An aerial night view of a city, likely Singapore, with glowing light trails from traffic and city lights. Overlaid on the image is a network diagram consisting of white lines and dots, representing cellular or data connections. The text is centered in the upper half of the image.

# Bonded Cellular and Beyond

What is it, what is it used for, is it still relevant  
in a 5G world, and is it enough?

**Dejero**

## What is cellular bonding?

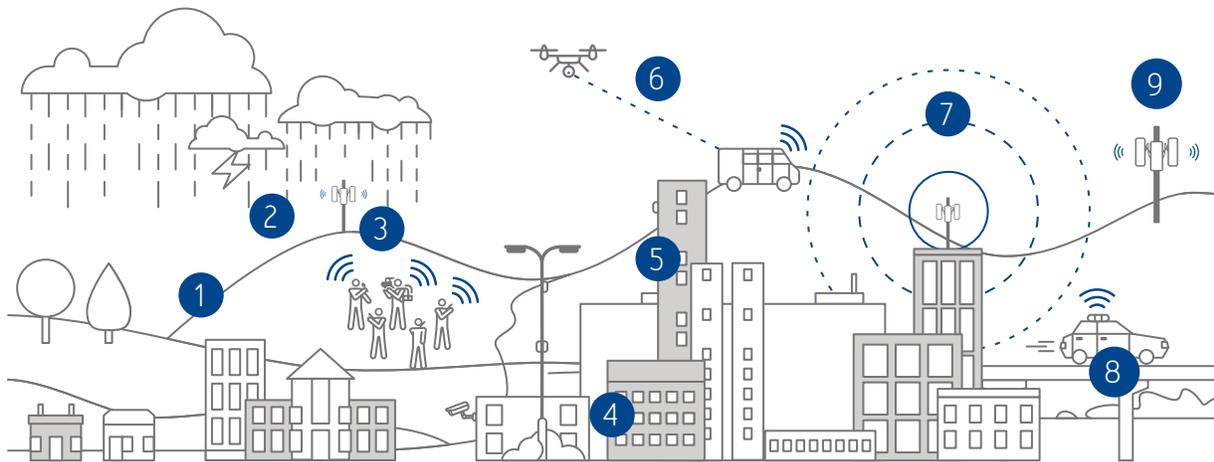
Cellular bonding refers to combining two or more cellular connections. The combination provides **more bandwidth** for uploads and downloads. It also provides **connection resiliency** in situations where cellular networks become congested due to high traffic, or in remote areas where cellular signal strength may be diminished.

There are many other factors that may impact cellular reception and the available bandwidth, which bonded cellular technology can address.

### Key advantages of Cellular Bonding

- Connection resiliency when networks are congested
- Connection resiliency in fringe coverage areas
- Greater upload and download bandwidth
- Expanded coverage with carrier diversity

## Factors impacting cellular reception and available bandwidth



1. Obstructions [hilly terrain, dense foliage, large buildings]
2. Weather conditions [humidity, heavy cloud cover, fog, precipitation, electromagnetic interference, temp inversions]
3. Number of users
4. Location [city, urban, rural]
5. Building materials [metal, concrete, tinted and low-e glass]
6. Data-intensive applications
7. Spectrum bands
8. Stationary vs in motion
9. Proximity to tower

## Carrier diversity delivers greater resiliency

**Carrier diversity** — using connections from different mobile network providers — delivers even greater resiliency. Should a connection drop, packet loss occur, available bandwidth diminish, or the latency not meet the needs of the application, packets are re-routed across the other connections in the bonded link.

Upload and download speeds on mobile networks vary. While the global average download speed is 48 Mbps and upload speed is 12 Mbps,<sup>1</sup> actual speeds vary greatly by country, carrier, specific location, and the degree of congestion on the network.

It's not unusual for users to only have 1 Mbps upload speed from a single connection, especially where crowds gather and cause network congestion, or in fringe coverage areas. But many applications require more

than that. Take video as an example. Approximately 5 Mbps upload bandwidth is required to send high-definition, low-latency live video. For 4K UHD streams, approximately 25 Mbps upload bandwidth is needed.<sup>2</sup>

**5** Megabits per second  
High definition (HD) bandwidth

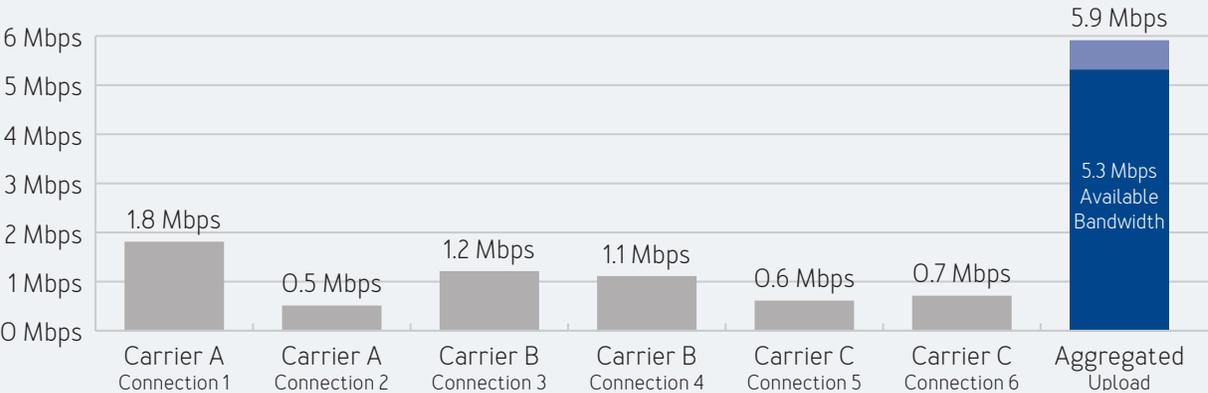
**25** Megabits per second  
Ultra HD (4K UHD) bandwidth

Applications relying on **wireless internet connectivity** — particularly those needing higher upload speeds to transmit uninterrupted high-quality live video or real-time data — can use multi-modem cellular bonding devices to aggregate multiple cellular connections to achieve the required bandwidth and connection resiliency. These devices use 3G/4G (including LTE)/5G modems to connect to the carrier networks.

<sup>1</sup> As of April 2021, see latest data from [Speedtest Global Index](#).

<sup>2</sup> Many factors impact the actual bandwidth needed including the type of video encoding, resolution, and upload headroom requirements.

## Aggregating Multiple Cellular Connections



Bonded cellular technology aggregates bandwidth from multiple connections. These connections may be with the same or different carriers. This example shows a scenario where upload

bandwidth from each connection may be extremely limited, but in aggregate, there's enough available bandwidth for high-definition, low-latency live video transmission.

## Isn't one connection enough?

While the upload and download bandwidth provided from a single carrier may be sufficient in a specific location, relying on a single connection leaves organizations vulnerable — especially if they need resilient connectivity while in motion, such as in a vehicle, or in nomadic situations where someone is moving from one location to another, but typically stationary. Mobile journalists and first responders are good examples of personnel that are frequently moving locations while they operate remotely.

No single carrier provides 100% coverage in every location. **Carrier network coverage** becomes an additional risk on top of the network congestion risk, and the risk of degraded service in fringe coverage areas. For critical communications, **carrier diversity** is essential.

### What about failover or load balancing solutions?

Failover solutions do not aggregate bandwidth, but instead use one connection at a time and switch to the next connection if the first connection fails. However, the performance of the first connection may degrade significantly before the failover occurs, providing a poor experience.

Meanwhile, load balancing solutions use a number of connections, but if a connection fails, the session is terminated and a new session must be initiated on another connection. This interruption is not acceptable for critical communications that depend on persistent connectivity.



## What about 5G?

The arrival of 5G holds tremendous promise to transform telecommunications with faster speeds and less latency when connecting to the network, as well as enabling many more devices to connect to the internet. Yet despite this, connectivity challenges will remain. While the bandwidth from a single 5G connection may be sufficient for data-intensive applications, such as real-time, high-definition video, reliance on a single connection leaves organizations vulnerable, and the coverage challenge remains.

*Relying on a single network for critical communications leaves organizations vulnerable*

Much like with 4G networks, carriers will have coverage gaps and “dead zones” in cities and urban areas, and it will take time for 5G networks to roll out, especially networks using high-band millimeter wave (mmWave) spectrum that promises blistering speeds and low latency. Since 5G mmWave networks face greater challenges

penetrating building materials than 4G LTE frequency bands, there are also implications for 5G coverage in buildings.

The higher power consumption required by 5G is another consideration. This is an important implication for portable, battery-powered devices used by personnel that operate remotely.

Since 4G LTE and 5G will co-exist for quite some time, choosing bonded cellular technology capable of aggregating the various generations of network technologies from multiple carriers remains key.



Field Connectivity  
in a 5G World

Enabling tomorrow's use cases with Dejero  
Smart Blending Technology

Whitepaper

For a deeper dive into the realities of 5G, read our *Field Connectivity in a 5G World* whitepaper

## Beyond cellular bonding

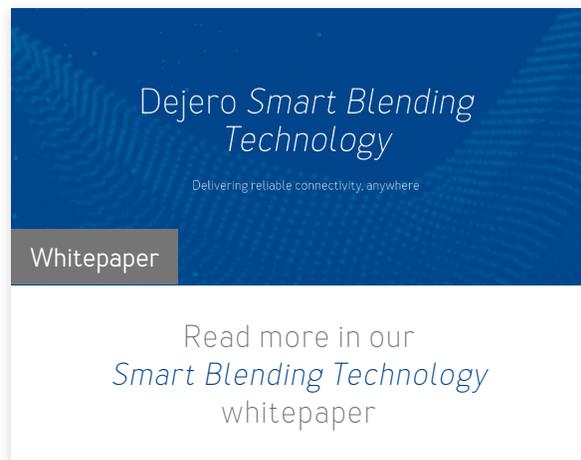
While bonding cellular connections may provide enough bandwidth for high-quality live video and real-time data exchange in mobile and nomadic scenarios, there are scenarios where aggregating other connections makes sense for greater connection diversity, resiliency, and continuity.

Dejero *Smart Blending Technology* not only aggregates 3G/4G/5G cellular connections, but also combines other wireless connections such as Wi-Fi and satellite, as well as cable/DSL/fiber broadband connections in a fixed location. In fact, any Internet Protocol (IP) connection from multiple providers can be aggregated to form a virtual 'network of networks' with Dejero technology. Sometimes this is referred to as *network bonding* or *IP-bonding*.

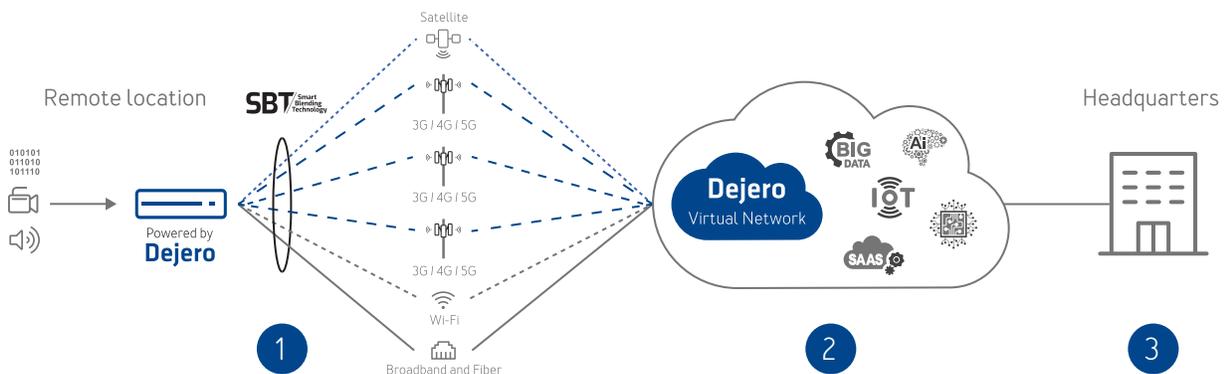
While each connection path has its own characteristics, Dejero dynamically and intelligently manages the fluctuating

bandwidth, packet loss, and latency differences of individual connections **in real-time**, seamlessly redirecting packets and maintaining **session persistence** if connections degrade, or are lost.

The result? Resilient, high-bandwidth internet connectivity when and where you need it. That means video, voice and data can be sent and received **uninterrupted**.



### Smart Blending Technology



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

## Resilient internet connectivity for critical communications

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From broadcasters and production companies, to public safety and government agencies, to enterprises spanning a wide variety of industries, organizations depend on internet connectivity for critical communications.

In many situations, an unstable connection or a network outage isn't simply an annoyance, it can have catastrophic implications.

Dejero aggregates and manages networks to ensure organizations have the resilient internet connectivity required for **live video transmission** and **real-time data exchange** from mobile, nomadic, and fixed locations.

Whether bonding purely cellular networks or aggregating diverse IP-based network technologies, Dejero eliminates the vulnerability of relying on a single network for critical communications.



Broadcast & Media



First Responders



Public Safety



Enterprise



# Dejero

## About Dejero

As organizations accelerate their digital transformation, they choose Dejero to solve the most challenging applications of live video and real-time data exchange over wireless IP networks.

Dejero delivers resilient, uninterrupted internet connectivity vital to critical communications and cloud access. It provides connection diversity, redundancy, and continuity by intelligently combining multiple networks into a single managed service.

### To learn more:

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