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Asia is a booming market with its own unique challenges, but it continues to set the pace for fibre rollout and mobile users

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Asia is a continent that tests to its limit the telecoms industry's ability to span borders and shrink geographic distances, as players grapple with a broad range of challenges and needs. There is no doubt that it is a booming continent. In the fixed broadband market alone, Asia is the fastest-growing region by connections in the world, according to the Broadband Forum, increasing by 16.2% during the first quarter of 2011. Asia's 226.4 million broadband connections already represent 42% of the global total.

This is in a continent where vast numbers of consumers in countries like India and China will experience the Internet for the first time via a mobile device. "It is a very challenging position to be in," said Bill Barney, CEO of network operator Pacnet, during CommunicAsia in Singapore in June. "Asia is too big, too different and too diverse," he continued. "There are first-world and third-world countries within 20 miles of each other."

Asia is too big, too different and too diverse

In fact, within a convention hall's distance of one another Japan's NTT DoCoMo was outlining its plans to extend NFC services to South Korea to cater to the demands of international travellers, while India's VNL was explaining how its solar-powered base stations deliver basic WiFi and GSM services to rural communities (see p.18 for our article on sustainability in telecoms).

Connecting all these seemingly disparate Asian markets to the world at large is a huge web of subsea cable systems that are vulnerable to the high levels of seismic activity in the region, and the rising volume of shipping as intra-Asian trade is driven by local economic growth.

Fibre networks will play a major part in that growth. European countries would do well to follow the fibre lead of countries like Japan and Korea; but as our stories on p.7 and p.10 show, many Western nations have a long way to go to catch up as operators grapple with the economics of business models.

Asia's mobile operators face many network challenges as subscribers soar, and self-organising networks could play a part in managing their infrastructure in future (p.14). But Asia-focused telcos face other unique challenges. According to Pacnet's Barney, if March's earthquake off the coast of Japan had struck 35 miles further south, Asia would have lost 80% of its connectivity to the US. "The successful [business] model for Asia is going to be very different from the rest of the world," concluded Barney. ■

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SELF SERVING

Self-organising networks promise to help mobile operators simplify the management of their infrastructure and to control costs, but challenges remain. **By Roy Rubenstein**

Mobile networks are becoming so complicated that operators are turning to self-organising network (SON) technology to help with their management. Proponents say that only by using SON technology will operators be able to manage and optimise their networks without operational costs spiralling out of control; in addition, the ability to optimise the network in real time could considerably benefit operators' revenues.

One operator which has implemented SON across part of its network has already added 29,000 new subscribers and reduced churn by 7,000 users in a year, according to consultancy Solution Matrix. That could lead to considerable revenues and a payback period of less than one year (see table below).

But there is a mismatch between what wireless operators want in terms of SON and what vendors are offering. SON technology is part of the Third Generation Partnership Project's (3GPP) Long Term Evolution (LTE) standard, and vendors are focusing on SON for LTE. Yet operators want SON to span all their networks including 2G and 3G.

Telekom Austria has assessed the SON offerings of five vendors. "What we have learnt is [that] SON is a fabulous experience in 4G [LTE]," says Armin Sumesgutner, head of network planning at Telekom Austria. "What we haven't seen so far is the full integration across a single radio access network." Currently, Telekom Austria is adopting a single radio access network (RAN) architecture where only one vendor's equipment is used at a site. This allows for optimisation across the wireless standards, both for SON and in terms of such issues as antenna design and site power consumption.

Vendors have invested their R&D dollars preparing for LTE and view additional investment in SON for 3G as wasteful, says Johannes Ritter, a partner at Solution Matrix, which has worked on SON with operators including KPN, T-Mobile and Vodafone. "Operators [only] want to buy what nobody offers: SON end-to-end for voice and data on 2G, 3G and LTE," he says.

Potential savings through self-optimising network deployment

Year 1 figures only	Self Optimising Network (SON)
Increase in gross adds (subscribers)	29,000
Reduced churn (subscribers)	7,000
Revenue per subscriber	€220.00
Revenue increase due to new gross adds	€1,540,000
Revenue increase due to churn decrease	€6,380,000
TOTAL INCREASE IN REVENUES	**€7,920,000**
Gross margin percentage	40%
Gross margin	€3,168,000
Total number of node Bs	8,000
Percentage of node Bs saved	5%
Number of node Bs saved	400
Capex and Opex saved per Node B	€48,000
Capex and Opex saved	**€19,200,000**
SON hardware Investment	€12,000,000
SON software Investment	€5,000,000
EBITDA	**€5,368,000**
Return On Investment (ROI)	**32%**
Payback period in years	**0.9**

Source: Solution Matrix

Moreover, SON has limited value to operators currently: LTE is only now being deployed, and optimisation requirements are limited because those networks are lightly loaded. "All the issues around coverage, bandwidth, utilisation, optimising between neighbouring cells to avoid interference—all the things SON can do—are currently not a pressing problem in LTE," says Ritter.

SON enables the fine-tuning of parameters to enable optimisation of a network's capacity and coverage, says Kamakshi Sridhar, director of the wireless CTO organisation at Alcatel-Lucent. The adaptation is performed by algorithms within the base station that use measurements from end terminals.

"One aspect of LTE that makes it suited to SON-like algorithms is that more intelligence is pushed into the base station," says Sridhar. "There are now more opportunities to automate what was previously done manually." There is also a specified interface between base stations that aids information sharing.

The operations, administration and management (OA&M) systems of an operator are used to configure the network's initial policy and parameters to ensure it starts up in a defined state. The SON algorithms, distributed across the base stations, then provide key performance indicators to the OA&M systems.

Using the indicators, the OA&M system decides whether to expand or contract the boundary conditions within which SON operates. "There is an inner fast [SON control] loop between the terminals and the base stations, and a slower outer loop set by the OA&M," says Sridhar.

Operators already have two decades of experience in optimising their networks manually. "The main difference [with SON] is that these [network planning] algorithms have been done outside the network on standalone hardware," says Yves Bellégo, manager for network technical strategy at Orange. "The algorithms

do not work in real time and do not use feedback from the network—from the device and the base station."

Many operators view SON as a key development that puts real-time expertise into on-site equipment. They say this will help them to contend with growing network complexity while also benefiting service quality.

"This [SON] is a big area and there is a lot to be gained from it," says Tommy Ljunggren, vice president, system development, technology solutions, business area mobility at TeliaSonera.

"Mobile systems are becoming so complex that we can't have an engineer looking at every site, every day," says Bellégo. "If we do not have SON we have to rely on our optimisation engineers, and since the systems are becoming so complex solving any on-site issue will take time."

Moreover, SON also benefits operators' revenues if they are able to convince users to upgrade to LTE and more advanced data services. "Such optimisation improves user experience," says Bellégo. That is a vital consideration for Orange which wants to ensure that users' experience of LTE is superior to the services they have been used to. "When we launched 3G, there were difficulties; the performance was not good enough," says Bellego.

An example benefit of SON is the automatic neighbour relation (ANR) between base stations. When a terminal discovers a new base station's signal, it forwards the information to its existing base station and that initiates the setting up of neighbour relationships.

Ericsson first demonstrated ANR using a chipset from Qualcomm and TeliaSonera's live network in November 2010. "After only a 20-minute drive test the network had established the vast majority of the ANR that had been manually planned prior to that," says Thomas Norén, head of LTE at Ericsson. "We did not drop one single call. Had there not been any neighbour relations prior to that, no user would have noticed."

Without ANR an operator must first plan the network to establish the desired relationships. This is then verified using a drive test that identifies any spots in the network where calls are dropped due to an absence of a relationship between base stations. A second network planning iteration is required, as is a further drive test. "We consider the ANR feature quite important as a missing neighbour relationship is a typical source of non-quality," says Bellégo at Orange.

SON will also benefit the ability to introduce heterogeneous cells in LTE (*Total Telecom+, July 2011*). "One thing making things more complicated is that as we go to small cells there are a lot of different interference scenarios that are not typical of macro cells and that are going to need to be understood," says James Seymour, senior director of the wireless CTO organisation at Alcatel-Lucent. "With optimisation techniques we can let the system manage itself."

For heterogeneous cells to work requires well-defined SON standards to ensure interoperability between different vendors' equipment. "One of the more advanced SON algorithms is inter-cell interference coordination," says Steve Bowker, CTO of Aircom International. "If people are rolling out heterogeneous networks, [the cells] have to operate across that boundary and co-ordinate interference; interoperability is key if the SON is to work."

Despite such benefits, operators are concerned that SON does not cover their 2G and 3G networks, which are still their main assets. "The operators have a problem to solve and in the next few years the networks will reach their peak of complexity," says Neil Coleman, director of marketing at network analytics and optimisation company Actix. "They are managing multiple networks and their need for reducing services effort in the networks is here, and it is really not being serviced by vendors and by the standards committees." This, he argues, opens the door for independent software vendors.

Large vendors also acknowledge operators' needs. "SON needs to cover multi-technology networks; it can't be limited to LTE only," says Outi Keski-Oja, product line manager, network optimisation, at Nokia Siemens Networks. "This is one area where the vendors'

SON standards: 3GPP defined use cases

Abbr.	Scheme	Description
CCO	Coverage and Capacity Optimisation	Optimises cell coverage and capacity for idle and active users in downlink and uplink per evolved UTRAN Node-B (eNB) in terms of Quality Class (QCI)
ESO	Energy Saving Optimisation	Switches off part or all of an eNB to save power usage (cost); reactivates when needed for capacity
IR	Interference Reduction	Identifies sources of interference and manages power reductions e.g. switch of home eNB when user not home
PCI	Automatic Physical Cell Identity	Automatically allocates Physical Cell Identity (PCI) — collision free (PCI unique in an area) and confusion free (neighbouring eNB PCI are unique)
MRO	Mobility Robustness Optimisation	Reduces handover (HO) related radio link failures, through optimal configuration of HO parameters to avoid too early, too late and wrong cell handovers
MLB	Mobility Load Balancing	Optimisation of cell reselection and HO parameters to balance load between LTE cells and between different radio access technologies
RO	RACH Optimisation	Minimises Random Access Channel (RACH) power and delay through optimisation of RACH parameters
ANR	Automatic Neighbour Relations	Optimises neighbour list as plug and play feature for optimised HO. Also provides self healing for self or adjacent cell/site failure
ICIC	Inter-Cell Interference Coordination	Co-ordination of radio resource management functions between cells to control inter-cell interference

Source: Aircom International

Self-organising networks: the development stages

There are three main elements that make up SON: self-configuration, self-healing and self-optimisation. Self-configuration adds functionality to simplify network deployments while self-healing enables a base station to undertake fault detection and fault recovery. "In 2G and 3G networks over the years, a hardware fault in a base station has required a manual restart," says Keski-Oja at Nokia Siemens Networks. "Now as part of the self-healing, this reactivation is done in an automated way after certain alarms are raised." Meanwhile self-optimisation, the largest of the three categories, incorporates features that set the optimal values for the network elements as part of the trade-off between coverage and capacity.

The main SON efforts in 3GPP Release 8 focused on simplifying network configuration. These include automatic neighbour relation (ANR) where a newly deployed base station is made aware of its neighbours based on terminal input. Other features include auto cell ID planning and 'plug and play'. "Each base station needs a separate cell ID to not interfere with each other," says Alcatel-Lucent's Seymour. "Plug and play figures out what IP address the base station should have." These are tasks that previously have been performed manually.

The SON focus in Release 9 is network optimisation. For example, base stations can communicate their respective loads to enable traffic balancing between 3G and LTE networks. There are also mechanisms to improve user cell handover performance. Network optimisation is extended further in Release 10 to improve coverage and capacity. Alcatel-Lucent is pushing for features to be added to Release 10 to extend SON into the core of the network to benefit the user experience. For example, SON could decide which network—WiFi, 3G or LTE—to place a user based on factors such as their profile and applications they are using rather than solely air interface considerations. "If I [an operator] have a Gold User, I may never want to put them on 3G," says Seymour.

stories vary a lot; we provide SON functionality for all these technologies."

Providing SON across a vendor's wireless standards equipment helps, but Telekom Austria stresses that its networks use technology from multiple vendors. "What we don't see is an approach of interworking," says Sumesgutner. "This is a big issue, because what it takes is full optimisation and this can't be achieved with the existing tools we have from the vendors."

One way to manage multi-vendor equipment is by adding an extra vendor-independent layer. "The vendors have no interest in that [extra layer] as it would be the kiss of death [for them]," says Ritter at Solution Matrix.

Actix provides SON functionality to NEC, but it also provides a layer above SON. "We provide an abstraction layer which allows operators to focus on the overall network quality as experienced by subscribers rather than focus on vendor-specific technology issues," says Dirk Stachorra, SON product manager at Actix. Here SON elements are monitored and used as input for a broader network optimisation, such as maintaining quality while minimising manual effort, and where decisions are made over a longer timescale than SON.

Third-party network optimisation players such as Actix and Aircom have a role here, says Ritter, but the deepest understanding is what happens within the hardware and that is the equipment vendors' domain; only so much can be done with standards-defined interfaces coming from the hardware.

Yet if operators are denied the full picture, there are additional techniques they can use, says Ritter. One is to insert probes and use active testing in their networks. Both provide extra information and reduce operators' need for drive tests, also a key goal of SON.

"Drive testing is expensive: up to €400,000 per test," says Ritter. Moreover, a drive test only covers a specific area and is by definition retrospective. "You may do it only every nine months because of cost and that is too late," says Ritter.

Active testing places a hardware device in the network to simulate customer behaviour, but this too is expensive. Several devices are needed in base stations across a country if dropped calls, coverage, bandwidth and latency issues are to be monitored across the network.

In a 3G network probes are used with the radio network controller (RNC) to measure traffic in real time. Typically, 40 RNCs are needed per operator, per country. Using probes and active testing, operators can eliminate most drive testing while optimising their 2G, 3G and LTE networks. "[By doing that] they could get a SON—maybe not fully automated but much less manual than now," says Ritter.

Indeed, that would be vastly superior to many operators' current setups. Solution Matrix says one small European operator has been identifying bandwidth and dropped call problems only when complaints at its call centre rise above a certain threshold. "They then send out a guy to measure," says Ritter. Even the largest European operators only have probes in 40% or 50% of a country, covering 80% of the traffic.

Ritter advises operators to adopt SON in stages. "They can optimise an area and end up deploying a lot less equipment using SON," he says. In his company's operator example for a typical LTE network, based on 8,000 eNodeB base stations, SON can reduce the total needed by 400 (5%). Assuming each base station costs €40,000 and the same amount again is spent in operational expenses over five years, the SON-related savings equate to €32 million (see table p.14). "SON does this; humans can't. Tuning each cell and countering interference [manually] is like playing 3D chess," says Ritter.

Another SON challenge is that only self-configuration is active so far; self-optimisation is still to be proven in a large, live network. "Self-optimisation routines within the equipment itself are not live yet," says Bowker at Aircom. "Vendors are trialling things but none of the commercial deployments are using self-optimisation."

Operators must also ensure that handsets incorporate support for SON. "The situation now is that the network is a little bit ahead of the devices on many things," says Ericsson's Norén.

These practical SON issues will preoccupy operators for some time. But longer term, they expect SON to broaden its scope and optimise users' service experience. "We are in the starting phase: a lot of technology and network planning issues," says Sumesgutner at Telekom Austria. "But we also see the necessity for a broader set of parameters to be recognised and optimised by the [SON] system [to enhance user experience]." ■