Open RAN
POLICY COALITION

Open RAN and Energy Efficiency

The disaggregation of the radio access network (RAN) will allow for greater adaptability, functionality, and energy efficiency. By opening interfaces and increasing flexibility, Open RAN enables rapid rollout of efficiency measures across the RAN supply chain. Understanding the impact on power usage in particular is critical for both cost savings and sustainability, as a major part of energy consumption in mobile networks stems from the RAN. Electricity costs constitute between 20 and 40 percent of cell site operating expenditures, the majority of which is consumed by the RAN and power amplifiers within the site.[1]

Leveraging Data Center Efficiencies

Compared with traditional RAN, Open RAN's disaggregated, software-centric approach can accelerate the shift of compute resources to large data centers, leveraging advances in data center power optimization. By running as much software as possible in the cloud, Open RAN networks can take advantage of the economies of scale inherent to large data centers. Cloud data centers can leverage centralized cooling, lighting, and electricity purchasing agreements, bringing down power costs compared to local compute operations.[2] Modularized components and open interfaces, combined with innovations in virtualization technologies, will allow telecommunications operators to unlock cloud efficiencies. Software virtualization in particular enables novel business approaches such as pay-as-you-grow models, by taking advantage of elastic virtualized resource scaling.

Total computations performed in data centers have increased by 550% since 2010, while total power consumption increased by only 6% over the same period.[3] As the transistors used in data center servers continue to shrink, power consumption will decrease as well, allowing telecommunications operators to reap the associated cost savings. Historically, every new generation of transistors has led to a 1.6x improvement in compute performance per watt (Figure 1). By shifting necessary computations to the cloud, operations will benefit from the efficiencies of scale. Meanwhile, the traditional approach using proprietary systems requires wholesale hardware replacement to obtain new efficiencies.

Innovations in the data center are beginning to be leveraged in 5G/Open RAN network architecture.[4] This approach will leverage price/performance savings of 40% driven primarily by higher processing speeds, lower power consumption and lower hardware costs. Having Open RAN solutions that include interoperable hardware, components, and semiconductors will significantly widen supply chain options based on capital expenditures, total operating costs and power/thermal limitations among other critical considerations and create significant new options and competition to drive efficiency.

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[1] *Energy Efficiency: An Overview*. GSMA, May 8, 2019. https://www.gsma.com/futurenetworks/wiki/energy-efficiency-2/

[2] *The Carbon Benefits of Cloud Computing*. Microsoft Corporation, 2020. https://www.microsoft.com/en-us/download/details.aspx?id=56950

[3] West, Robert. *Data Center Power Optimization: Increase Efficiency with a Data Center Audit,* October 23, 2020. https://www.datacenters.com/news/data-center-power-optimization-increase-efficiency-with-a-data-center-audit.

[4] "Analysis of Dish Network – AWS partnership to build 5G Open RAN cloud native network" (https://techblog.comsoc.org/2021/04/30/analysis-of-dish-network-aws-partnership-to-build-5g-open-ran-cloud-native-network/).

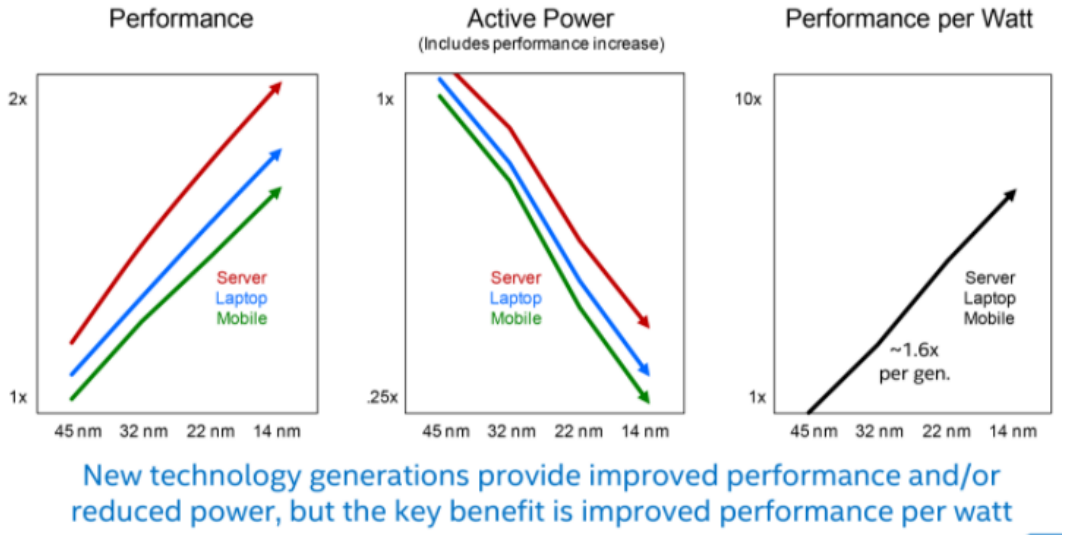

Figure 1: Efficiency Gains from Semiconductor Innovation (Source: Intel)

Cloud Multiplexing Gains

Shifting the software components of the RAN to the cloud can also realize multiplexing efficiency gains. With scalability and demand-based usage, processors that are processing radio software for Open RAN can also run other applications during non-peak times. This is not possible with proprietary baseband systems using dedicated, non-reusable hardware. Traditional RAN is power inefficient when the network traffic load is low, as the [dedicated hardware involved] is intentionally over-engineered for maximum capacity. A study by the Next Generation Mobile Networks Alliance (NGMN) on European networks shows that 80% of cell sites carry only 20% of total traffic, while the busiest 10% of sites handle a full 50% of traffic.[5] Pooling across sites could significantly reduce capacity requirements with significant compute and power savings (Figure 2).

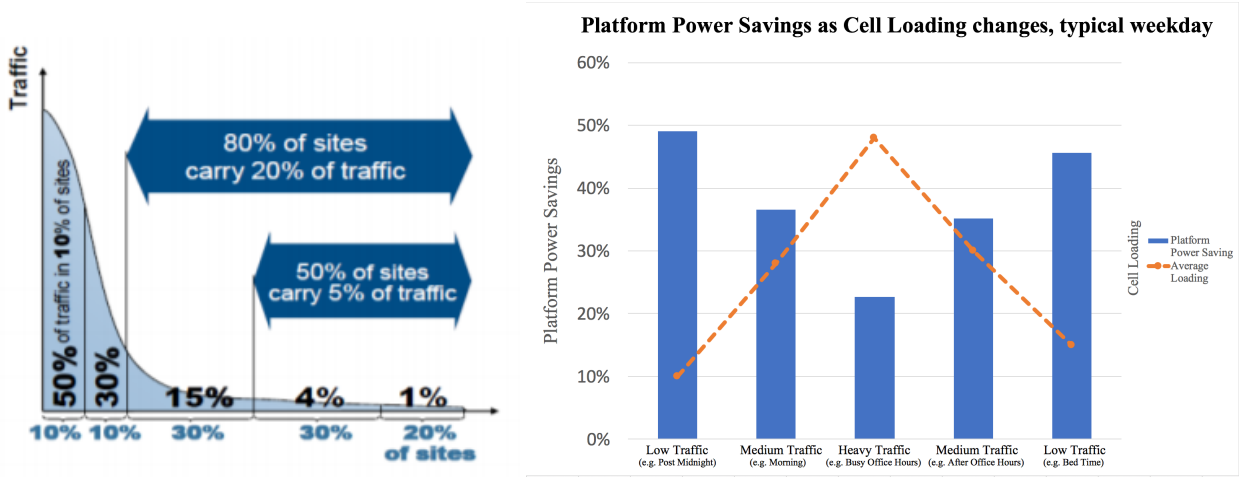

Figure 2: Network Traffic Profile with Elastic Power Savings (Source: NGMN)

[5] *Further Study on Critical C-RAN Technologies*. NGMN Alliance, March 31, 2015. https://www.ngmn.org/wp-content/uploads/NGMN_RANEV_D2_Further_Study_on_Critical_C-RAN_Technologes_v1.0.pdf.

In densely deployed networks, as in city centers, the network traffic load can fluctuate heavily during the day, with periods of minimal traffic at certain cell sites for extended periods. There are also many short gaps in the data transmissions even during highly loaded times. Modeling the cell load profile over a 24-hour period over different types of cells demonstrates that power savings in the range of 30-50% can be achieved through pooling and consolidation (Figure 2).

Radio Frequency (RF) Efficiencies

RF power requirements constitute the majority of power consumption for 5G sites. Open RAN interfaces do not currently impact RF power consumption, as the radio only performs limited processing and is already relatively optimized compared to other components of the RAN. However, the breadth and diversity of the Open RAN ecosystem could enable rapid future rollout of RF device innovations.