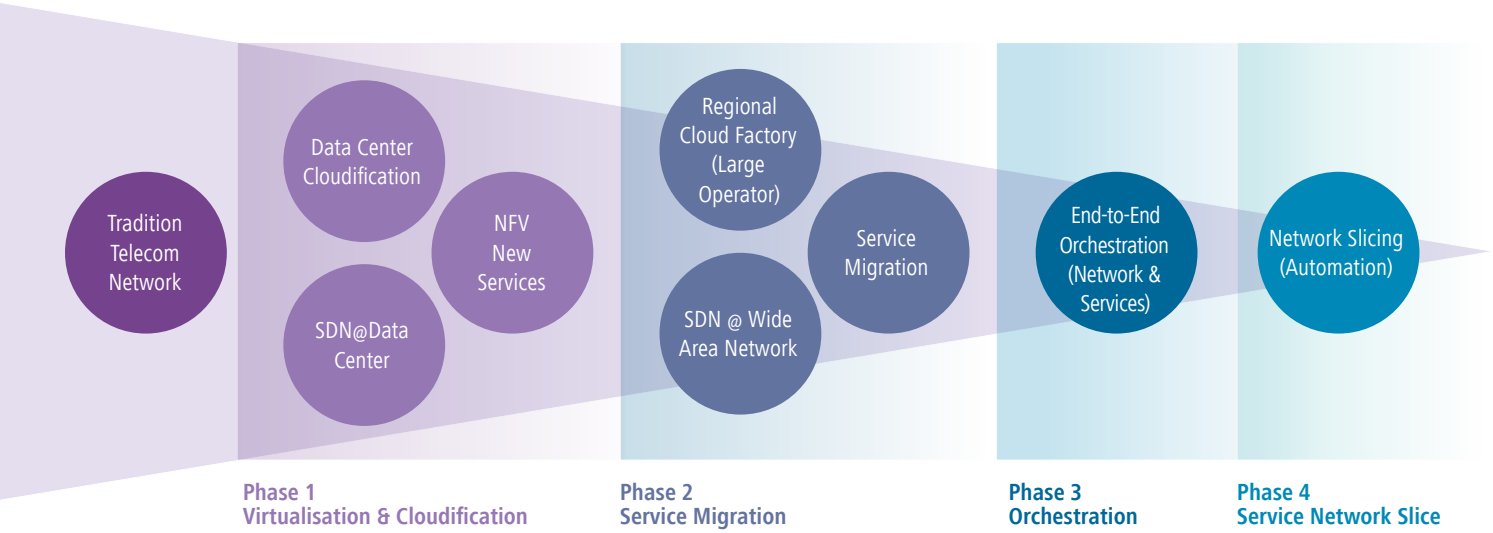
One slice at a time: SDN/NFV to 5G network slicing

The network modernization journey is one that every telco must take. NFV and SDN are the fuel, software and cloud define the route, and customer experience sits waiting expectantly at the destination. Telcos need to approach this transformative journey with three buzzwords in mind: agility, efficiency, and speed. But, to be really effective, end-to-end (E2E) network-wide slicing needs to happen.

By Gary Maidment
Adapted from the white paper *NFV/SDN to 5G Network Slicing* by Dr. Ling Yim-Kwong

Fast, efficient, agile

The digital age has coalesced extremely quickly from the invention of the Internet as ARPANET in 1969 and the first mobile phone call in 1973. Ten years later, Motorola rolled out the first commercial mobile phone, around a decade ahead of when the Internet became big in the early 90s. It wasn't until 2007 that networked and mobile tech really joined hands with the first smartphone from Apple. A true game changer, this gave birth to the world of smart phones and apps from OTT providers that we know and love today.



The four phases of NFV/SDN transformation

People's appetite for apps and social networking has seen network traffic shoot up, a trend that will continue as new IoT services come into full force for consumers and verticals. Up to 100 billion connections are predicted for 2025, with an estimated 8 billion of these coming from smartphones.

However, profits for the telcos that run the networks that underpin the modern world are one of the few things that aren't heading skywards. Ovum predicts that traffic on broadband networks will increase by 205 percent from 2015 to 2025. In contrast, global spending on broadband services will limp up by a comparatively weak 51 percent over the same ten years.

To stay profitable and meet traffic demands, networks need to be made more efficient. They need to provide a better experience at lower CAPEX and OPEX. They also need to be agile, so telcos can quickly innovate and roll out the services that people want when they want them. Efficiency, agility, and speed are set to become the hallmarks of success. And NFV and SDN are the tools for transformation.

To best apply this tech, 5G networks can be portioned into individual slices, where each has independent characteristics for best delivering a particular service type and sharing resources between services and slices.

Take it one step at a time?

Grand aims are one thing, but implementation is another when legacy networks and the maturity of the tech and ecosystem are factored in. Additionally, it takes time for people to acquire the requisite skills and for organizations to transform the way they work into this new software- and customer-centric mode. There are four phases involved in transformation (as shown in the above graphic).

However, a far more bullish approach to construction is possible that compresses these phases and works like this: Build a separate NFV/SDN network, overlay it on the telco network, and migrate legacy services in one go. Despite the concertina effect that this approach delivers, it's still important to understand each phase.

Phase 1: Virtualization and cloudification

Virtualization separates the hardware and software functions of network

elements (NE) like routers.

It reflects a shift towards software-defined functions based on advances in computing hardware, which allows computing power and storage to be shared and offers far greater flexibility. Applications can run as efficiently on commercial-off-the-shelf (COTS) hardware as they do on specialist hardware.

Alongside virtualization, computing power and storage are shifting from PCs to a centralized cloud infrastructure that decouples functionality and location. Advantages include scalability and resource sharing, resilience, low power use, and efficiency. Centralizing large amounts of data for different uses from different users supports big data analytics and its wealth of corresponding applications.

NFV extends virtualization technology to network infrastructure. NFV decouples the software functions from dedicated hardware, allowing Virtual Network Function (VNF) software to run on commodity-based servers, which emulates an NE's function and performance. Commercially available products for doing this include vIMS and vEPC.

SDN takes control

Common transmission networks comprise dedicated routers and switches for data forwarding and network control. SDN, however, centralizes the control function in a single network controller – the software-based SDN Controller. Then, the network router and switch only perform forwarding, cutting costs on the elements that forward packets.

The SDN controller oversees a large part of the network and easily finds the best routes for packets, which is especially useful when the network is congested or part of it is down. The controller's decision-making ability is far superior to traditional routing where routers and switches make decisions based on a limited network view.

According to a Gartner report published in January 2016, only 2 percent of its clients have deployed SDN, with delays largely being attributable to a lack of standardized equipment. For telcos, large-scale deployment of SDN is still in its infancy.

Regional cloud factory

National network architecture normally comprises two or three layers, typically including access, aggregation, and core. Cloud infrastructure is also arranged in layers, which are normally local, regional, and national data centers. For both, layering is better for performance, scalability, flexibility, resilience, maintenance, and consolidation.

For example, each OpCo under a multinational telco usually has its own national network and platforms. With optical fiber reducing transmission costs, it's wise for multinationals to consolidate multiple national infrastructures into a cross-border international infrastructure. This concept – a common, unified, and converged platform – is referred to as a Regional Cloud Factory. For multinationals, it allows advantages like running a single VAS platform instead of one for each OpCo.

Although synergy benefits for pan-European or pan-African cloud factories are potentially huge, hurdles exist. These include regulatory constraints, data security, privacy, local customization versus regional content availability, and local versus regional support. For example, some services can be migrated to regional centers, whereas others might be best served locally.

Phase 2: Service migration

There are several strategies for implementing NFV and SDN and migrating services from legacy to new platforms. Each strategy must consider service criticality and the interdependence of multiple services. The main strategies are:

New service deployment such as

VoLTE with IMS and Bandwidth on Demand (BoD) services for enterprises.

End of lifecycle updates where legacy hardware and software need massive capacity upgrades, in which case it may be better to replace the platform.

Deploying a central SDN and NFV platform, which will allow big data analytics to provide new integrated services.

Unifying services to encourage the deployment of new, more efficient technologies.

Phase 3: End-to-end orchestration (EEO)

As independent but complementary technologies, both NFV and SDN can transform telco networks into software-based entities. But, network-wide applications with EEO on both technologies are necessary for the benefits to shine.

Orchestration yields the agility for operators to allocate network resources efficiently and cut TTM. Of the several initiatives to achieve EEO across NFV and SDN, Open-Orchestrator (Open-O) managed by Unix Foundation is a key one. First announced at MWC 2016, Open-O is a collaborative effort that aims to develop the first open source software framework and orchestrator for agile SDN and NFV operations. Although early applications of EEO are in place, such as China Telecom's Cloud VPN, the first release of Open-O is scheduled for September 2016.

Phase 4: Network slicing

Existing traditional mobile networks operate under a monolithic model where a single network carries out all services, with protocols such as DiffServ in IP prioritizing different services. But, the protocols tend to be piecemeal, not E2E.

Network slicing is documented as part of the NGMN's vision for 5G. The technology optimally arranges network resources for maximal cost-efficiency to satisfy new and diverse 5G service demands. NGMN defines slicing as E2E, including on core and access networks.

The new 5G air interface supports network slicing. On a core network, network slicing can be implemented separately or ahead of the new 5G air interface. Each slice is a logical self-contained network where a service runs on its own network slice; for example, one slice could be for video, one for IoT, another for critical communication, and so on. But, it's also possible to group multiple, similar services on one network slice.

Each slice is optimized for a particular service type and each is E2E, including the RAN and core. Unlike LTE, 5G air interfaces can be sliced dynamically or semi-dynamically. Several concurrent network slices can be deployed on a common physical infrastructure; for example, a critical communications slice would provide ultra-low latency channels while the IoT slice would deliver a massive number of connections.

Putting it all together

Network slicing is based on NFV and SDN technologies. Both NFV and SDN need to be overlaid with orchestration, on top of which EEO is required to coordinate the two. Telcos like China Mobile, DT, KDDI, KT, NTT, and SK Telecom are making moves into slicing tech, with NTT already developing a slice management system – a key part of the overall solution.

What can Huawei do?

Huawei is a leading provider of NFV and SDN technologies and continues to play a leading role in developing both. Providing products, solutions, and consultancy services for operators, Huawei Consulting is adept at helping telcos transform into the future – a future in which SDN, NFV, and network slicing on 5G networks are poised to deliver service rollout benefits that can greatly ramp up profitability.