All LTE networks, whether TDD or FDD, need an accurate Time Of Day (TOD) reference delivered to the base stations. The 1.5 microsecond accuracy levels (compared to Coordinated Universal Time UTC) required by 3G and LTE base stations for the provisioning of timing reference are expected to be in the order of hundreds of nanoseconds in LTE Advanced networks to support capabilities as Multiple Input Multiple Output (MIMO) and Location Based Services (LBS).

RAD’s new Distributed GM™ solution for LTE backhaul and small cells delivers the required TOD accuracy at a lower cost compared to centrally-located 1588 Grandmasters or GPS receivers installed at every site. This is achieved by bringing the Grandmaster functionality closer to the base station in a small form factor device. The Distributed GM is positioned at the last aggregation point in a radio access network to greatly reduce the number of hops the synchronization packets must traverse, thus ensuring better timing performance. It also offers a more effective solution as LTE networks scale to hundreds, or thousands of eNodeBs and small cells.
Previously in Mobile Backhaul Timing Synchronization...

GPS receiver deployment at every site and centrally-located 1588 Grandmasters, the two approaches that have been typically used for distributing frequency and time to eNodeBs and small cells, may not fit all installations, cost considerations or performance requirements:

**Method 1: GPS at Every Site**

A GPS receiver can be used to deliver local timing at every cell site with very high accuracy (typically within ±50 nanoseconds compared to UTC). However, while it is impervious to network conditions such as delay and packet delay variation (jitter), it nonetheless poses several challenges to network operators:

- **Cost:** Deploying a GPS antenna at every cell site is very expensive and involves high installation and maintenance costs. Such costs may prove prohibitive as LTE networks scale to thousands of end points with the rapid profusion of small cells to increase capacity and coverage in crowded urban areas.

  - **Vulnerability:** GPS is subject to both unintentional and intentional interference, such as radio frequency interference/ spectrum congestion and GPS jamming and spoofing.

  - **Reach:** In some locations, such as in dense urban areas and indoor shopping malls where there can be no “sky view” for the GPS receiver, service coverage could be dramatically impaired.

**Method 2: Centralized PTP Distribution**

IEEE 1588 Precision Time Protocol distributes the timing flows from a centrally located PTP Grandmaster at the network core, whereby a single Grandmaster services hundreds or thousands of PTP Slaves. Such centralized PTP distribution is performed hop-by-hop via the backhaul network all the way to the base stations. The key challenges in this methodology are cost and operational complexity as such an approach requires forklifting ALL of the intermediate transport nodes to support 1588 Boundary or Transparent Clocks.
RAD’s Distributed Grandmaster solution, based on G.8275.1 PTP time telecom profile, is deployed at the last aggregation point in the network, e.g., at a POP or hub site typically located one or two hops from the eNB or small cell. Since PTP distribution begins closer to the cell site and involves a minimal number of hops between the GM and the end points, the integrity of the PTP timing reference is maintained. This allows for several major benefits over other methodologies:

1. Maintaining TOD and synchronization accuracy performance for LTE, LTE Advanced, at a lower cost
2. Better service coverage for small-cells, in-building and underground installations
3. Reduce cost by eliminating the need for investing in hop-by-hop BC/TC support for in the core/aggregation network
4. Lower cost per base station compared to a “GPS on every tower” scenario

Furthermore, RAD’s Distributed Grandmaster capabilities are incorporated into its Service Assured Access mobile demarcation and aggregation solutions that serve up to 64 or 512 eNBs/small cells. This combination delivers even further benefits:

- Service differentiation for premium traffic with end to end service monitoring, connection fault management, SLA verification, and flow based traffic management.
- Lower TCO with multiple functionalities in a single device and small form factors to reduce POP rental costs
- Readily-available service extension to additional downstream eNBs/small cells, in a linear or daisy chain fashion over fiber or microwave links
RAD’s Distributed Grandmaster Solutions

**ETX-5**  
Carrier Ethernet Service Aggregation Platform

**ETX-2**  
(Ordering Option ETX-205A)  
Advanced Carrier Ethernet Mobile Demarcation Device

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