vRAN makes future upgrades easy

MOBILE EXPERTS

Mobile operators are very rational creatures. They rarely introduce new technologies unless the new idea can either save money or make money. In the case of virtualization, both aspects are true. Mobile operators such as Verizon, KDDI, and Vodafone are now implementing virtual DU and virtual CU in commercial deployments, because they expect both cost savings and new flexibility that should enable new revenue streams in the future.

A few suppliers are moving quickly to support the vRAN market. Samsung, in particular, has deployed vDU software in live networks in North America, Europe, Japan, and Korea, and launched the earliest large-scale deployment in December 2020. Ericsson and Nokia have also launched vDU and vCU software, but the timing of commercialization at Verizon in high-density markets was later, coming in the late 2021 timeframe. Smaller vendors have offered vRAN for some time, but have not penetrated large high-density markets.

In this white paper, we focus on the cost savings. Some operators are confused about how much cost is really saved by virtualization. In an environment where they have centralized their baseband processing, they have already realized some of the physical costs of transport and maintenance in a distributed network. But other cost savings can be even more significant over the longer term.

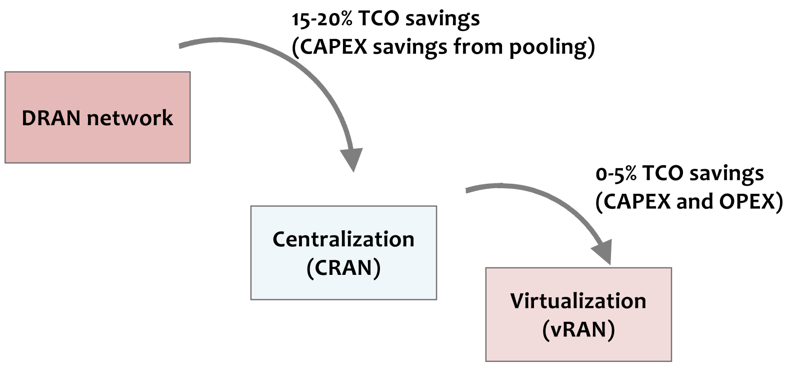
> Verizon, KDDI, and Vodafone are deploying commercial vRAN now -- for the flexibility vRAN brings to the network

A waterfall of cost savings

The savings associated with virtualization are all tangled up with other things that are happening in the mobile network. Centralization of the network is already taking place, with significant savings from pooling that allow for less money spent on DU and CU compute resources. We've detailed the savings for CRAN in some lengthy research reports[1], and noted that the actual savings can vary from about 5% to 30%, depending on the cost of fiber and other local factors. We show a 15-20% savings in

[1] Cost benefits of Cloud RAN, F. Rayal and J. Madden, Mobile Experts, December 2013 and Virtual Mobile Networks, J. Madden and G. Collins, Mobile Experts/Exact Ventures, June 2021

Figure 1, to reflect a typical scenario for a highly developed telecom network in East Asia or the United States with strong fiber availability.



Source: Mobile Experts

Figure 1. Illustration of cost savings upon initial deployment for CRAN and vRAN

The next step in the waterfall is the move to virtualization. If the operator only takes this step by itself (comparing a centralized network with dedicated hardware to a centralized network with virtualized DU and CU), the savings is minimal. In fact, in some cases the initial cost of a macro base station deployment might be a bit more expensive for the vRAN case, but operational savings over an 8-10 year life will bring a small net savings to the operator.

The up-front savings with vRAN can be small--- but much larger savings accrue over time.

Here's the fallacy of conventional thinking: if the operator is looking at cost savings for each step individually, they might conclude that vRAN is a marginal investment. But there's a lot more to the story. Let's examine the cost of network deployment over a long period of time, with multiple network upgrades along the way.

Case Study: Life Cycle Cost Analysis with several network upgrades

To accurately reflect the realities of the telecom world, we consider the extended Total Cost of Ownership including a 5G C-band deployment, a C-band small cell overlay, addition of mm-wave sites, upgrades to beamforming and the addition of additional MU-MIMO layers, and software upgrades to optimize 'sleep mode' and add Network Slicing. Our cost analysis is limited to the RAN in this case for simplicity.

Figure 2. Illustration of seven steps in case study analysis

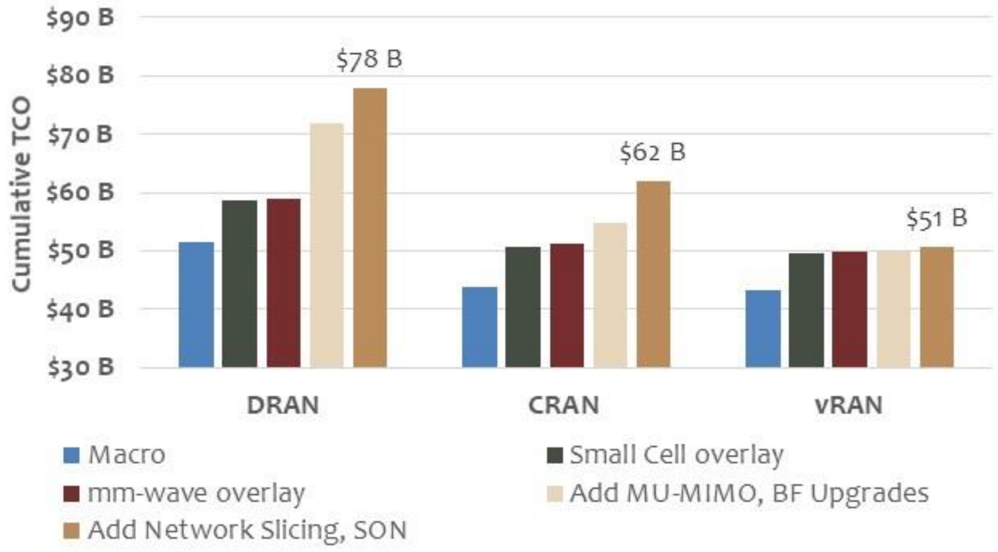
For our case study, we investigated three cases:

1. Distributed RAN (DRAN): In this case, the radio and baseband processing for the RAN are all located at the tower or small cell location.
2. Centralized RAN (CRAN): Not to be confused with Cloud RAN, this "CRAN" scenario simply evaluates the savings associated with centralization. We assume in this case that the RAN equipment uses dedicated hardware. This is a typical case in the early 5G networks today.
3. Virtual RAN (vRAN): This case uses the same centralization concept as the previous case, but shifts from dedicated DU and CU hardware to vDU and vCU on COTS hardware. Note that this case does NOT take into account the cost savings associated with open competition in each network element. We consider Open RAN to be a different dimension, and similar analysis for Open RAN can be found in a separate report.[2]

Considering these three cases, the most obvious up-front savings come from centralization. But virtualization is an important step in making future network upgrades quick, easy, and inexpensive.

In fact, microservices on a cloud-native vRAN allow for upgrades on the fly with continuous integration/continuous delivery (CI/CD). Using microservices, the workload can be ported to redundant compute resources for the upgrade, allowing a big network upgrade to roll out much more quickly than today's process of scheduling upgrades in maintenance windows.

[2] Open RAN 2021: J. Madden, Mobile Experts. September 2021



Source: Mobile Experts.
Note: TCO includes CAPEX and 8 years of OPEX for each network upgrade, each step adds to cumulative TCO.

Figure 3. Expected TCO over the life cycle of a 5G network, with six upgrades over 10 years

In our case study scenario, involving a high-density nationwide network, over the life cycle of this 5G network, we see $27B in savings overall, comparing the Distributed RAN case to virtual RAN. That's a savings of 38%. And while the initial macro deployment cost is virtually identical from the Centralized RAN case to the Virtualized RAN case, we see that the flexibility of vRAN results in major savings in the subsequent upgrades for MU-MIMO, Beamforming, SON, and Network Slicing. Specifically, the flexibility of vRAN saves $11B or 19% of the total life cycle cost for this network, compared with centralized RAN with dedicated hardware.

In other words, cloud-native virtualization allows for much easier roll-out of software upgrades, with significantly lower deployment and maintenance costs.

vRAN makes ongoing network upgrades quicker and more scalable.

In real-life networks, we don't know the future upgrades that will be necessary. Our case study uses six likely upgrades (adding small cells, mm-wave, MIMO layers, beamforming, network optimization software, and automation for network slicing). But in a true 5G network we're likely to see even more upgrades, which are often implemented in a patchwork that is not uniform. Virtualization allows for better consistency across a nationwide network, reducing the overhead required in testing, upgrading, and maintaining the network.

Our conclusion: Virtualization saves significant cost across the life cycle of a network with many upgrades, even if the savings are not obvious at the beginning.