Mobile communications networks have, traditionally, been developed and rolled out using a one-size-fits-all approach that provides for services to all types of devices, regardless of the connection requirements of vertical services. In the future, and especially in the emerging 5G domain, this just won’t do.

Operators will want, and need, to target a complex and wide range of differentiated services. One way of achieving this is by using the relatively new concept of network slicing (NS).

The idea is to allow operators to offer discrete virtual networks built on one, shared network, with multiple functional layers dedicated to each application or service type. The technology relies heavily on the concepts of Software Defined Networking (SDN) in the backhaul, Network Functions Virtualisation (NFV) in the mobile core, and network orchestration.

Proof of Concept (PoC) projects and some field trials,” Andy Corston-Petrie, Principal Researcher in the Converged Networks Research Lab in Martlesham told New Electronics.

The main goals, at least from the point of view of an operator, is the opportunity to roll out new service types for different sectors and for emerging applications significantly faster and more economically than has been possible in the past.

Efficient network slicing will, importantly, need some sophisticated orchestration capabilities that will reserve and allocate the virtual resources for slices in multiple domains.

One key technical issue being investigated at BT - and Corston-Petrie stresses throughout the industry - is exactly how to ensure this orchestration is smart and dynamic so that users can access the right resources at exactly the right time in each domain. After all, one of the drivers for 5G networks is the ability to integrate multiple services with wide-ranging performance requirements - for instance high throughput, low latency, very high reliability and fool-proof security. And all that in a single physical network infrastructure that provides each service via a customised logical network - that is a network slice.

“It is a very complex, exciting and fast moving area with a host of challenges, and it is vital that for it to succeed, the industry comes together as much as possible and work to make it a standardised reality,” argues Corston-Petrie.

More work is being carried out at BT into exactly how to slice the radio and backhaul domains, investigating where there will need to be partial slices as well as end-to-end slices (see Figure). There may also have to be slices for services that target administrative, security and regulatory domains.

Beyond that, industry needs to start addressing more advanced topics such as automation, machine learning, self-healing, self-optimising and real-time monitoring.

One of the initial conclusions that Corston-Petrie suggests is crucial to support the business case is that the benefits of slicing increase as the...
over the same period. There are in revenues of 15% could be expected
in dedicated resources, an improvement in revenues of 1.5% could be expected
over the same period. There are also significant benefits to be made
with the deployment of slicing when it comes to operational and capex
efficiencies, the report stresses.

R&D collaboration
The research within Corston-Petrie’s group will also link into a major R&D
project into slicing announced in June in collaboration with one of BT’s
major suppliers, Huawei.

He is also co-chair, with HPE’s
Marie-Paule Odini, of research
within the Facebook led Telecoms
Infrastructure Project that focuses
on End-to-End Network Slicing (E2E).
Launched late last year, the project
will deliver use case specific Proofs
of Concept across multiple vendors,
domains and operators, connecting
elements of UE to radio/access
networks, backhaul, mobile core
and the application/service provider.
One project aims to demonstrate the
capability to support at least four
simultaneous network sub-slices at
the UE level ported across two 4G
networks.

“We are looking to bring together
ideas and projects that are currently
not being followed within other
collaborative research projects in the
network slicing area,” said Corston-
Petrie, again emphasising his view
that collaboration is vital to make all
this happen.

Other companies involved include
operators Orange and NTT DoCoMo,
Airhop Communications and Finnish
start-up Cloudstreet.

Other projects, mostly backed
by EU funds, includes the 5G
Transformer activity, launched two
years ago, which focuses on the
management of network slices and
includes companies such as NEC,
Nokia, Ericsson, Telefonica and
InterDigital and numerous academic
institutions.

Another project, dubbed
MONARCH, which started last July,
focusses on cloud-enabled network
protocols and includes Nokia,
Huawei, Samsung and Real Wireless.

Bristol based Zeetta Networks, a
spin-out from the local university, has
already developed network slicing
software and protocols, and its NetOS
open source products are being used
in an E2E slicing project at Bristol
City’s Ashton Gate football stadium to
manage high density mobile use. The
slicing software is also being trialled
within the Bristol is Open smart city
test bed.

Also, in the mix is Mavenir
(Richardson, Texas) with a slicing
orchestration suite, dubbed
CloudRange, that is basically virtual
partitioning software that works
across the radio and core networks
and applications. And Affirmed
Networks, (Acton, Massachusetts)
is offering the Virtual Slice Selection
Function to 4G operators. This
software will steer traffic into slices
over both legacy, virtualised and
future multi-vendor networks.

Previously mentioned Cloudstreet
(Espoo, Finland) - which even brands
itself ‘the Network Slicing Company’ -
has recently been awarded patents in
both the US and Europe for underlying
technologies said to be crucial in
dynamic slicing and orchestration.
The patents, applied for 5 years ago,
were based on PoC demonstrators in
conjunction with Finnish carrier Telia
in Europe and the US Government’s
unified public safety network FirstNet.

“We are reaping the benefits
of early innovation in this exciting
area, and we intend to build
on this to pursue further advances
and commercial deals.”
Mika Skarp

“IT is a very complex, exciting
and fast moving area with a host
of challenges, and it is vital that
for it to succeed, the industry
comes together as much as
possible and work to make it
a standardised reality”
Andy Corston-Petrie

number of service types an operator
is looking to introduce grows. “So
there is economy of scale in slicing”.

Another clear but maybe less
palatable message is that significant
investment up front will be necessary
into automation to make a success
of this at scale, otherwise complexity
and operational challenges are likely
to mount up.

These and other results have
helped BT and Ericsson while working
on a major economic study published
late last year that attempts to
quantify the benefits of slicing in the
core network for both operators and
users.

Slicing was compared and
contrasted with two alternative
scenarios for new service
deployments: one was dubbed ‘one
big network’, the other ‘separate
specialised networks’.

The companies suggest that,
over a five-year period, the slicing/
automation scenario could generate
35% more revenue than the ‘one
network’ would achieve. Compared
with the idea of several networks with
dedicated resources, an improvement
in revenues of 1.5% could be expected
over the same period. There are also
significant benefits to be made
with the deployment of slicing when
it comes to operational and capex
efficiencies, the report stresses.
COVER STORY

NETWORK SLICING

(DPC), basically a sophisticated virtualised application function. “We have identified IPTV as an important first use case application for network slicing, and we are in discussion with several carriers regarding the opportunity,” said Skarp.

The Cloudstreet founder, who previously worked for Nokia, maintains the biggest obstacle to significant rollouts of NS—and indeed the bigger picture 5G—is the mind-set of many carriers who are procrastinating on how best to transition from the core, SIM-card based business model to selling differentiated capacity products.

“Undoubtedly, this is a huge change, but they need to consider the bigger picture and start taking maybe early revenue-generating ‘baby steps’ on 4G networks to reap the benefits that will come in the 5G era”.

Many of the major carriers and equipment makers are, to be fair, taking more than simply ‘baby steps’ into the NS area. Ericsson and NTT DoCoMo have been working on network slicing since 2014 and demonstrated two years later a PoC dynamic network slicing technology they suggest will work on 5G core networks.

The Japanese carrier designed the network slice creation and selection functions, while Ericsson developed the network slice lifecycle and service management protocols.

The Swedish group has also joined forces with SK Telecom in 2015 and have developed and deployed NS technology optimised for 5G services. The partnership also demonstrated ways to create virtual network slices specifically targeting services such as super multi-view and augmented reality/ virtual reality, massive IoT offerings.

Slicing automatically

Elsewhere and more recently, Huawei and Deutsche Telekom (both also early adopters and designers of NS technology) started a project that demonstrated how different networks slices can be created automatically and in an optimised way on a shared Radio Access Network (RAN), core and transport network.

Anders Rosengren, head of technology and industry engagement at Ericsson’s Digital Services unit concurs that the real opportunity for NS will only emerge within true 5G networks, but suggests it’s in PoC projects and trials has been, and for a while continue to be, of vital importance.

He notes that collaborative projects, such as the one recently announced with “forward looking” carrier Swisscom, will prove the case as the partnerships “anticipates” 5G like applications. The companies are testing RAN slicing and Quality of Service control, as well as Ericsson’s core network functionality to be able to configure dedicated slices for some critical use cases in the railways sector and public safety, as well as those targeting IoT and manufacturing.

“We are targeting, for instance, Gbit rate mobile broadband to be used in trains, as well as remote location. At the other end of the scale we have a set-up monitoring and remotely controlling machines that require extremely low latency but very high reliability,” Rosengren told New Electronics.

When asked if they were disappointed that such core network developments have received less attention than, for instance, the progress, publicity and standardisation efforts with the radio access side of the equation or mmWave links, all three interviewees concurred that the 5G NR emphasis was understandable since that had to be the catalyst that triggers other crucial 5G infrastructure advances.

And now that 5G NR specifications are up and running, not surprisingly, all three are keen that NS grabs the technological and business opportunity.

Not that this will be easy. There are, as suggested, many unanswered questions in the NS area, not least exactly how operators can – will –deliver the capability. There is a big debate and little consensus over just how many slices—whether horizontal or vertical—may be needed or sensible. And whether every vertical sector, such as healthcare, IoT, automation, automotive or entertainment will need or want its own slice.

And perhaps the biggest conundrum, for equipment makers, carriers and potential users, is exactly when all this is going to happen—since the opportunity clearly depends on everyone delivering on the promise of 5G.