Combining ATSC 3.0 Datacasting with resilient connectivity and edge life cycle management to enhance Remote Responder's services and capabilities

Enhanced Remote Responder Services and Capabilities

PEAK3

Dejero

ZEDEDA

Introduction

In 2021, there were 5,984 wildfires with an estimated total damage between $80 and $90 billion with $45 billion to $55 billion of those damages to California alone. This estimate includes damage to structures as well as their contents, wages and farm losses, infrastructure damage, school closures and firefighting costs. This number doesn't include what's most important – loss of life.

This paper will focus on the benefits of leveraging the existing capital investment of ATSC 3.0 Datacasting infrastructure to combine the higher availability of national broadcast distribution with the Edge Life cycle management and Resilient Connectivity to improve response coordination and communication to protect lives, property and natural resources with Enhanced First Responder Services and Capabilities.

A **remote responder** is any person or group of people who go to rural areas where connectivity and infrastructure are minimal and intermittent to respond to emergencies impacting life, property and natural resources. Examples include forest firefighters, smokejumper firefighters who go where equipment cannot, first responders (police, fire, medical), National Guard as well as tactical military units.

The typical definition of the edge is any location or device which is one network hop from a reliable network connection. We further the definition of the **remote edge** as any edge location or device which has unreliable and intermittent network connectivity. Furthermore, these connections are characterized by low throughput, high cost, on-demand, ad hoc networks which are typically in low population density areas.

When operating at the remote edge, the remote responder needs:

- Situational awareness with real-time information
- Resilient connectivity
    - Availability based on PACE plans.
    - Availability of high value communication when using low throughput links
- Resilient Continuity of edge devices with life-cycle management

To address these remote responder needs, we explore the combination of the following technologies:

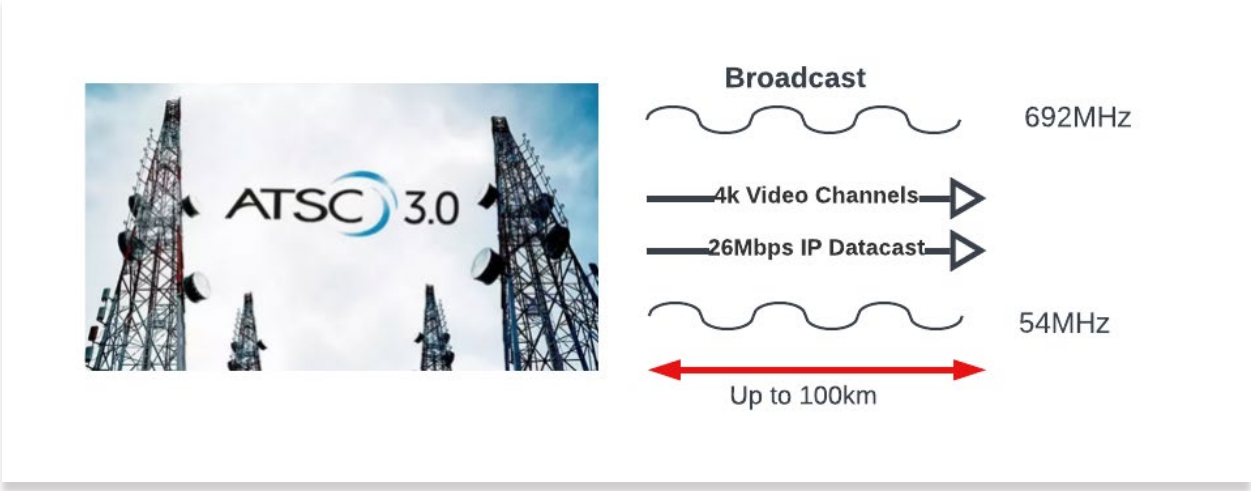
- ATSC 3.0, known as NextGen TV to datacast files, alerts, video using highly available, national coverage.
- Edge life-cycle management infrastructure software to visualize, monitor, and update operating systems and workloads to keep distributed edge devices operating through feature enhancements, bugs fixes and hot patches.
- Blending and bonding multiple communications channels and types for higher availability and higher throughput.

While we use the Remote Responder Services example as a primary use case, it should be noted that this combination of technologies can be leveraged and deployed for any enterprise application which needs remote resilient connectivity and continuity.

ATSC 3.0 Overview

ATSC 3.0, also known as NextGen TV, is the third generation of the Advanced Television Systems Committee (ATSC) digital television standard. It offers several benefits over its predecessor, ATSC 1.0, including:

1. Enhanced picture and sound quality: ATSC 3.0 supports higher resolution and frame rates, wider color gamut, and immersive audio technologies, such as Dolby Atmos, for a more immersive viewing experience.
2. Better reception: ATSC 3.0 has improved signal reception capabilities, making it easier for viewers to receive signals in areas with weak signal strength or interference.
3. Interactivity: ATSC 3.0 enables broadcasters to provide interactive content and services, such as targeted advertising, personalized content, and interactive applications.
4. Mobility: ATSC 3.0 supports mobile reception, allowing viewers to receive content on their smartphones and other portable devices.
5. Emergency alerts: ATSC 3.0 has a robust emergency alert system that can deliver important information to viewers in real-time during emergencies, including weather alerts, evacuation notices, and other critical information.
6. **Datacasting**: ATSC 3.0 enables broadcasters to use their spectrum to deliver data services, such as weather updates, software upgrades, real time video distribution of video segments, alerts and news headlines, and other information to the remote edge.



ATSC 3.0 operates in the lower frequency bands and travels further and penetrates buildings or obstacles compared to higher bands which can't be received as far away.

ATSC 3.0 has a significant advantage in price/cost for content distribution due to the ability to reuse the capacity many times over (i.e. one file can be sent to many endpoints at the same time). This also has the advantage of offloading terrestrial networks and avoiding congestion.

While IP networks have traditionally been asymmetric, many of today's applications further drive an explosion in usage such as Video Streaming, firmware updates (Autonomous vehicle, Gaming consoles,

IoT, etc.) and distance learning only accelerate the trend. This one-way connection further opens a broad range of applications such as improving position accuracy, improving time accuracy, GPS replacement in denied applications, industrial automation, alerting, security token distribution and CDN offload.

ATSC 3.0 is an established standard with a broad range of chip sets embedded in a wide range of form factors including dongles, SDR radios, compute boards and gateway devices. More information can be found at www.atsc.org.

ATSC 3.0 ushers in a large-scale advance for broadcasting technology that brings together the capabilities of over-the-air (OTA) broadcasting, the internet, and a host of additional use cases that provide the opportunity for companies like PEAK3 to partner with the broadcasters and demonstrate the true value of the spectrum they now possess.

ATSC 3.0 is a smarter way to reach edge devices.

Edge Life Cycle Management

Edge Life Cycle Management Problem

Managing an edge network

Managing devices at the remote edge presents some notable challenges including:

- Network quality: Intermittent, low throughput, expensive
- Physical and Network Security: highly distributed network with a large attack surface
- Many different device types from different vendors
- Critical Operating System and Workload updates (trucks roll if you brick the unit!)
- All operations must be done over the air without impacting service.

Edge Management Solution: ZEDEDA

ZEDEDA delivers an open, distributed, cloud-native edge management and orchestration solution, simplifying the security and remote management of edge infrastructure and applications at scale.

ZEDEDA's platform consists of several components, including:

1. Open Foundation: ZEDEDA leverages an open architecture built on Project EVE, from the Linux Foundation. EVE is a lightweight, open-source Linux-based edge operating system, with open orchestration APIs. EVE runs on over 75 different hardware platforms providing customers the flexibility to choose the ideal configuration for every workload.

2. Cloud-based Orchestration: ZEDEDA’s platform enables entirely remote deployment, configuration, and monitoring of applications at the edge, including the underlying hardware layer.

3. Edge Security: ZEDEDA utilizes a zero-trust security model including built-in security features, such as measured boot, secure updates, and hardware root of trust.

4. Edge Analytics: ZEDEDA's platform includes built-in analytics capabilities that enable enterprises to collect and analyze data at the edge in real-time, helping them make faster, more informed decisions.

ATSC 3.0 Enabled Edge Management

Combining the highly resilient, one-to-many efficiency of ATSC 3.0 with the power of edge life cycle management, expands the reach, reliability and cost effectiveness of the Edge.

Remote edge devices will likely have low throughput, intermittent connectivity using traditional terrestrial wired and wireless networks. With national coverage of resilient ATSC 3.0 coverage, critical updates can be safely distributed to remote devices using an out-of-band communication path which avoids congestion of critical networks.

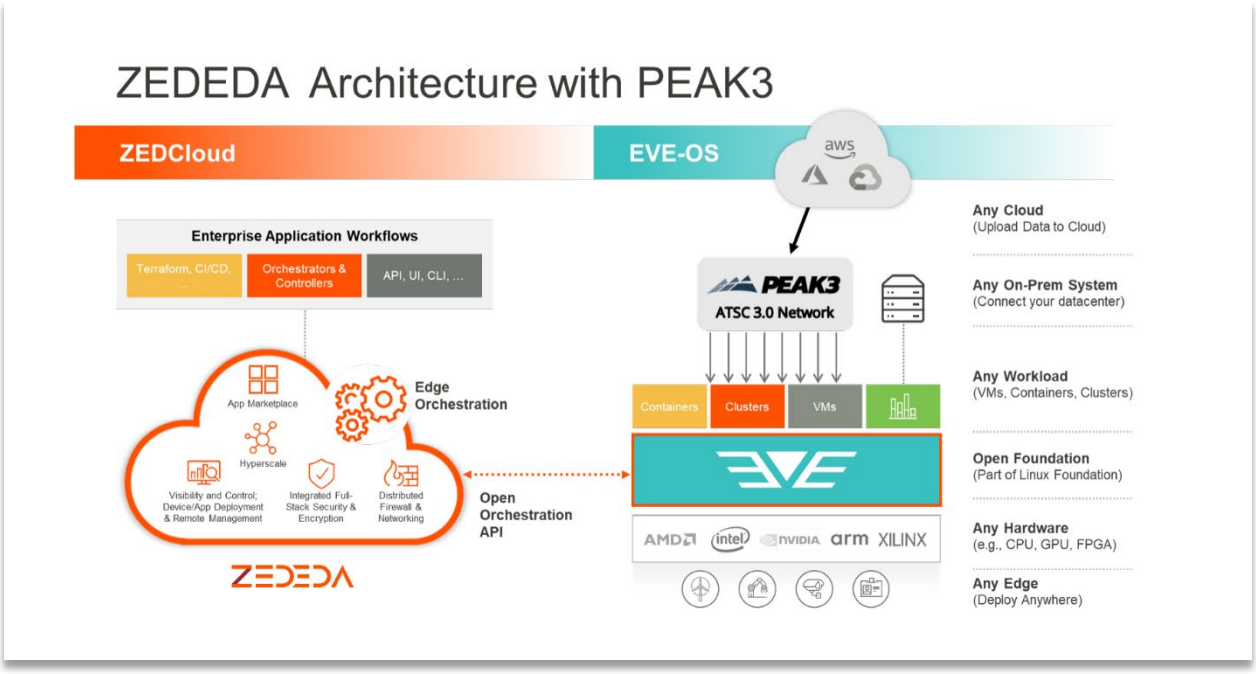


Figure 1 ATSC 3.0 and Edge Management Architecture

Containerized workloads, VM images and OS image files which would traditionally be passed in a peer-to-peer connection, can now be offloaded to the PEAK3 file distribution network to be broadcast out to multiple devices as once.

Costs are managed by leveraging the ATSC 3.0 network infrastructure rollout and reusing the same "bit" many times.

Resilient Connectivity

Connectivity challenges at the Remote Edge

The remote edge, by definition, is characterized as existing in locations with limited connectivity, which is intermittent and unreliable causing packet drops, increased latency and low data throughput.

The remote edge is also characterized as mobile units which rely on cellular wireless (3G/4G/5G), tactical radio or Satcom for network connectivity.

The remote edge can also be characterized as a network which is ad hoc (created on the fly) with new equipment used to augment and extend networks which either don't exist, are adversarial in nature, or were very limited in coverage or throughput based upon minimal population demand to drive network deployment.

In these conditions, network connectivity can be unavailable for seconds, minutes or hours and requires the device to move to another location to get better reception which is not always possible.

Edge Communications Solution: Smart Blending Networking with Dejero

As the world continues to become more interconnected and mobile, many organizations are embracing the cloud. They are also becoming reliant on cloud services for collaboration, productivity, and communication—taking advantage of cloud storage, compute, and AI.

A single connection is not enough.

For many organizations, staying connected is extremely important and often mission critical. Having only one connection path leaves organizations vulnerable to having insufficient bandwidth to carry out key tasks, or in the worst case, downtime.

Unlike traditional failover or link aggregation solutions, Dejero simultaneously blends together multiple wired (broadband, fiber) and wireless (3G/4G/5G, Wi-Fi, satellite) IP connections from multiple providers to form a virtual Dejero 'network of networks'.

We dynamically and intelligently manage the fluctuating bandwidth, packet loss, and latency differences of individual connections in real-time.

The result? Reliable, high-bandwidth connectivity when and where you need it.

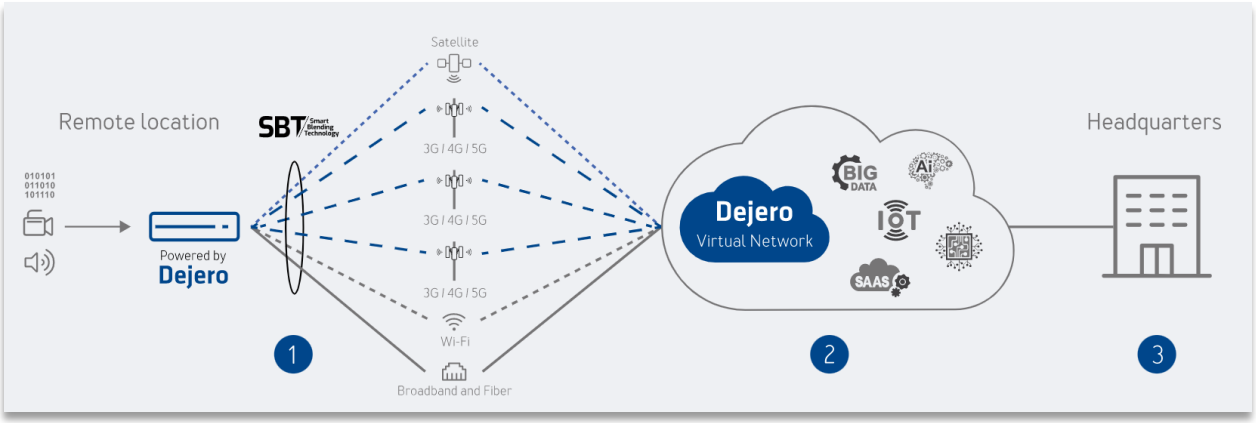


Figure 2 Dejero Smart Blending

1. Combine the bandwidth of multiple network providers and diverse technologies with Smart Blending Technology™
2. Access cloud resources such as compute, storage and software...
3. ...or connect to resources at headquarters or datacenters

In this new connected world, reliable connectivity is key. For Dejero, the vision is to provide that connectivity, anywhere.

ATSC 3.0 Enabled Resilient Connectivity

With national coverage, long distance, highly available, high penetration signal, ATSC 3.0 datacasting is a powerful addition to improve connectivity availability. The intrinsic one-to-many nature of ATSC 3.0 is perfectly suited for distribution of shared content to offload other communications channels.

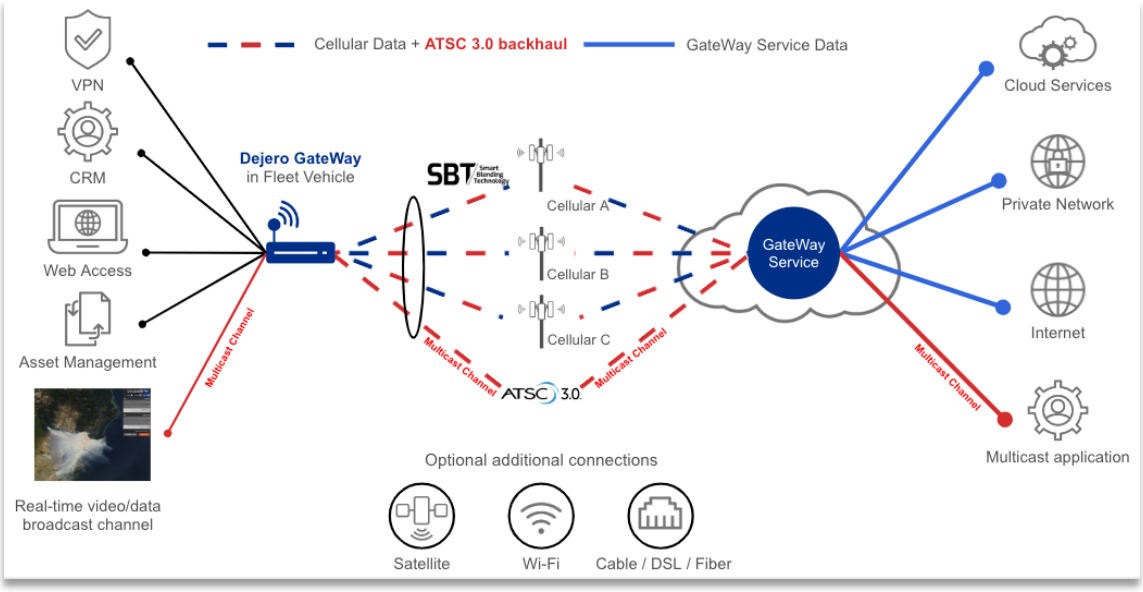


Figure 3 ATSC 3.0 Enhanced Resilient Connectivity

Use Case: Fighting Forest Fires with Enhanced Services

ATSC 3.0 + Edge Management + Resilient Connectivity

Forest fires represent a persistent and significant danger to life, property and natural resources across North America and around the world. Some facts:

1. There were 5,984 wildfires in 2021.
2. The United States averaged 46 acres burned per fire in 2021.
3. More than 2 million homes in California are at extreme risk of damage from wildfire.
4. Humans cause nearly 85% of wildfires.
5. Wildfires caused $16.5 billion in damage in 2020.
6. There has been a clear increase in the number of forest fires since the 1980s.

7. Fires killed more than 1,400 senior citizens in 2019.

While the winter of 2022/2023 has brought much needed relief to parts of North America, the long-term outlook continues to point to rising temperatures, drier forests and increased fires.

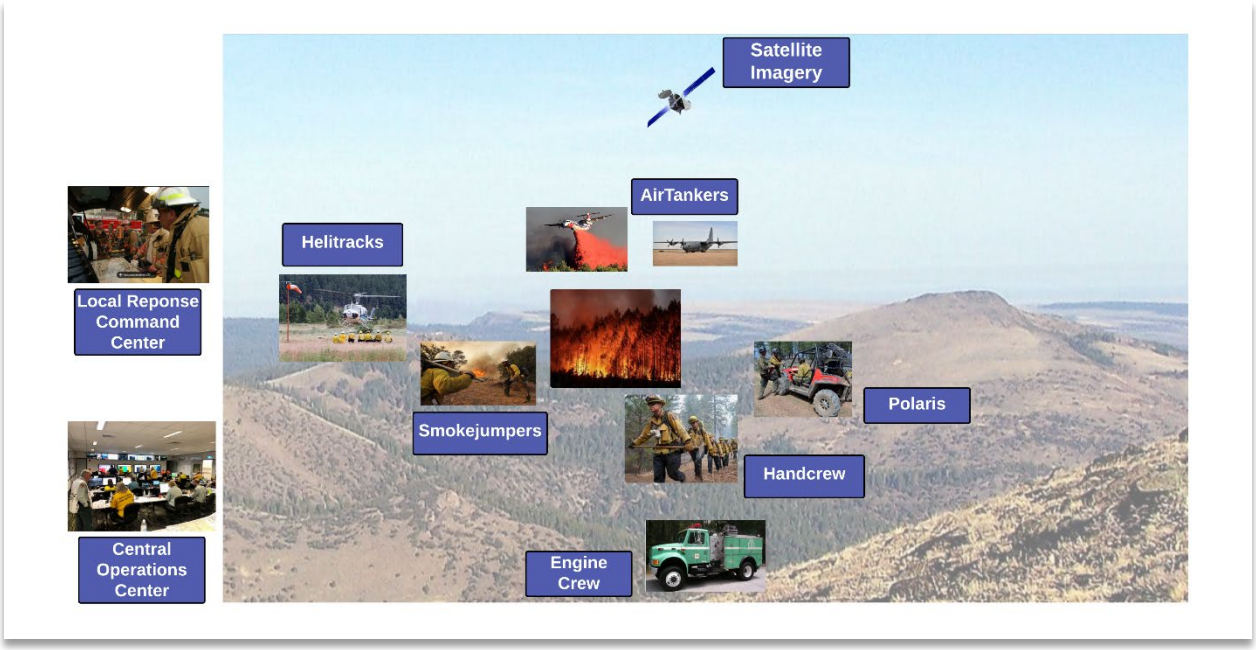


Figure 4 Remote Responder Operational View

To fight a forest fire requires many different types of assets be mobilized, including:

- **Engine crews** range in size from two to ten firefighters. They work with specialized wildland fire engines that carry special equipment to spray water and foam.
- **Handcrews** construct fire lines, which resemble a hiking trail, by removal of burnable woody material down to mineral soil that cannot burn or smolder.
- **Airtankers** and **helicopters** - can drop water to wet, or cool down vegetation reducing fire intensity.
- **Helitack** crews are teams of firefighters who are transported by helicopter to wildfires. Once on the ground, crews build fire lines using hand tools, chainsaws, and other firefighting tools. They often remain overnight in remote locations. After they have completed their assignment, crew members may pack up to 120 pounds of equipment over difficult terrain to reach a pick-up point.
- **Smokejumpers** travel all over the country, including Alaska, to provide highly trained, experienced firefighters and leadership for quick initial attack on wildland fires in remote areas. Firefighting tools, food and water are dropped by parachute to the firefighters after they land near the fire making them self-sufficient for the first 48 hours.
- **Satellite imagery**
- Onsite **video feeds** from mobile assets

All these assets need to coordinate and communicate to safely and effectively fight a forest fire.

When operating at the remote edge, the remote responder needs:

- Situational awareness with real-time information

- Resilient connectivity
    - Availability based on a PACE plan
    - Availability of high value communication when using low throughput links
- Resilient Continuity of edge devices with life-cycle management

The PACE plan (short for Primary, Alternate, Contingency and Emergency) method determines which parties need to communicate and then identifies the four best methods of communication between those parties as technology degrades or becomes unavailable. When planning for communication contingencies, it's vital to create different levels of comms to account for unpredictable variables as every situation will have different needs according to the type of emergency.

Remote Responders Solution

Managing a network is hard. Managing an ad hoc, remote, austere network under emergency situations where availability and timeliness will directly impact preservation of lives, property and natural resources presents an especially difficult challenge.

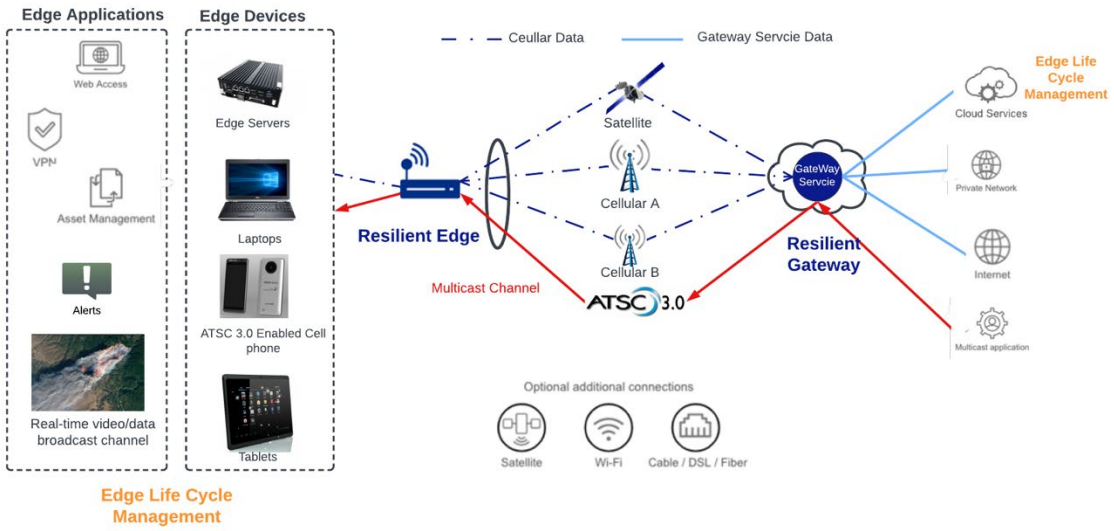


Figure 5 Enhanced Remote Responders Solution

With the combined solution, Remote Responders services and capabilities are enhanced through:

- Hands-free, always-on real-time contextual alerting
- Situational awareness with real-time distribution of satellite imagery and on-site video feeds
- Better connectivity by combining multiple channels including ATSC 3.0 for higher availability and higher throughput.
- Offload of shared file/context to preserve available two-way bandwidth capacity.
- Equipment continuity with OTA/out-of-band edge Life-cycle management software to visualize, monitor, and update operating systems and workloads to keep Distributed Edge Devices operating through feature enhancements, bugs fixes and hot patches.

Enhanced First Responder Services Solution Partners

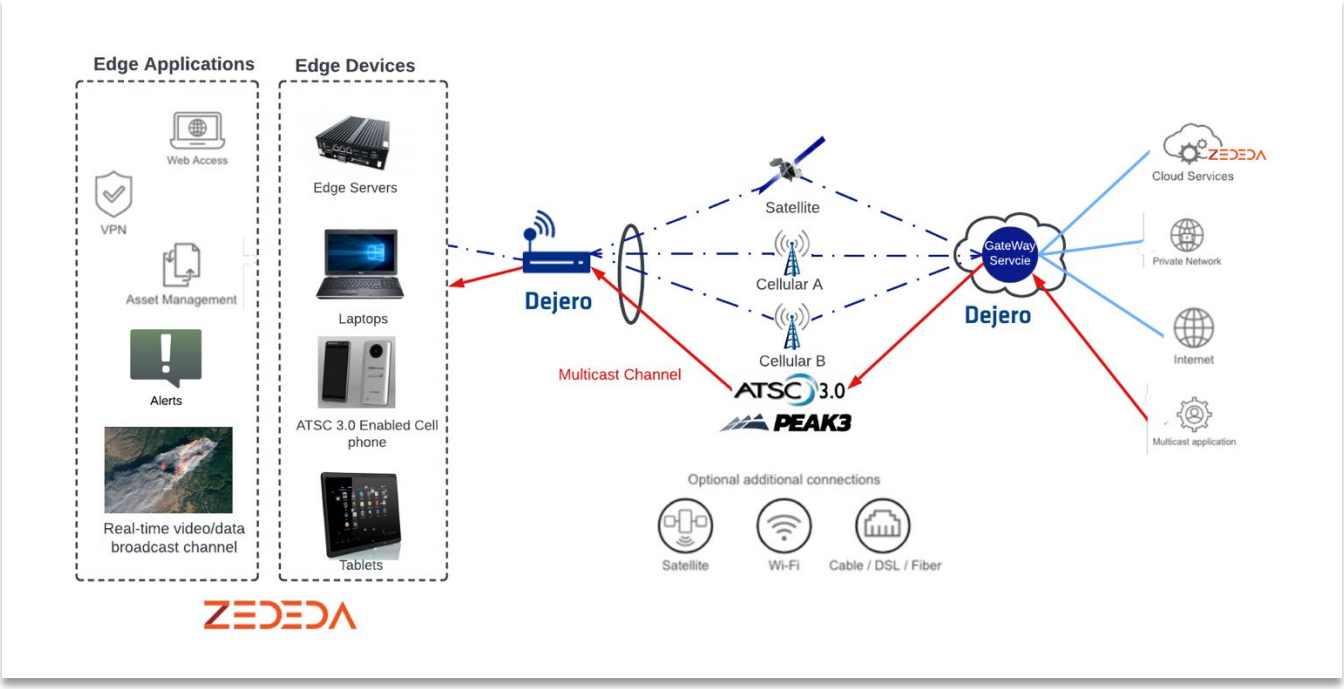


Figure 6 Remote Responders Solution Partners

About PEAK3

PEAK3 has a long-term engagement with the spectrum owners to offer this alternative data highway to its many technology partners, its enterprise clients, and to its engineering teams to further develop novel applications where the ATSC 3.0 value proposition can enable the edge-device community. From hardware architecture through the application layer, the PEAK3 team has a rich history of successful enterprise edge deployments and IT system designs and operations.

We recognize the unique value proposition ATSC 3.0 provides in delivering secure, efficient, data-delivery methods to the edge. The foundation of our business model is Data-Streaming as a Service for organizations wanting to efficiently get data from one point to many.

PEAK3 provides a standards-based, open, end-to-end, nationwide, wireless, IP, multicast network. In simple terms, we provide a cost-effective datacasting pipe for Internet Service Providers, public and private cloud providers, and any organizations operating large edge device architecture.

About Dejero

Driven by a vision of reliable connectivity anywhere, Dejero delivers real-time video and networking solutions that provide resilient, uninterrupted internet connectivity for critical communications. Powered by intelligent network aggregation technology, Dejero combines diverse telecommunication networks including 4G/5G cellular, GEO/MEO/LEO satellite, and fixed broadband to create a

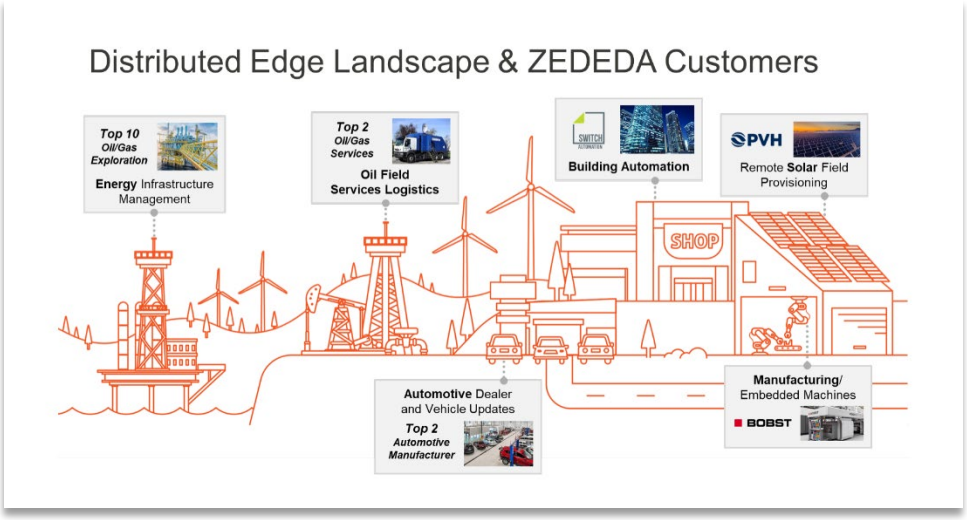
Figure 7 Dejero Resilient Edge

software-defined ‘network of networks’ managed in the cloud. The result is enhanced reliability, expanded coverage, and greater bandwidth for their global customers.

About ZEDEDA

ZEDEDA delivers a distributed, cloud-native edge management and orchestration solution, simplifying the security and remote management of edge infrastructure and applications at scale.

ZEDEDA ensures extensibility and flexibility by utilizing an open partner ecosystem with a robust app marketplace. ZEDEDA leverages an open architecture built on EVE-OS, from the Linux Foundation. EVE-OS is a lightweight, open-source Linux-based edge operating system, with open orchestration APIs.



Conclusion

ATSC 3.0 Datacasting, Edge Life-cycle Management and Smart Blending combine to enhance Remote Responder services and capabilities.

Some key benefits include:

- Leveraging the long distance, highly penetrating, national coverage of ATSC 3.0 to extend the use of smart blending technology to deliver resilient connectivity to the remote edge.
- Leverage the one-to-many nature of ATSC 3.0 deliver workloads and updates to a distributed remote edge network with higher availability and lower cost.

ATSC 3.0 Datacasting’s ability to reuse the same “bit” many times over significantly reduces distribution costs while leveraging the upgraded infrastructure and spectrum of the ATSC 3.0 national network.

Beyond firefighters, other examples of remote responders include first responders, the energy sector, National Guard, military, mining, among others could also benefit from this combined technology.