



# CENTRALIZED SELF-ORGANIZING NETWORKS (C-SON): ESSENTIAL FOR M2M & IoT

WHITE PAPER

## ADDRESS THE CHALLENGES AND REALIZE THE POTENTIAL OF MACHINE-TO-MACHINE AND INTERNET OF THINGS

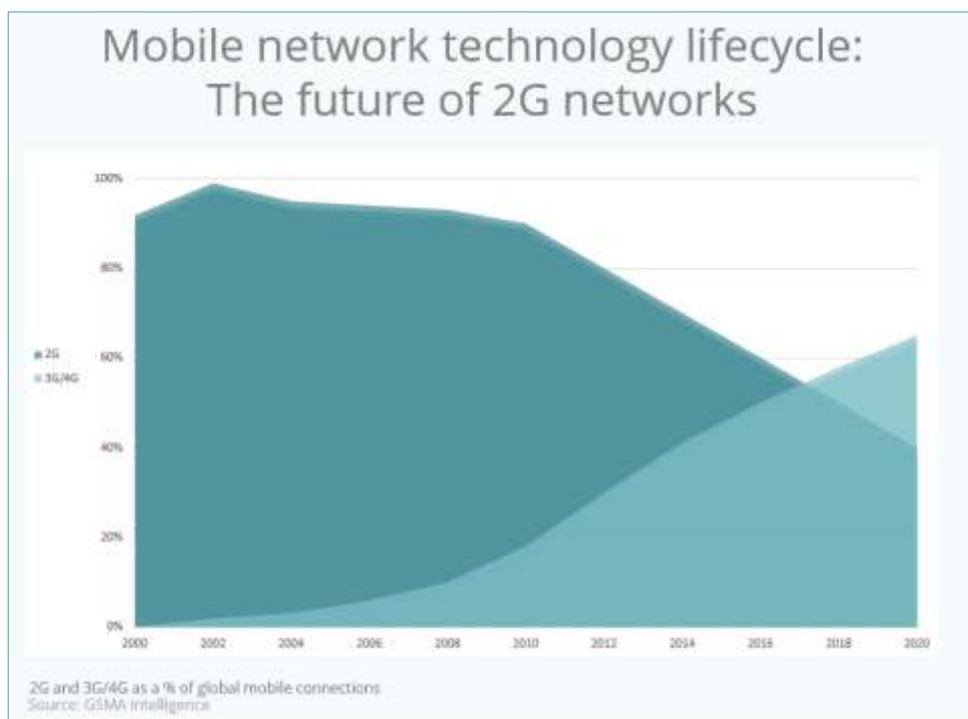
Mobile Operators facing challenges in meeting SLAs of M2M/IoT services, much of which uses 2G connectivity, can turn to C-SON to ensure the provision of SLAs by overcoming congestion and coverage challenges. C-SON for 2G - in addition to 3G and 4G/LTE - is a reality today. Adding big data to SON capabilities can bring even more benefits.



## EXECUTIVE SUMMARY

Much has been written about Machine-to-Machine (M2M) and “Internet of Things” (IoT). It is clear that connected devices will continue to proliferate and bring many dramatic changes to our world. A staggering number of devices are forecasted to be ‘online’ by 2020 and many – if not most – of these will use mobile communications networks as part of their overall service delivery.

As much as M2M and IoT represents an exciting opportunity for mobile operators to both use and monetize capacity, that opportunity is not without challenges. Most M2M traffic today works on 2G networks, but with time M2M devices will work on all the mobile technologies and evolve as these technologies emerge. This paper examines some of the network-based challenges and discusses Self-Optimizing Network (SON) solutions as a way to address them. However, most SON solutions on the market today do not handle the 2G network, which is the infrastructure of much of today’s M2M/IoT traffic – and will continue to be for some time. One Centralized SON (C-SON) solution offers a holistic, cross-technology approach, providing optimization capabilities for all networks: 2G, 3G and 4G/LTE. Cellwize is the ideal partner for M2M. Cellwize elastic-SON™ brings the benefits of C-SON to all technologies, including 2G, addressing the common challenges of network congestion and poor coverage that can be associated with an operator’s M2M/IoT traffic today, and offering a path forward as devices evolve to 3G and 4G/LTE networks.



40%  
OF MOBILE  
CONNECTIONS IN  
DEVELOPING REGION  
WILL STILL BE  
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NETWORKS BY 2020  
COMPARED TO LESS  
THAN  
10%  
IN THE DEVELOPED  
REGION

# CONNECTED EVERYTHING

It is clear that mobile communication has transformed the way people live, work, interact, access information...and even how they play! The rise of mobile infrastructure has also been one enabler fueling the rise of communications between devices – commonly called Machine-to-Machine - as well as other ‘smart’ applications like smart grid or smart cities. Connected vehicles, buildings, medical monitors, TVs, game consoles and other consumer electronics and appliances will increasingly be connected wirelessly and intelligently, communicating and interacting with each other, thereby creating a connected life. This scenario has been termed the “Internet of Things”, the “Internet of Everything”, “Smart World” and the “Connected Life”.

Regardless the phrase used to describe it, this dramatic evolution of technology, again fueled in part by mobile technology, represents opportunities on several fronts. Gartner Research predicts that the Internet of Things (IoT) will include 26 billion units installed by 2020. IoT product and service suppliers will generate incremental revenue exceeding \$300 billion, mostly in services, in 2020. It will result in \$1.9 trillion in global economic value-add through sales into diverse end markets<sup>1</sup>. IDC is more bullish on the market potential, but notes that collaboration and coordination will be necessary to reach the 30 billion autonomously connected end points and \$8.9 trillion in revenues that it believes IoT will generate by 2020<sup>2</sup>. IDC also expects to see new industry partnerships emerge as traditional IT vendors accelerate their partnerships with global telecom service providers and semiconductor vendors to create integrated offerings in the consumer electronics and connected device spaces<sup>3</sup>.

Mobile networks - from 2G through LTE and beyond - play, and will continue to play, a pivotal role in the development of IoT, providing a scalable, global platform to support the growing demand for connectivity. But with the increase in network size, complexity and cost, operators need to consider optimization approaches to best manage their network for M2M/IoT. In addition, operators can - and should - pursue a wider role in the M2M/IoT value chain. Like IDC, the GSMA notes, “Beyond connectivity, mobile operators will play a crucial role in working together with a range of industry partners in health, automotive, education, smart cities and a range of vertical industries to accelerate the launch of valuable connected services. Mobile operators have the opportunity to generate value beyond basic connectivity through managed connectivity, stewardship services and platform innovation<sup>4</sup>.”

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<sup>1</sup> Forecast: *The Internet of Things, Worldwide 2013*, Gartner Research 18 November, 2013

<sup>2</sup> *IDC Predicts 2014 Will Be a Year of Escalation, Consolidation, and Innovation as the Transition to IT's "3rd Platform" Accelerates*, IDC press release December 3, 2013

<sup>3</sup> *ibid*

<sup>4</sup> Ana Tavares Lattibeaudiere, Head of Connected Living, GSMA. *Connected Life*

# CONNECTION COMPLICATIONS?

With the explosion of device (or “thing”) connectivity - much of it over mobile networks - come challenges. With billions of devices communicating, the potential for network congestion seems an obvious challenge. Data bursting, as when an alert or emergency situation occurs, can add unexpected - and unpredictable - load to the network. While faster networks such as 3G and 4G/LTE may lessen these issues, many M2M devices and modules in use today have modems and SIM cards that work with 2G networks only. These will not get swapped out anytime soon for both logistical and business-case reasons. In addition, the pace of evolution to 4G/LTE is different in each geographical region. Both of these facts mean that 2G networks - especially GPRS/EDGE - will remain a part of the M2M/IoT ecosystem for some time to come.

Of course, 2G networks are not used for M2M alone. The situation often occurs in which data traffic on an operator’s 3G network “falls back” to the 2G network, due to 3G coverage holes. In this case, contention starts to occur on the data bearer of the 2G resources, affecting M2M/IoT traffic, potentially to the point of missing Service Level Agreements (SLAs) associated with the M2M service.

Some M2M/IoT applications require adherence to strict SLAs in order to deliver on their value propositions. This is most obvious in medical situations, but could also be the case for applications like fleet and asset management where large dollars may be at stake, or credit card payments for taxicabs where a taxi could move out of coverage. Other M2M services may not be so mission critical, but are likely to have some sort of SLA.

It is easy to see how large volumes of traffic, some of it bursty, running in contention with 3G downgraded to 2G data traffic can start to create network management headaches for the service provider - especially if strict SLAs are in place.

M2M/IoT applications that have geographical range may also suffer from situations where the service provider’s network lacks coverage, has blind spots, or has areas with a high potential for interference. In these cases, a device may be unable to get a signal or have the connection dropped, in both cases preventing completion of the transaction. Operators have talked about a failure rate upwards of 30% for M2M sessions, which is obviously high and needs to be addressed.

One cause for sudden service disconnections, or network accessibility issues, could be poor mobility robustness. Alternatively, an M2M/IoT device could face a limit on upload rates, which would affect service - or even

WITH THE EXPLOSION  
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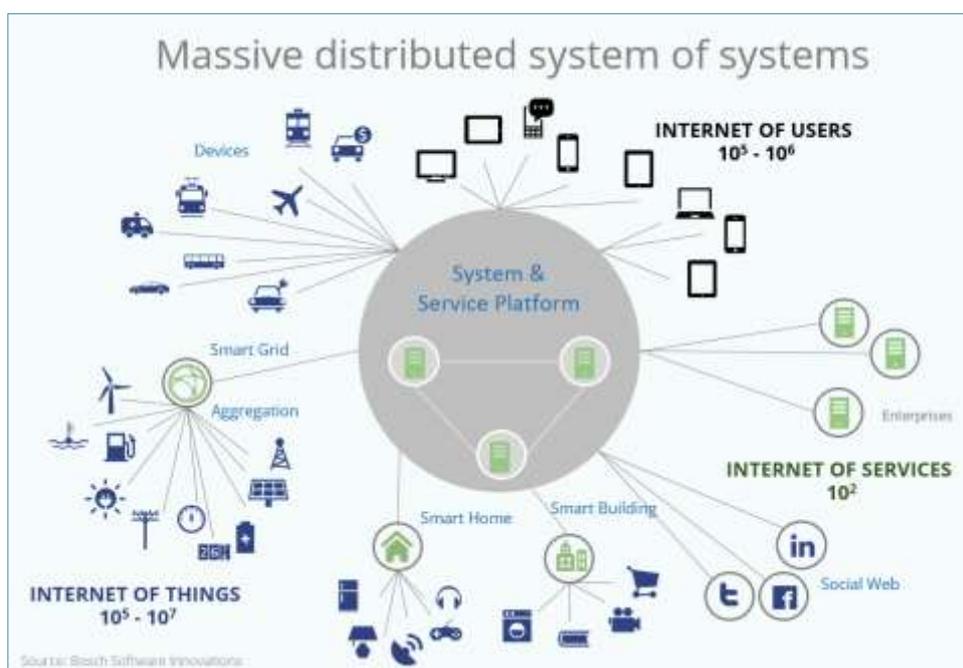
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*The impact of the Connected Life over the next five years, PWC, February, 2013*

prevent service if the data to be uploaded is large, as in the case of an image or video streaming.

Obviously these are less than optimum scenarios that a service provider needs to manage in order to deliver the expected M2M service.

Clearly, a heterogeneous network with multiple Radio Access Technologies (multi-RAT) is today's reality for most operators. In the IoT space, Telefonica Digital's smart grid contract involves its existing cellular network and complimented with mesh technology to provide connections in hard to reach areas<sup>5</sup>. Not all operators have a holistic strategy for managing the heterogeneous network, or the tools to efficiently implement a holistic network strategy. Addition of capacity to the network used to be the most common "management" tool. But recent broadband traffic growth - including increases in M2M/IoT - is making continual build out an untenable approach.



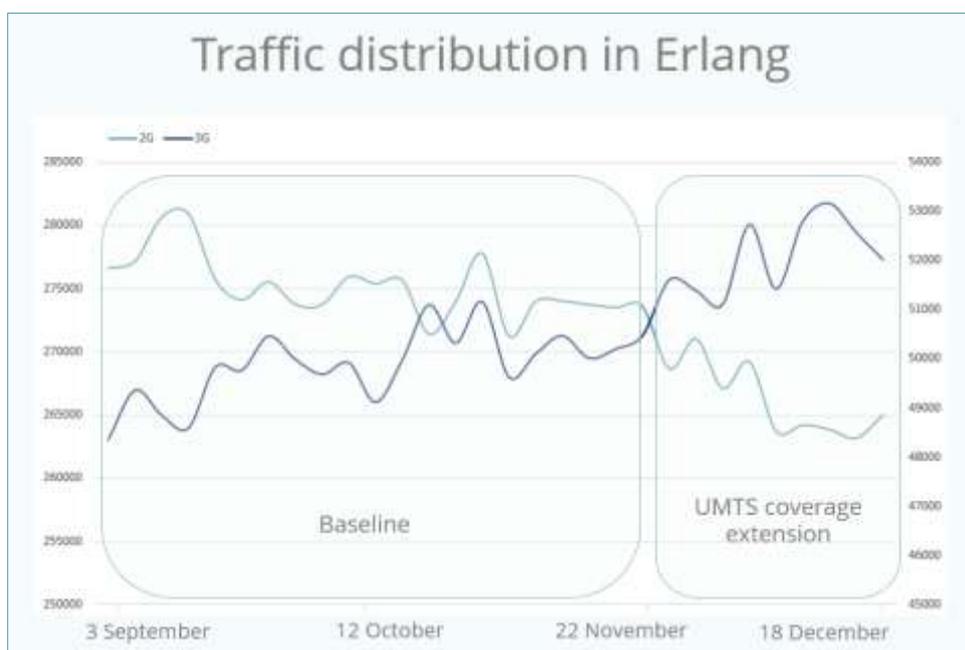
WITH THE EXPECTED  
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<sup>5</sup> <https://m2m.telefonica.com/m2m-media/m2m-news/item/579-telefonica-signs-uk-smart-meter-m2m-deal>

## C-SON AS A SOLUTION?

Centralized Self-Organizing Network (C-SON) solutions - which cover self-configuring, self-optimizing and self-healing capabilities - have come to the fore in recent years as a way to make the planning, configuration, management, optimization and healing of mobile radio access networks simpler and faster. With the complexity of network topology, its multi-layered nature, and radio frequency (RF) physical limitations, managing and maintaining network assets is difficult and costly. C-SON helps make more efficient use of existing network assets. Mobile networks boosted by C-SON are better and more accurately optimized and are therefore able to deliver better capacity, coverage and quality of service. In turn, optimization through C-SON solutions helps reduce OPEX by streamlining network management, and also reduce or postpone CAPEX through improved utilization. C-SON optimized networks also have benefits around the user experience through better - or more predictable - quality of service.

Specifically as it relates to M2M/IoT, C-SON solutions certainly would address the congestion and SLA issues addressed above, optimizing an operator's network for M2M services. However, most SON solutions have so far addressed only 4G and 3G networks and so cannot tackle head-on the specific challenges of M2M/IoT. As discussed above, M2M/IoT applications make heavy use of 2G networks today and will continue to do so for some time. So, to be of any benefit to an operator's M2M business, a C-SON solution would need to be able to handle 2G as well as 3G and 4G networks.



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# CELLWIZE: CLARITY FOR THE CONNECTED LIFE

Cellwize delivers the first ever elastic-SON, a lean and effective solution that optimizes the mobile network in response to changing circumstances and needs. elastic-SON delivers a network that can stretch and contract in ways that meet an operator's business and operational priorities. It does this by rerouting resources dynamically - in near real-time - to improve coverage, capacity or quality. The result is a network that is focused on delivering the best possible performance when and where it is needed. Cellwize handles multi-vendor networks and all wireless technologies (multi-RAT) including 2G, making it perfectly suited for M2M/IoT transactions.

In the M2M/IoT scenarios discussed above, if congestion were to build up due to high bursts of M2M traffic or due to 3G data traffic 'fall back', Cellwize elastic-SON technology will sense the situation and use capabilities such as Dynamic Load Balancing (DLB) to shift traffic to another cell so that the congested node reverts to normal operation. This advanced mobility load-balancing (MLB) can be performed between frequencies or neighbors as a way to steer traffic to remove congestion, allowing M2M burst data streams to pass smoothly without any delay, continuously. In addition, elastic-SON can utilize RET (Remote Electrical Tilt) to manage antennas tilt in 3G & 4G/LTE networks to recover poor coverage situations. With its Interference management, it neutralizes interference resulting in overall network capacity boosting. For the scenarios in which poor coverage was the culprit in preventing an M2M device from uploading or downloading information, Cellwize address this with a set of its patented algorithms for antenna optimization. Coverage Capacity Optimization (CCO) techniques can change the angle of an antenna in order to increase coverage to extend network reach, thereby giving service to M2M/IoT devices that were out of range.

Cellwize elastic-SON senses the mobile network – any type of mobile network - to identify real-time phenomena such as overload, areas of poor coverage and interference. It analyzes these undesired phenomena, considers operator-specific business priorities – including M2M SLAs - and applies the relevant C-SON capabilities (e.g. Dynamic Load Balance, Inter-Carrier Load Balancing, Adaptive Neighbor Relations, Antenna Tilt and others) needed to rectify the undesired situation.

In short, Cellwize C-SON solutions transform a rigid physical network - of any type - into a flowing, responsive dynamic tool that provides for the ever-changing unpredictable traffic topology that M2M/IoT represents.

As an example of the difference Cellwize elastic-SON can make, one operator uses Cellwize solutions for 2G optimization in a dense urban area. The operator's GSM network contains an average of 8 TRXs per cell in a multi-layer band 900/1800 network. After deploying Cellwize, Temporary Block Flow (TBF) congestion on the GPRS network was reduced by 90%, and call congestion was virtually eliminated, being reduced by 97%. As a result, both data (GPRS) and voice traffic on the network were improved significantly. In addition, the quality of uplinks (UL) and downlinks (DL) were also improved. These improvements would have direct positive impact for M2M/IoT devices that faced network congestion on that operator's 2G network.

The Cellwize elastic-SON capabilities mentioned above work for 2G, 3G, 4G/LTE networks. So an elastic-SON solution will be able to offer the same M2M/IoT improvements as device technology evolves beyond 2G.

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# M2M OPTIMIZATION BEYOND CONGESTION CLEARING

This paper has so far laid out the potential for M2M/IoT, discussed some current challenges and proposes C-SON as a way to address congestion and coverage challenges. As expressed in the GSMA quote from the start of the paper, operators should look to provide a wider role in the M2M value chain beyond connectivity and transport. Customer experience and value-based charging are two possible ways to increase the share of the M2M opportunity that comes to operators.

While “customer experience” may not be an obvious term in the context of machines or devices, when one thinks about the “connected life” with wearables, intelligent cars, and the like, the end-consumer quickly becomes part of the picture. And, as most operators around the globe are painfully aware, today’s end-consumers certainly have customer experience expectations. The concept of customer experience in the IoT world is borne out by comments from those currently active in the M2M/IoT space:

Harbor Research, a research, technology and business development consulting firm that works extensively in the IoT space notes that “The continuing developments of IT systems, the Internet, and of next generation telecommunication network architecture will enable movement and analysis of very large amounts of information...Customers will require a tailored experience from service providers; user experience will become critical.<sup>6</sup>” Stephen Odell, president of Europe, the Middle East and Africa at Ford Motor believes that “Consumers expect to have the same connected experience with their cars that they have with the mobile phones.<sup>7</sup>”

By being able to optimize network performance as discussed above, the Cellwize elastic-SON solution can be part of the overall customer experience equation by ensuring quality of service. When combined with analytics around customer importance (based on revenue, criticality of application or other parameter), Cellwize’s elastic-SON moves to a value-driven SON™ approach that can be used to guarantee different levels of service quality to different groups of customers and/or machines, based on business parameters. This holds true for all service types, not just M2M. But is of interest in the M2M space particularly as it can be a key way for an operator to move beyond “just” transport. For example, Facebook, LinkedIn, twitter and Google+ users with large social networks and high level of activity might have more value in service assurance and SLA than other users. Higher service levels – whether for an experience reason, or for the value of the data (e.g. medical) – should be able to demand a premium.

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<sup>6</sup> The Emergence of Smart Systems, Internet of Things Backgrounder, Harbor Research, <http://harborresearch.com/>

<sup>7</sup> <http://www.pcworld.com/article/2102761/the-internet-of-things-beyond-the-hype-at-mobile-world-congress.htm> Beyond the hype: Internet of Things shows up strong at Mobile World Congress, Marc Ferranti, pcworld.com, February 27, 2014

## CONCLUSION

As much as IoT/M2M represents an exciting opportunity for mobile operators to both use and monetize capacity, that opportunity requires effective network utilization management to ensure service delivery. And perhaps the full potential of the opportunity cannot be realized without the ability to manage IoT traffic based on value, and also ensure the desired end-user experience.

Self-Organizing Network (SON) solutions and the network optimization benefits they bring seem an obvious necessity for an operator offering an M2M or IoT transport or broader service offering. However, SON solutions generally do not handle the 2G network which is the backbone of much of today's M2M/IoT traffic – and will continue to be for some time. So there is a mis-match between most SON solutions and needs of operators as it relates to M2M and IoT traffic optimization.

One vendor, however - Cellwize - brings the benefits of C-SON to operators' 2G M2M/IoT traffic. The company is unique in that its elastic-SON solution works with multi-technologies including 2G networks, as well as 3G and 4G/LTE, making it the ideal C-SON solution for optimizing networks in an M2M/IoT context.

With the addition of analytics capabilities to the elastic-SON solution, Cellwize's Value-Driven SON provides the right tools for operators to be able to offer premium services around customer experience or value of the data being delivered, as it is able to combine network information with customer information and take actions accordingly.

With Cellwize, an operator should be able to translate premium M2M service capabilities into premium service charges, unleashing even more potential from the M2M/IoT explosion.

# ABOUT CELLWIZE



Cellwize provides cutting-edge SON (Self Organizing Network) solutions to mobile operators. Mobile networks empowered by Cellwize continuously react to real-time changes and match capacity, coverage and quality with evolving usage patterns and users' needs.

Our elastic-SON™ platform utilizes Big Data processing to transform volatile networks into user-centric and over-performing mobile networks across multiple vendors and wireless technologies (Multi-RAT). Our agile and proven technology improves network management and reduces on-going CAPEX and OPEX investments.

Cellwize Value-Driven SON™ concept supports NPS and loyalty programs, offering operators in-depth insights and actions on their radio networks, enabling them to differentiate their offering, provide superior personalized user experience and use network analytics to enable revenue generation.

Cellwize was founded by Telecom professionals and its technology was designed by RF experts mastering network topology and behaviors. Cellwize is headquartered in Singapore with R&D and sales offices across the EMEA region.

More about elastic-SON™ by Cellwize: <http://www.cellwize.com>



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