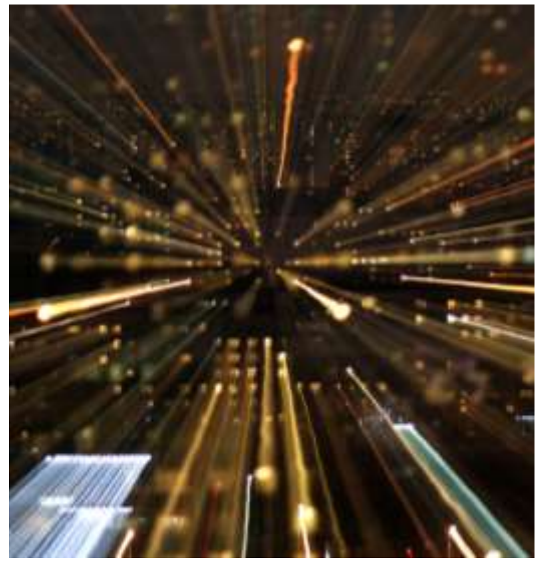
Local Breakout - A Solid Business Case for MEC at the Edge

Mavenir Virtualized Media Breakout Controller (vMBC)
White Paper

May 2018

WP-18-05-13

Executive Summary



Mobile operators around the world are challenged by the continued increase in demand for mobile data. As well as more subscribers using mobile broadband, each consumer is increasing the amount of bandwidth they consume. Streaming TV and movies, high definition video content, increased use of video conferencing and personal chat, and more embedded video in web pages all contribute to increasing demand for mobile bandwidth.

As an example of the increase load being placed on mobile networks, consider that the mean bandwidth for each macrocell in the U.S. in 2018 is just over 428 Mbps. By 2022, iGR estimates this figure is forecast to grow to 763 Mbps, an increase of 78 percent. As a result, mobile operators have to add more capacity to the macrocell itself, the backhaul link (between the cell and the packet core) and to the EPC (Evolved Packet Core).

One solution is to use a MEC (Multi-access Edge Computing) server to provide local breakout of some mobile data traffic. MEC servers enable content and applications to be processed as close as possible to the edge of the network, close to the end user, thereby improving the user experience and reducing the traffic that has to be sent over the network.

Mobile Operators need to add over 78% capacity per cell site by 2022

When used for breakout of local Internet traffic at the cellular base station, a media breakout application is run on the MEC. This application provides traffic routing functions to recognize and direct traffic that can be broken out immediately or tunneled to the Internet peering point. Mavenir refers to this MEC application as a virtual Mobile Breakout Controller (vMBC).

All of the traffic from the local cell towers is routed through the MEC running the vMBC application, which then decides if the traffic should be backhauled to the EPC or broken out to the Internet. Traffic for the Internet is therefore routed immediately, through a firewall, to a dedicated Internet link. This traffic is therefore not routed through the EPC and thus the backhaul and EPC load and capacity requirements are reduced.

WP-vMBC-18-05-13

The benefit of local breakout can be quantified quite simply. In short, the more traffic that can be offloaded locally, the lower the load on the rest of the mobile network. And since mobile operators have to continually add network capacity to meet the growing demand for bandwidth, any traffic that can be offloaded reduces the need for investment.

*i*GR estimates that approximately 80 percent of mobile data traffic today is video. Of this mobile data traffic, *i*GR estimates that 40 percent in encrypted and can be broken out locally. This means that 32 percent of total mobile data traffic can benefit from local breakout. As a result, the load on the backhaul and EPC is reduced by 32 percent.

About 80 % of mobile traffic is video.

32 %

of total mobile data traffic can benefit from local breakout

Obviously, a mobile operator is not going to *remove* current capacity from the network but rather will extend the time before additional capacity needs to be added. This means that local breakout will extend the current macrocell backhaul and EPC capacity by ***25.6 months***.

To quantify the potential benefits of local breakout, iGR modelled four mobile operators in different regions of the world. For example, in the U.S. example, total savings over the 5-year period are $546 million for a mobile operator with 50 million subscribers. In Germany, a MNO with 30 million subscribers sees total savings of nearly €189 million over the 5-year period. In Australia, an operator with 10 million subscribers could save $106 million over five years from local breakout. And in India, a mobile operator with 150 million subscribers could save 38,764 million Rs over five years.

These examples demonstrate that a mobile operator, no matter the location, can benefit from considerable savings by deploying local breakout.

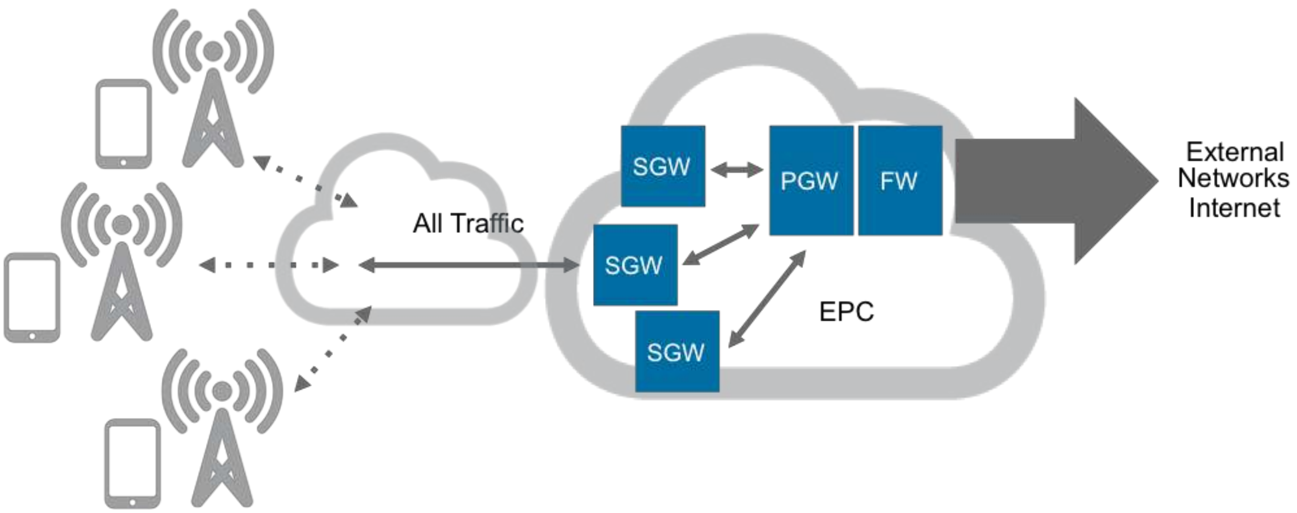
How local breakout works

To explain how local breakout functions, we must first overview the traditional mobile network architecture. Figure 1 shows a basic architecture and the flow of general mobile data traffic. Working from left to right, the mobile device connects wirelessly to cellular radio on the local cell tower.

The data traffic is then typically connected through a fiber network to the Evolved Packet Core (EPC) – this is likely housed in a local data center. The S-Gateway (SGW) and P-Gateway (PGW) act as routers, forwarding the traffic to the appropriate location. Data traffic also passes out of the EPC (through a firewall – FW) to external networks and the Internet.

Note that all traffic follows this general route. For example, a request from a mobile device for Google News will pass from the cell tower through to the EPC and then out to the Internet – the appropriate web page content is then sent back the same way.

Figure 1: Traditional Mobile Network Architecture



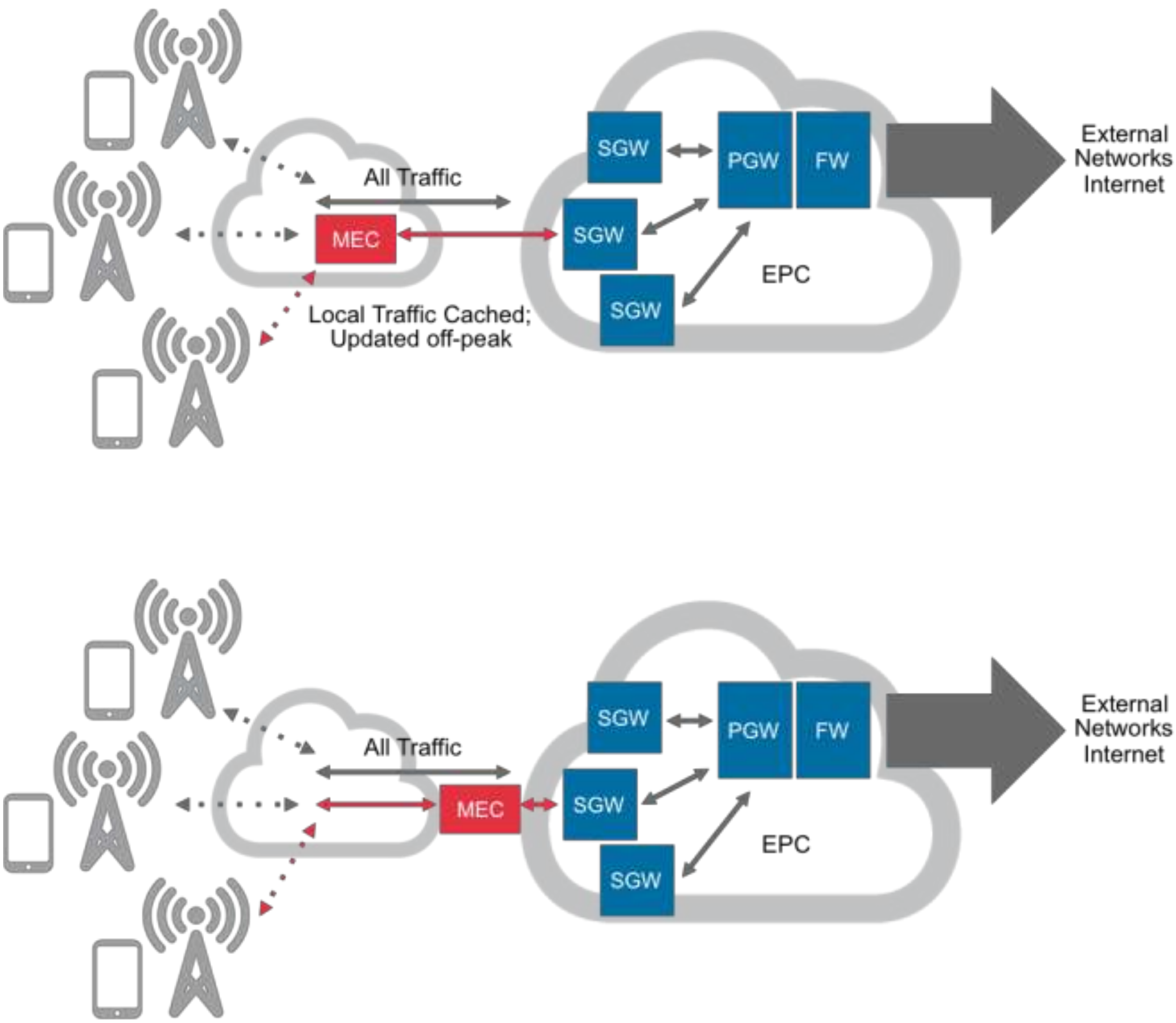
Source: iGR, 2018

The next architecture diagram (Figure 2) shows where the MEC server can be placed in the network. Multi-access Edge Computing (MEC) servers enable content and applications to be processed at the edge of the network, close to the end user, thereby improving the user experience and reducing the traffic that has to be sent over the network. The MEC can be used, for example, to optimize and cache video traffic close to the end user. Note that the MEC can be placed anywhere between the baseband unit and the EPC – the location depends on the solution required and is not constrained by internet connectivity points.

MEC is an ETSI standard and many mobile operators around the world are planning deployments. MEC solutions are also implemented by enterprises to support private networks and aggregate IoT sensor traffic, among other applications.

Since the MEC puts the processing and compute power closer to the radio (and hence the end user device), applications running on the MEC benefit from lower latency. Since the application request or data does not have be backhauled to and then traverse the EPC before being processed, the latency is much reduced. For this reason, a MEC architecture is required to support low-latency applications and services. MNOs that deploy MEC for local breakout can therefore use the same architecture for 5G.

Figure 2: Mobile Network Architecture with MEC



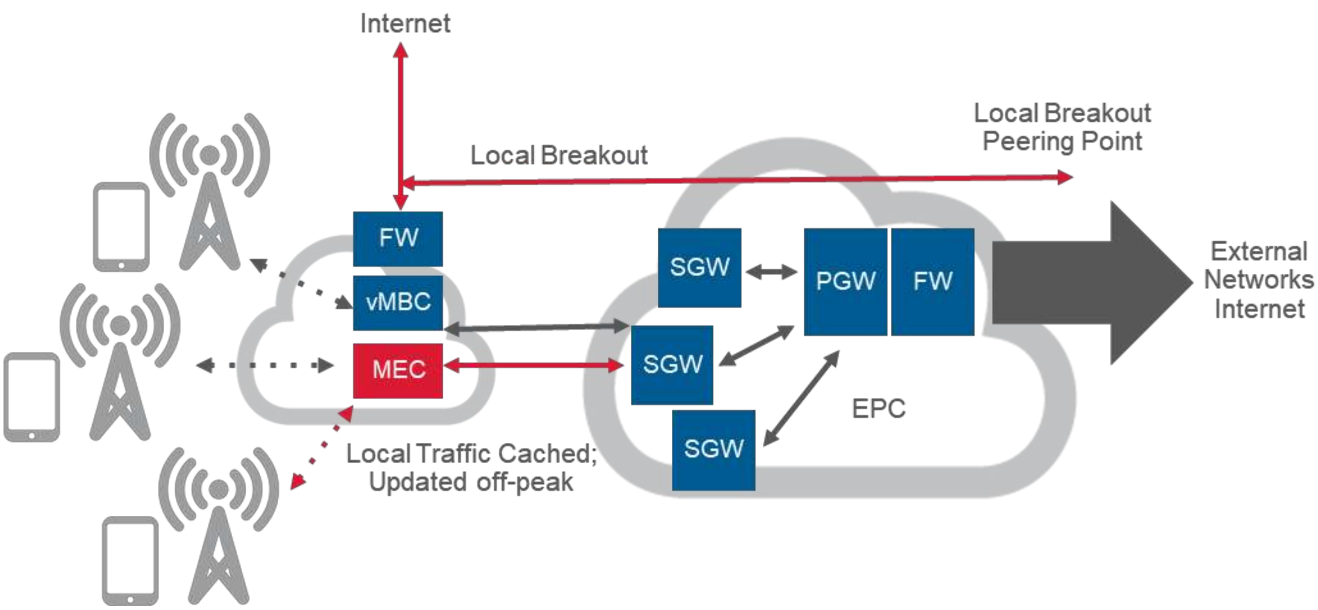
Source: iGR, 2018

WP-vMBC-18-05-13

The MEC server can also be used to breakout local Internet traffic at the cellular base station. In this application, the MEC is configured as a virtual EPC and provides traffic routing functions to recognize and direct traffic that can be broken out immediately to the Internet. This architecture is shown in Figure 3 – in this example, the break out application on the MEC is shown as a vMBC – virtualized Mobile Breakout Controller.

All the traffic from the local cell towers is routed through the MEC running the vMBC application, which then decides if the traffic should be backhauled to the EPC or broken out to the Internet. Traffic for the Internet is therefore routed immediately, through a firewall, to a dedicated Internet link and if necessary tunneled to a local peering point. This traffic is therefore not routed through the EPC and thus the backhaul and EPC load is reduced.

Figure 3: Mobile Network Architecture with Local Breakout



Source: iGR, 2018

WP-vMBC-18-05-13

Critical success factors for local breakout

The are several factors that will determine the success of local break out in a mobile network:

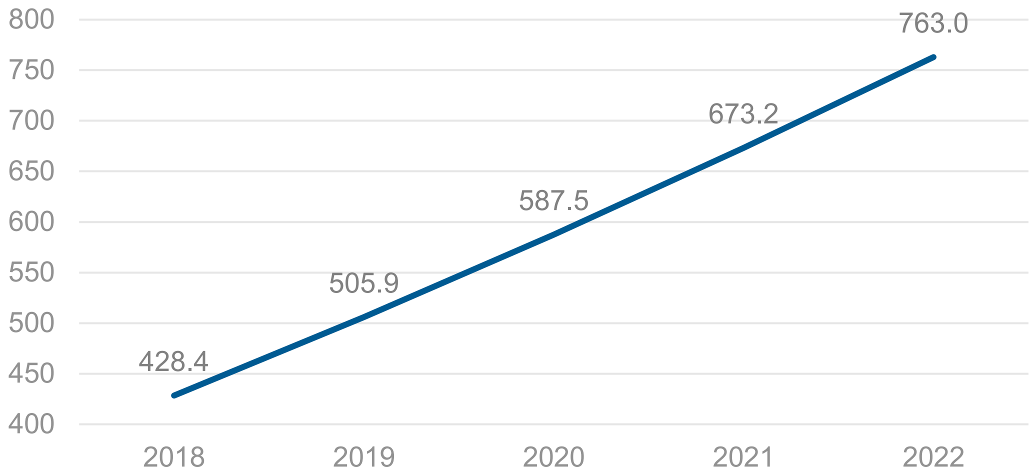
- Significant traffic on a particular cell site can be offloaded – in other words, there must be a significant amount of general Internet traffic (web searches, YouTube videos, etc) to make the cost and complexity of deploying the MEC and break out application worthwhile. The good news is that most of the mobile traffic is video and most of this traffic comes directly from the Internet.
- Break out to the Internet should be optimized to occur before the traffic hits the core EPC and at the closet peering point to the cell site.
- Can be installed selectively site by site where needed.
- CALEA (or other Lawful Interception standards) compliance – the break out application and MEC must enable law enforcement to conduct lawful intercept of mobile communications – this would include some data that is subject to local breakout. Since the local breakout traffic would likely be passed to a local telco or ISP for connection to the Internet, the CALEA compliance could be completed by the telco/ISP.
- Suitable location for the vMBC solution – the MEC and local break out application must be located in a secure location that offers suitable power, cooling, access to the cell base station and accessibility for maintenance, etc. This could be at the base of a macro cell tower or in a local data center. Note also that the location must offer strong network security as well as physical security.

Benefits of vMBC

To quantify the benefits of a MEC and break out application, we can look at the amount of data traffic that the cellular network processes. In short, the more traffic that can be offloaded locally, the lower the load on the rest of the mobile network. And since mobile operators have to continually add network capacity to meet the growing demand for bandwidth, any traffic that can be offloaded reduces the need for investment.

Figure 4 shows the mean bandwidth per macrocell for the U.S. (in Mbps). Obviously, as the demand for mobile data bandwidth increases (due to increased use of HD video, streaming music, video conference calls, etc), so the average capacity of the cell site increases as well. Hence the mean bandwidth increases from 428 Mbps in 2018 to 763 Mbps in 2022, an increase of 78 percent over four years.

Figure 4: Mean Macrocell Bandwidth in the U.S., 2018 - 2022 (Mbps)



Source: iGR, 2018

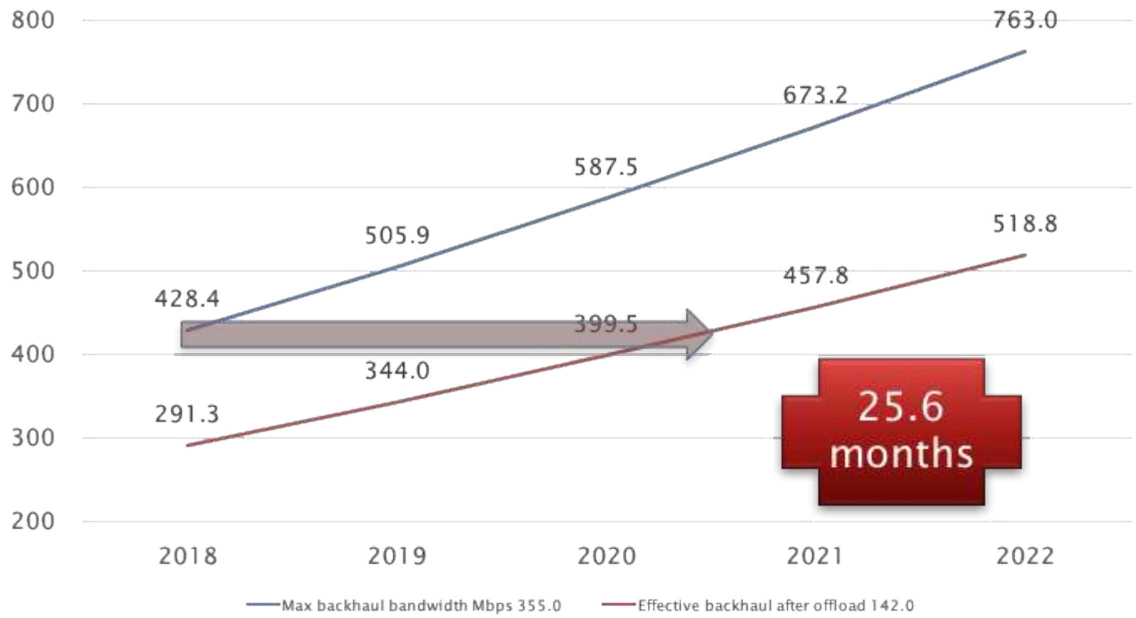
Since the macrocell has to support more data capacity, so more capacity is needed in the backhaul connection (between the macrocell baseband units and the EPC) and in the EPC itself. MNOs usually try to build in excess capacity when they are upgrading a network so that they do not have to revisit a macrocell for a couple of years. If a MEC is deployed to provide local breakout, the benefits can be measured in several ways:

- The demand for backhaul between the baseband units and the EPC is reduced – this means a smaller link can be used.
- Since multiple fibers are usually deployed when building backhaul to provide capacity for growth, local breakout extends the time before additional backhaul is needed. Simply, what is already available last longer.
- Since the existing backhaul will have a longer life with local breakout, the need for additional investment is reduced.
- The load on the EPC is also reduced, since any traffic that is broken out will not be processed by the packet core. As with backhaul, the time before additional EPC capacity is extended reducing the need for investment.
- Reduced load on the EPC also reduces the need for maintenance cost.

To quantify the benefits of local breakout, consider that approximately 80 percent of mobile data traffic today is video. If this seems high, remember that most web pages today, and especially those with news, include embedded video – as soon as the page is loaded, the video starts playing. Mobile data video traffic is therefore not limited to streaming TV and movies but also includes many general Web searches.

Of this 80 percent of traffic, *i*GR estimates that 40 percent can be broken out locally (i.e. this traffic comes directly from the Internet). This means that 32 percent of total mobile data traffic can benefit from local breakout. Reducing the mean macrocell bandwidth by 32 percent gives the red line in Figure 5.

Figure 5: Mean Macrocell Bandwidth in the U.S. with Local breakout @32%, 2018 – 2022, (Mbps)



Source: iGR, 2018

As Figure 5 shows, using local breakout reduces the mean macrocell bandwidth from 428 Mbps to 291 Mbps in 2018 and from 763 Mbps to 519 Mbps in 2022. Obviously, a mobile operator is not going to *remove* current capacity from the network but rather will extend the time before additional capacity is needed.

This means that local breakout will extend the current macrocell backhaul and EPC capacity by ***25.6 months***.

vMBC Benefits by Region

To show the potential savings of deploying a local breakout solution, consider the following four mobile operator examples:

- An operator in the U.S. with 50 million subscribers and ARPU of $44 per month
- A German mobile operator with 30 million subscribers and monthly ARPU of €15.40
- An operator in Australia with 10 million subscribers and ARPU of A$15 per month
- A mobile operator in India with 150 million subscribers and monthly ARPU of 152 Rs.

In each case, the cost of backhaul and EPC was estimated from published network costs. *i*GR then applied the 32 percent local breakout calculation to show the savings each year. The results are shown in Table 1.

WP-vMBC-18-05-13

Table 1: Savings from 32 percent local breakout for MNOs in different regions, 2018 – 2022

Offload Savings @32% local breakout	2018	2019	2020	2021	2022	Total
U.S. MNO	US$95.1M	US$99.9M	US$108.2M	US$117.0M	US$126.4M	US$546.7M
German MNO	€ 29.3M (US$35.4M)	€ 33.0M (US$39.9M)	€ 37.2M (US$45.0M)	€ 42.0M (US$50.7M)	€ 47.3M (US$57.0M)	€ 188.8M (US$227.9M)
Australian MNO	A$16.7M (US$12.6M)	A$18.8M (US$14.2M)	A$21.0M (US$15.9M)	A$23.5M (US$17.7M)	A$26.2M (US$19.8M)	A$106.2M (US$80.2M)
Indian MNO	8,375.1 RsM (US$ 128.M)	7,213.3 RsM (US$ 110.9M)	7,374.0 RsM (US$113.4M)	7,660.8 RsM (US$117.8M)	8,139.9 RsM (US$125.2M)	38,763.9 RsM (US$596.2M)

Source: iGR, 2018

As the table shows, the savings can be considerable. For example, in the U.S. case, total savings over the 5-year period are $546 million, rising from $95 million in the first year to $126 million in 2022. The German MNO, with fewer subscribers than the U.S. operator, sees total savings of nearly €189 million over the 5-year period.

These examples demonstrate that a mobile operator, no matter the location, can benefit from considerable savings by deploying local breakout.

For more information visit Mavenir.com

WP-vMBC-18-05-13