LTE Access Controller (LAC) for Small Cell Tool Design and Technology

http://parallelwireless.com/products/lte-access-controller/
Team Expertise Came Together to Reimagine the RAN
Key Strategic Industry Inflection Points

- More powerful/less cost SoC/Moore’s Law → DOES DELIVER more Capacity in a Smaller Form Factor at Lower Cost, one $100 chip can handle one sector

- SDN/NFV → DOES DELIVER - network simplification, operational simplification and cost reduction through elasticity/programmability and automation

Leveraging the two together makes a new RAN architecture possible ...
Parallel Wireless is reimagining the RAN and building solutions that will enable and accelerate the long term transition from today’s 4G LTE to tomorrow’s 5G cellular networks.

Our Vision

Making carrier-grade cellular network deployments as easy and cost-effective as enterprise Wi-Fi
How the LAC and CWS Fit

- Paging
- Mobility Management

Located on edge of the core network (e.g. super sites)
NEW: LTE Access Controller

**intelligent RAN orchestration**

- Virtualizes the 3GPP interfaces; standard interfaces, open APIs
- 4X10 Gb interfaces → plenty of capacity
- Allows hundreds of cells to be abstracted in a similar way to VMware allowing hundreds of servers to be managed as an abstraction
- SDN/NFV architecture leveraging cloud to manage RAN remotely/automatically
- Enables node self-configuration (speed of deployment) and self-management/hands free maintenance with dynamic real-time SON, node aggregation
- Decentralizes and decouples RAN from EPC, so you can scale/upgrade without impacting either side
- Node aggregation, S1 Gateway, X2 Gateway and Security gateway functionality, MOCN, real-time ICIC
- Resource configuration and optimization with real-time dynamic SON
- True COTS
LAC: NFV/SDN Simplifying LTE Network
Simplicity and Lower TCO

LTE Access Controller Functions
NFV:
- MOCN Enabler
- Edge/cell site aggregation router
- X2 Interface Brokering and S1 Aggregation
- SON server
- Small Cell gateway/HeNBGW
- HNB gateway
- Security GW
- Wi-Fi Controller/Gateway,
  - IoT Enabler
  - MBMS Enabler
  - Analytics

One carrier-grade COTS platform for many network functions + SDN to manage RAN
Parallel Wireless SON uses innovative approach of using UE measurements to dynamically optimize the network conditions

- **Self-Organizing Network**
  - SON Server dynamically configures eNodeB parameters such as ANR, PCI, initial power levels, etc.

- **Self-Optimizing Network**
  - SON Server dynamically configures eNodeB power levels to mitigate interference
  - Cell edge user experience improvement based on UE measurement report based eNodeB power adjustment
  - Cell overload management/ load balancing based on UE load and UE experience on a given cell

- **Self-healing**
SON Server: Real-time Hybrid SON

Traditional SON:
- Additional hardware
- All cells must have X2 links with all the neighbors
- Any incremental cell addition creates X2 configuration challenges

LAC integrated SON server
- No need for a separate SON server
- LAC aggregates all X2s
- With new cells addition, LAC manages the automatic configuration and inter cell interference
- 3rd Party SON mediation
Why Real-Time SON Matters (1 of 2)

- Automated **network optimization**: allows more accurate adjustments in the network based on traffic and network/node conditions
  - UE measurements, performance measurements, and other monitoring information is used for better QoE
  - Better resources utilization

- Real-time intercell **interference coordination** (ICIC)
- **Congestion detection** on a RAT to trigger HO to different RAT
  - Seamless service experience on 3G, LTE and Wi-Fi

- **RF Profiling**
  - Maintains RF Characteristics, Network KPIs and QoS Characteristics for a GPS Location.
  - Input to schedulers to provide optimized coverage in real-time when a UE is in problematic coverage area or handoff UE to some other eNodeB.
  - More visibility into coverage gaps, call drops and throughput issues
Why Real-Time SON Matters (2 of 2)

- Real-time cell **outage detection and compensation coordination**
  - Fewer outages and better coverage
  - Automatic mitigation of eNodeB failures -- LAC can inform neighboring cells to provide coverage in coordinated fashion to fill coverage gap until eNodeB comes back

- Energy savings (LAC can instruct certain eNodeBs to turn power off during certain periods of time and request neighboring eNodeBs to provide coverage in coordinated fashion)
**X2 Interface Brokering and S1 Aggregation:**

**Without LAC:**
- One S1 interface per each cell towards the EPC
- X2 link required among all neighboring eNodeBs
- Any incremental cell addition creates S1 configuration challenges

**With LAC:** LAC appears as one or more virtualized macro
- Programmable interoperability with dynamical learning of proprietary protocols
- LAC has X2/S1 with Macros and Small Cells it manages
- More ability to do load balancing as sits in S1 path → LAC aggregates cells as one virtual eNB
- Other Macros still send S1 interface directly to the EPC
LTE Access Controller (LAC) Network Benefits

- Easy to deliver **spectral efficiency**
- Easy to achieve **resilience** across simpler cores
- Easy to achieve eNodeB **interoperability** including ICIC over X2 and open SON interfaces
- Easy to **configure and manage** multi-vendor nodes
- Easy to achieve resilient **backhaul mesh**
- Easy to **mask complexity** of incremental deployment, failures, etc.

- **Dramatic cost reduction**
- **Superior user experience**
- **Ability to roll out new services faster**
Example - Rural Deployment –
What do We Bring?

- Simple quick Installation –
  - 6 hours to install and commission one CWS
  - 3 days to light up a rural community with cluster of 4 CWS
  - Planning “Lite”

- Eliminates the backhaul Challenge
  - Use what is available when it becomes available & aggregate all sources
  - In Band 4G Backhaul
  - Mesh Backhaul
  - Fiber / DSL / ADSL

- Low cost of Operation/Hands-free maintenance
  - SON resource optimization
  - Power adjustments
CWS connect together via wireless mesh to form a CWS cluster
- Mesh is pure “multi-point” to “multi-point” link, i.e. there is no server node, client node, etc.
- Multi-homed – any egress (wired or LTE) on a given node is available to full mesh cluster
- The Cluster aggregates all backhauls available

Each CWS supports two independent wireless mesh → can operate on multiple frequency and transmit /receive packets independent of each other
- Each CWS is self-configured and self-managed via the LTE Access Controller
- Each CWS has an integrated GPS receiver location reporting and time sync
# How Solution Addresses Rural Coverage Challenges

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<th>Challenges</th>
<th>Parallel Solution</th>
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| **Cost:** Need to spend as much on low density rural network infrastructure as for high density urban areas | **Reduced Cost:**  
  - eNodeBs are built from low cost commodity components  
  - LAC runs on COTS hardware |
| **Time and skill level to deploy**                                         | **Less time and lower skill** level to deploy  
  - Instant on auto SON for instant/plug-n-play deployment |
| **On-going maintenance**                                                   | Hands free with SON → local community can manage itself                           |
| **Backhaul**                                                               |  
  - LAC enables mesh backhaul on CWS nodes, only a few require fixed backhaul connections  
  - Two independent wireless mesh: can operate on multiple frequency and transmit/receive packets independent of each other  
  - Nodes can daisy chain to each other to extend coverage |
| **Power**                                                                  |  
  - Low power consumption  
  - Can run up to 24 hrs on car battery as a power back up. |
| **Spike in Usage/traffic mitigation**                                      | **Optimize spike in usage** due to season; special circumstances, time of day, etc.  
  - SON on LAC auto optimizes resource usage  
  - X2 brokering mitigation, ICIC, CoMP for great customer experience |
| **Resilience: potential equipment damage or vandalism in remote locations** | **Monitor** any potential equipment damage or vandalism in remote locations  
  - Remote analytics  
  - Self-healing SON |
Making carrier-grade cellular network deployments as easy and cost-effective as enterprise Wi-Fi

with

Self-configuration
Self-optimization
Self-healing
Multi-vendor Interoperability
Real-time ICIC and traffic mitigation
X2 brokering and S1 aggregation
Automatic resource allocation
Paging, handoff and signaling optimization/reduction
One Technology: Many Deployment Scenarios

**Public Safety w/Bring Your Own Coverage (BYOC)**
- LTE Access Controller
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**Rural**
- Rural Corridor
- Mesh

**Resilient Island Mesh**

**Urban**
- Macro Coverage Area
- Small Cell
- Small Cell
- LAC management area

**Deployment Flexibility:**
- Rural
- Urban
- Island Mesh
- In-building
- Femto Optimization
- IoT
- Public and Emergency Services
- ENT

**Coverage**

**Resilience:**
- Self-optimization
- Self-healing

**Cost effective:** Intelligent software enabling cost-effective hardware and consumer devices
Thank You