

Accelleran dRAX™: Dense Networking for the 21st Century

THE CHALLENGE

Much has been written about the challenges facing the wireless industry in the age of ubiquitous smart mobile devices and massive connectivity. The scale of the challenge is not to be underestimated –reference is often made justifiably to a fourth industrial revolution.

Almost everything to do with the regulation, financing, design, construction and operation of wide area wireless networks needs to be rethought and re-engineered if we are to deliver a commercially viable infrastructure which meets the kaleidoscope of needs and use cases envisaged for the 5G era.

John Donovan and Krish Prabhu (respectively CSO and CTO at AT&T) have recently argued in their introduction to Building the Network of the Future (CRC Press, 2017) that telecommunications service providers can simply no longer afford to continue to build their networks from hardware-based “black-boxes”. They provide three key reasons for this:

- Lengthy development cycles delay bringing new service to market
- Resulting in:
 - Vendor lock-in which stifles innovation and results in an inability for the network to benefit from falling technology costs in
 - Over-provisioning of network resources due to long deployment timescales

Set these challenges against the expectations which the industry is setting for enhanced Mobile Broadband:

- Average data rates per device around 50Mbps
- Peak speeds to 1Gbps to multiple users
- Massive MTC connectivity
- mmWave connectivity
- Low latency communications

These fundamental economic and market-based challenges drive two of the most significant characteristics of the next generation network which will be cell site densification – driven by the exponential increase in capacity needs – and network function virtualization – driven by the need for cost-effective, agile delivery of bespoke services to a range of different user groups. Capital costs of deploying massively dense networks have to be reduced to levels approaching those which have enabled the global success of WiFi, while traditional “Five 9’s” service assurance and availability levels have to be achieved to recognize the critical role that these networks increasingly play in the national economy and in supporting safety critical systems. Rapid and low cost deployment, automated network monitoring, analytics and optimization as well as enabling a breed of new ecosystem players and business models play an essential role in achieving these objectives cost-effectively.

Accelleran is leading the way in developing the future network with dRAX™ – delivering real-world solutions today in 4G and Advanced 4G and working at the forefront of global initiatives for 5G and network virtualization such as ONF M-CORD and Facebook TIP. This white paper will set out the vision for 2020 and beyond towards which we are working today.

THE dRAX™ VISION

We are at an important crossroads. Above and beyond the sound and fury of marketing hype and inflated expectations which inevitably surround a major investment cycle in a global industry, it is possible to identify some clear, achievable technical objectives which are essential to success. We believe the following criteria are among the most vital.

CORRECTNESS AND RELIABILITY

Modern cellular networks are extremely complex systems. Just one look at the key standards is enough to show the scale of the challenge - the RRC control plane protocol specification for R14 LTE is now over 700 pages long. Ensuring the correctness of radio access network implementations over a full range of operational scenarios is an engineering challenge comparable with delivering the most advanced systems in aerospace, if it is to be done right. Stepping up to this challenge is core to Accelleran’s DNA.

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The mean time between software failures – defined as a failure to provide a requested service due to an error of software implementation – must be measurable in months and years, not days. There are no short cuts, no silver bullets other than world class software engineering and relentless testing and validation through world class automated testing frameworks and processes which we apply to all our production code.

CLOUD NATIVE

Accelleran software was cloud native avant la lettre. The principle of microservices delivering well-defined functionality behind clean interfaces has always been central to our approach, even when the software was destined for an embedded product. Migration into a virtualized, multi-vendor environment is a natural progression for us. We are enthusiastic players in this new and exciting ecosystem.

NETWORK SLICING

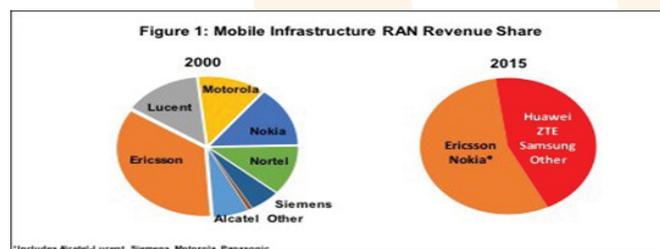
Network slicing, multi-tenanting and neutral hosting are concepts which are as much about changes in the regulatory, ownership and operational models of radio networks as they are about technical solutions. Accelleran recognizes the importance of delivering robust technology which supports new business models vital for encouraging the deployment of private LTE and dense in-building and urban solutions. We have RAN slicing and multi-operator solutions in the field today and we continue to invest in developing these capabilities.

VIRTUALIZATION AND ARCHITECTURAL INNOVATION

Network Virtualization brings with it the freedom to bring real architectural innovation to the Radio Access Network. There is a very clear tension between the advantages of centralization for the efficient management of scalable resources and the pull towards distribution of network assets to deliver low latency services with localized content. The truth is that there is no one-size-fits-all approach -virtualization must enable network operators to deploy and adapt appropriate solutions to meet the local need. Novel approaches to distributing network functions – potentially with dynamic redistribution depending on conditions, separation of user and control plane functions, opening up of the radio basestation black box to enable optimal management of spectrum and user experience are all realistic and achievable goals supported by the latest virtualization frameworks such as ONAP. Accelleran believes that the edge cloud will be a vital part of the future network, supporting not only network functions but providing an important platform for localized Multi-Access Edge services.

ECOSYSTEM DISRUPTION

The marketplace for telco infrastructure equipment is historically dominated by a small number of multinational companies. The trend has been for the merger and acquisition process to steadily reduce the number of dominant players.



Network virtualization is all about breaking down the market dominance of the telco black box vendors. By commoditizing network hardware and enabling a genuine market in NFV software components, the operator community is avowedly seeking to shake up vendor dominance and to encourage smaller, innovative entrants to bring best-in-class software solutions into play.

Virtualization will be a key element to reduce current TCO models, not only by ecosystem disruption but also by reducing Opex (Site lease, Operations, Back- and Fronthaul) and Capex (RRU, Installation, Site acquisition).

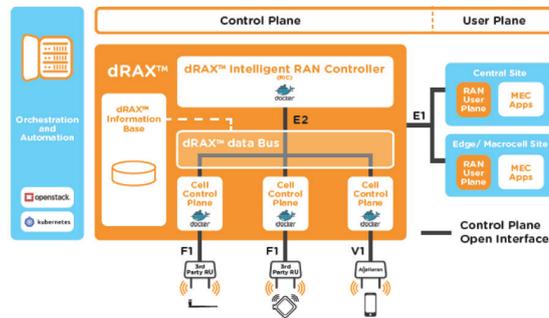
EVOLUTION TO 5G

Today few people can honestly say they know what a 5G network will be. What we can be sure of is that there is plenty of life left in 4G and Advanced 4G technology. Indeed, LTE Advanced Pro standards are capable of coming close to many of the objectives set out for 5G. Virtualisation and RAN Slicing techniques are as applicable to 4G as they are to 5G NR. NB-IoT enables massively scalable M2M communications. Gigabit LTE can make use of sub-6GHz spectrum which is available today. Cost effective and performant LTE Small Cell and RRU technology is in the market and in production. There is no need to wait – we can create the future with the tools we have in our hands today.

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ACCELLERAN dRAX™

dRAX™ delivers on the promise of a virtualized, carrier-grade 21st century RAN. Leveraging our long experience of RAN software development, Accelleran is leading the way towards a dense and programmable virtualized RAN.

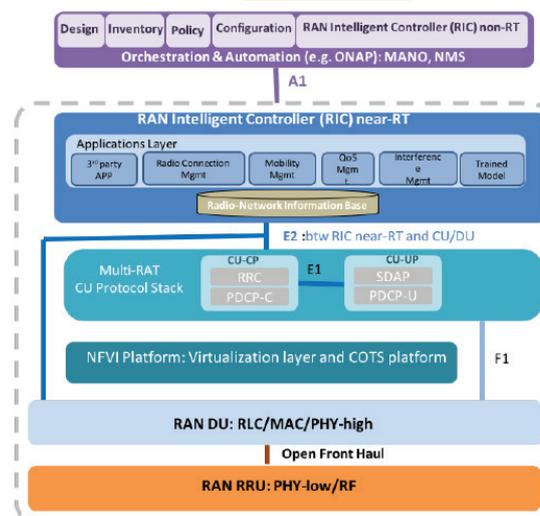


An ecosystem which delivers genuinely cloud-native VNF's is vital enabler for the vision of an agile, multi-vendor, continuous-deployment network. Central to the challenge of creating such a network and to avoiding single vendor lock-in, is a set of high quality control plane VNFs which are architected against open APIs to deliver plug-and-play interoperability. Our high reliability, carrier-grade control plane was originally developed to solve this problem for classic, embedded eNB Small Cells. The design approach we took for the embedded solution – to provide silicon, OS and user plane stack independence – was originally conceived to solve supply chain lock-in concerns, but it turns out the ideas we developed to solve the embedded problem map perfectly into the network cloud. Accelleran dRAX™ is the result - a field proven and highly portable VNF library. We have proven interoperability with 3rd party technologies:

- Layer 2 stacks
- Small Cell and RRU Silicon
- User Plane acceleration
- SAS servers

ORAN AND THE VRAN ECOSYSTEM

Accelleran is committed to a multi-lateral Vran ecosystem building on and collaborating with leading industry collaborations. Through our participation in consortia such as ONF M-CORD and the Telecom Infra Project we are trialling leading-edge features such as Network Slicing and multi-tenanting with our lead customers today. Accelleran is also proud to be a member of the ORAN Alliance. We strongly support this initiative to build on and extend the work of 3GPP and enable a truly multi-vendor open RAN architecture. We believe that, since truly effective RAN optimisation and automation requires real-time access to a large and complex dataset, the establishment for open standards for data sharing is an essential prerequisite for success.



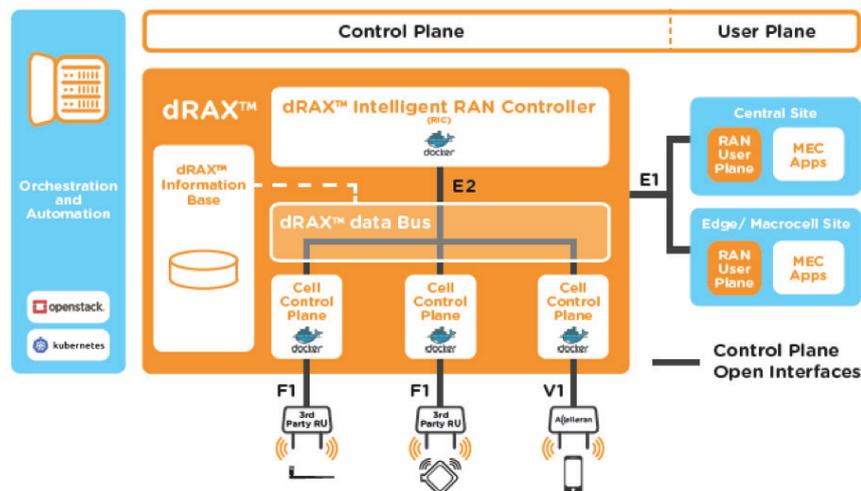
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MICROSERVICES, DISAGGREGATION AND SCALABILITY

dRAX™ is characterized by microservice components with well-defined APIs and service boundaries. We go well beyond most implementations that we are aware of, by decomposing the design of RAN control software into a set of collaborating components. The advantages of this approach are numerous:

- Fine grained control of function lifecycle management and scaling
- High levels of testability
- Transparency of operation and issue analysis
- Fault resilience
- Ease of integration with external systems

Virtualisation of the RAN brings with it opportunities for architectural innovation. In particular, we have implemented cell cluster resource management capabilities into the framework. This approach allows for a smarter, more optimal, approach to radio resource management in dense environments than the classical black box eNB. Admission control, mobility decisions, interference management can all be managed much more effectively by a network function with a more global view of the network than just one cell or cell site. Measurement data from each cell and connected UE is shared via a publish-subscribe framework based on open standards – supporting Accelleran’s RRM implementations, but also enabling rapid integration of alternative or additional features requiring deep real-time knowledge of network conditions. Based on this foundational framework, Accelleran is collaborating with industry and academic partners to explore the potential for this approach for new resource management strategies and algorithms.



Control - User Plane separation is supported out of the box, enabling location independence between RAN control functions and the user plane functions serving any specific user. In real world networks with multiple distributed aggregation points, the specific location of the user plane termination can be chosen based on the user identity or the service requested. This drives efficiencies in the use of network resources for access to edge applications, for example.

The extension of dRAX™ to support 5G NR is ongoing. Our initial approach is to extend the existing 4G control plane to support a non-standalone 5G NR deployment alongside a 4G RAN and EPC. This is achieved through the implementation of a gNB Central Unit VNF which plugs into the microservices framework. Through support of the standardized F1 interface, this enables our vRAN and 4G solution to support any 3rd party gNB Distributed Unit implementation. Of course, fully native 5G Core Network support can be added as a further step in the future. dRAX™ supports an Option 2 stack split (above RLC). In the future we aim to work with partners to add virtualized, vendor-independent RLC-MAC capabilities to our portfolio, delivering a split 6 (nFAPI) capability or, through integration of higher layer PHY options, a split 7 (split PHY) solution. Once again our vision here is that the choice of the right vRAN architecture is one for our customers, not for us – our framework must provide the flexibility for the Dev Ops and network architecture teams to choose the right deployment approach to suit each situation on the ground.

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ORCHESTRATION AND ANALYTICS

A huge amount of industry effort is being devoted to network orchestration standards and frameworks - eg ETSI MANO, OPNFV, CORD and ONAP.

These initiatives are realizing the building blocks of the future network by applying proven technologies from the datacenter to telecommunications networks. The capabilities provided by such frameworks catalyze network transformation:

- Metadata-driven service design
- Layered infrastructure, NFV and service orchestration
- Failure management and service continuity
- Big Data analytics
- Policy driven network automation

Being cloud-native means designing network functions which embrace these technologies and make full use of the power they provide to deliver exceptional end-user experiences. Services which adapt and scale to demand, network load and resource availability to deliver QoE while optimizing the use of network assets.

dRAX™ is container-based and integrated with mainstream virtual environments such as Kubernetes and Openstack.

Accelleran's core focus is to bring innovative, cloud-native software solutions to market and to work with the rapidly evolving telco ecosystem to enable high-quality end-to-end solutions, without necessarily waiting for the 5G nirvana to be fully defined. Our approach is bringing value to our customers and partners today.

ACCELLERAN TEST CONFORMANCE TESTING

RAN disaggregation and multi-vendor service chaining opens exciting possibilities for a new era of dynamic network service innovation. At the same time it brings significant system integration and validation challenges as the proprietary black-box is prised open.

As an essential part of our commitment to quality, Accelleran has developed a unique software-based wrap around test and conformance solution for RAN virtual functions. Based on industry-standard TTNC3 technology, dRAX-TEST enables fully automated, rapid and comprehensive protocol conformance and regression testing of RAN NFV components against published interoperability specifications. Message sequences are validated at bit-level and non-conformances easily identified and traced. Using dRAX-TEST to pre-validate individual VNF components before integration of service chains dramatically shortens network integration cycle times, leading to predictable delivery schedules and robust and reliable outcomes.

CONCLUSION

Accelleran is walking the vRAN talk and is showing unique technology for a dense and programmable network.

Our technology is been trialed in different Tier 1 and Tier 2 operator labs and live on the streets of Barcelona, Bristol and Lucca as part of the H2020 5GCity project.

5GCity has designed, developed, deployed and demonstrated, in operational conditions, a distributed cloud and radio platform for municipalities and infrastructure owners acting as 5G neutral hosts. For Details on the the Program's Objective see <http://www.5gcity.eu/objectives>.

