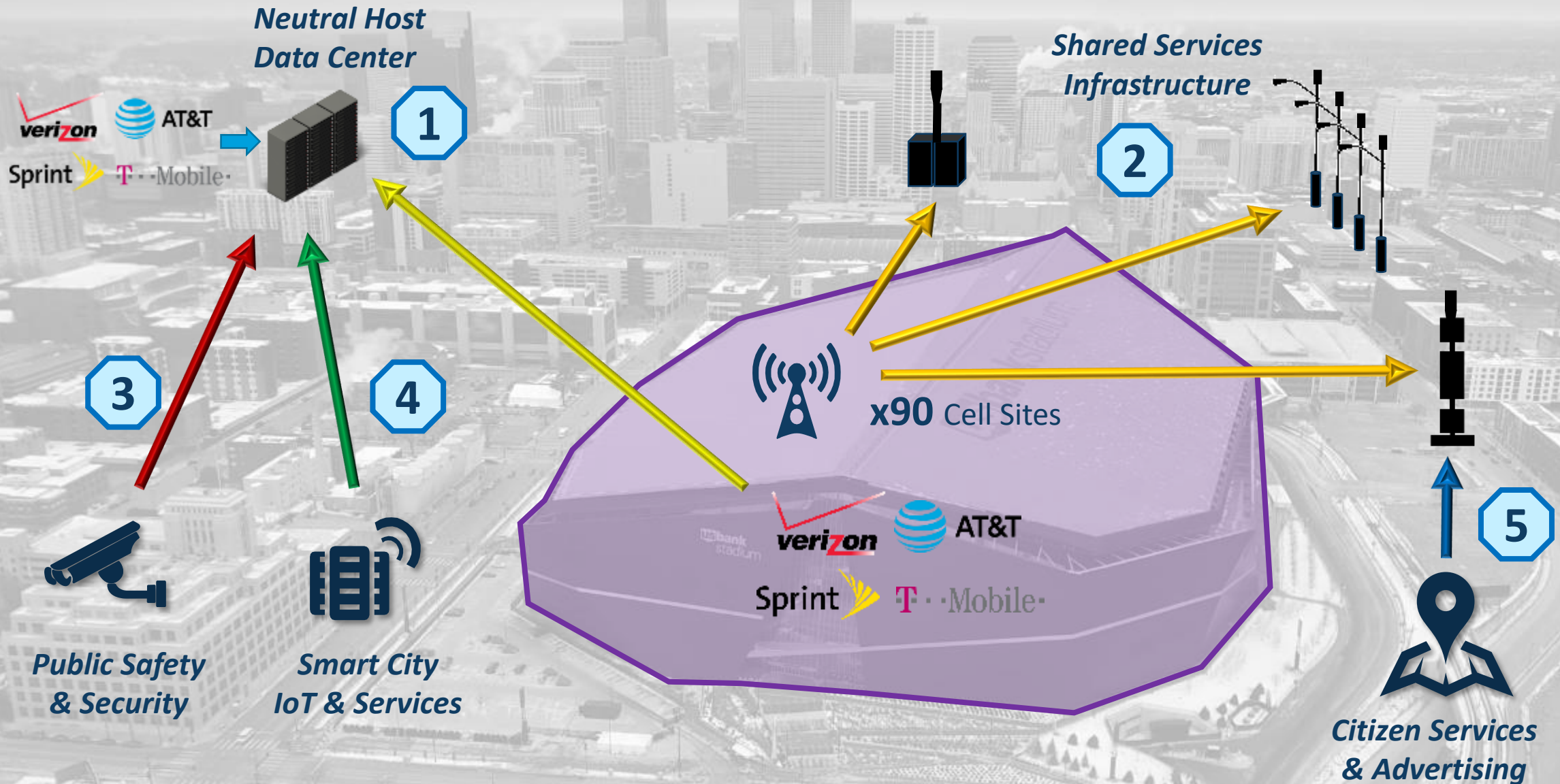
Major Venues

Private Campus

Transportation Systems

Metro Area Neutral Host

Metro Area Neutral Host



Evolution of the RAN towards an All Software EdgeRAN Solution

100% ALL Software RAN operating a LIVE Commercial LTE Network Service



Bologna, Italy City Center Area
Approximately 40 Acres in downtown area

- Standard Intel Xeon servers
- JMA Wireless TEK0 RF Distribution
- Supporting LTE Data, VoLTE, and IoT Services
- Multiple Bands, Multiple Sectors, MIMO
- More than 180K RRC Connected UEs & 40GB per day
- Handling more than 150K handovers per day



RAN Software by

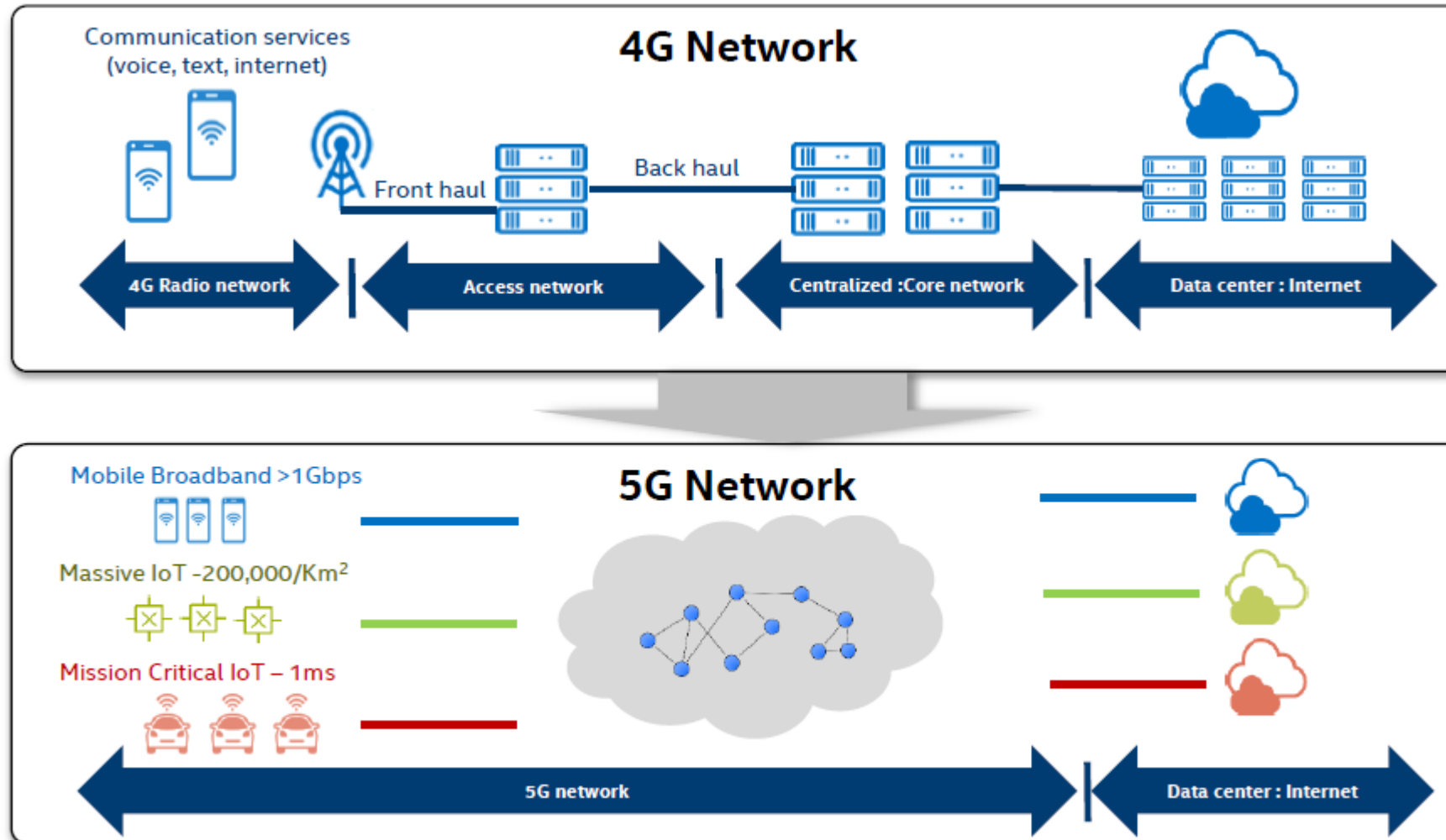


XRAN
Adaptive Baseband

Running on



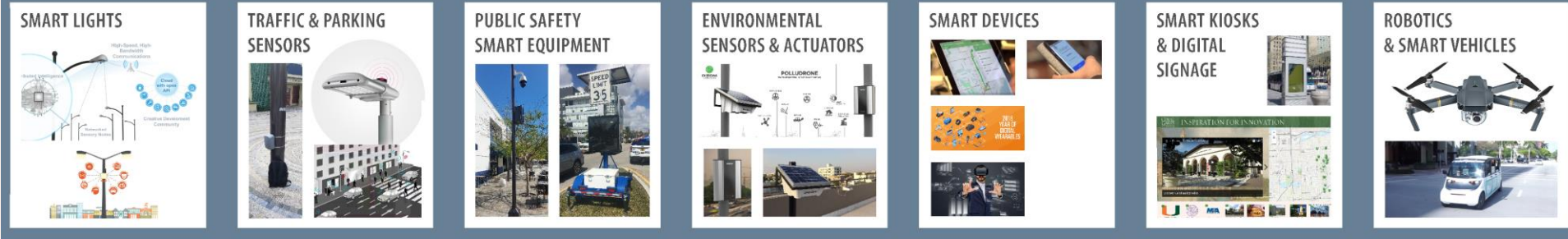
Multiple Dimensions of 5G



CITY OF CORAL GABLES
 INFORMATION TECHNOLOGY DEPARTMENT
 SMART CITY CYBER-PHYSICAL SYSTEMS – MANAGING RISKS

INTERNET OF THINGS

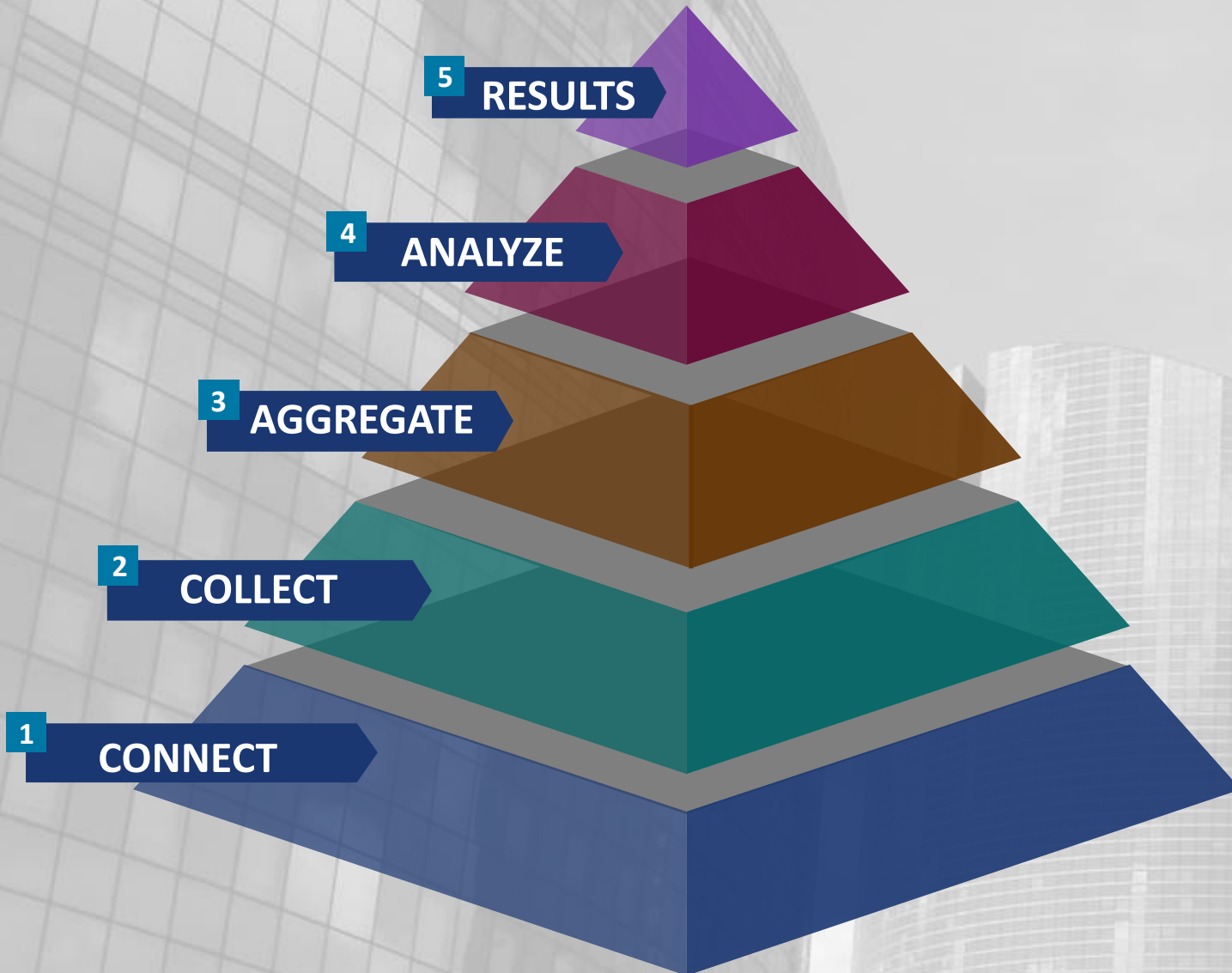
REAL-TIME URBAN AND ENVIRONMENTAL VISIBILITY / PHYSICAL INTERFACING



- CCTV, LPR cameras and public safety smart devices
- IoT sensors:
 - Pedestrian counters, Visitor counters, RF sensors
 - Waterway Gauge IoT Sensors
 - Traffic counters (pedestrians, vehicles, bicycles)
 - Parking sensors (counting available/busy spots)
 - Environmental sensors: air quality (pollutant particulate PPM, CO, CO2, Noise dB, weather temp/pressure...)
 - Smart Lights & LoRa Network.

- IOT SENSOR DATA IS STRATEGIC AND BECOMES ACTIONABLE INFORMATION.
- OPEN IOT DATA AGGREGATED IN THE SMART CITY HUB ([HTTP://WWW.CORALGABLES.COM/SMARTCITY](http://www.coralgables.com/smartcity)) AND PRIVATE IOT DATA IS ACCESSED/STUDIED BY OUR ANALYSTS AND USED BY CITY PLANNERS, PUBLIC SAFETY OFFICIALS, TRAFFIC ENGINEERS, CITY OFFICIALS AND OUR CONSTITUENTS THAT ARE PART OF THE SMART CITY ECOSYSTEM.
 - IOT DATA IS STORED AND GOVERNED IN IOT AND DATA PLATFORMS ON OUR PUBLIC AND PRIVATE CLOUDS.
- SECURING AND TRUSTING IOT DEVICES REQUIRED A BROAD STRATEGY SEGMENTING, ENCRYPTING, SEGREGATING, VETTING AND GOVERNING TRAFFIC AND DATA.

Building Smart City Infrastructure



USERS & CONSUMERS



Transform user and customer experience with engaging, enhanced and autonomous services

ANALYTICS & INTELLIGENCE



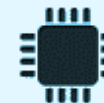
Transform data into insight, action and knowledge. Integrate into business and operational processes.

DATA FLOW & DEVICE CONTROL



Collect data and manage devices on the network. Use edge computing and gateways prior to sending to the cloud.

DEVICES & SENSORS



Deploy devices and sensors to measure existing and new data sets. Inventory assets that are not measured today.

CONNECTIVITY & ACCESS



Build a network foundation for connectivity and access for more bandwidth, device types & mobility.

CITY OF CORAL GABLES
INFORMATION TECHNOLOGY DEPARTMENT
SMART CITY DATA PLATFORMS LAYER – REDUNDANCY AND HIGH AVAILABILITY

DATA PLATFORMS

DATA AGGREGATION, INTEGRATION AND CORRELATION / BUSINESS INTELLIGENCE AND ANALYTICS BACKEND

PUBLIC & PRIVATE CLOUDS
& DATACENTERS



BIG DATA-AGGREGATION
& ANALYTICS



ARTIFICIAL INTELLIGENCE
& MACHINE
LEARNING



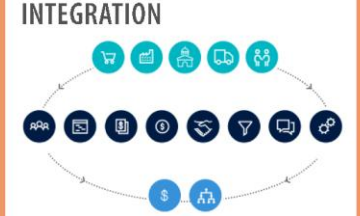
VIDEO ANALYTICS



OPEN DATA & APIs



HORIZONTAL & VERTICAL
INTEGRATION



- SOFTWARE DEFINED NETWORKS – SCALABILITY, HIGH-AVAILABILITY AND RESILIENCE
 - . HYPER-CONVERGED INFRASTRUCTURE – SURVIVABILITY
 - HYBRID CLOUDS – REDUNDANCY AND SCALABILITY