

# RAN Sharing Solutions

## Network Performance Monitoring



### Introduction

Radio Access Network (RAN) sharing is an increasingly popular method used by carriers to cost-effectively increase their coverage. It involves sharing RAN and networking infrastructure between two mobile operators—not as a means of obtaining revenues from each other, but rather fairly, mutually offering access to each others' resources to better serve customers.

RAN sharing especially makes sense for carriers in markets with a mostly pre-paid customer base environment, where having more network availability means more revenue from more billable minutes. Simply put, if the network is not available, calls paid by the minute cannot be placed, and revenue is lost. 5G networks will also likely rely on RAN sharing to reduce the cost of a new RAN build out that may employ new millimeter wave spectrum, as well as sophisticated multi-tower, multi-carrier aggregation.

Ad hoc RAN sharing arrangements emerge when two mobile operators agree to work together to gain increased coverage with each others' network assets. Lacking any formal monitoring infrastructure, these sharing arrangements are often based on an agreement involving like-kind swapping of towers/resources (e.g. one-for-one exchange of radio-backhauled base stations, or similarly, fibered sites). As a fair means of sharing, this is a simple approach. But in practice, like-kind resources do not account for equal performance. For example, RF-backhauled sites can deliver similar performance to fibered sites, whereas fibered sites do not guarantee higher performance if not properly configured or assured.

To set up sharing in a way that's truly equal and value-based requires an equal exchange of assured performance, as opposed to similar assets. This requires a performance monitoring (PM) system that looks at key performance indicators (KPIs) like delay, delay variation and packet loss in addition to assessing available throughput and bandwidth utilization. Such a system allows carriers to create and enforce meaningful service level agreements (SLAs). When deployed over shared assets, both operators gain expanded network coverage and revenue opportunities, assured by unbiased performance metrics and reporting that ensure accountability and fair access.

Often, though, carriers simply do not have the tools installed to validate network performance, notably not in a way that offers the complete range of monitoring metrics, or the ability to selectively share results with a third party without security concerns. Such a solution is possible, with the right equipment, but the methods used depend on a variety of factors. This white paper explores the possibilities for RAN sharing PM monitoring, with several use cases that illustrate how it could be set up.

Table of Contents	RAN Sharing for Performance Monitoring and Reporting
	2
Performance Monitoring and Reporting Options for RAN Sharing	Use Cases: Reporting and Deployment Options for RAN Sharing
2	3
Solution Components	Conclusion
5	6

## RAN Sharing for Performance Monitoring and Reporting

PM monitoring for RAN sharing has many benefits for carriers, such as:

- Allows carriers to achieve cost efficiencies of sharing RAN resources in a fair way based on performance rather than resource type.
- Makes it possible for both carriers to create and deliver on meaningful SLAs.
- Eliminates finger-pointing and accelerates problem location isolation.
- Helps with capacity planning.
- PM overlay helps each carrier provide better performance for their own network customers by monitoring and reporting on KPI thresholds used to provide evidence into the real customer experience.

Likely requirements for an effective RAN sharing PM monitoring solution include:

- Availability of performance reporting—segmented appropriately—to both parties.
- One-way measurements that address the asymmetrical nature of RANs.
- Ability for each carrier to see when something changes with Ethernet virtual connection (EVC) used for a particular service.
- Ability to monitor deviations from "normal" performance, determined on a rolling basis.

Use cases in the next section explore approaches to RAN sharing and what's involved to make these performance monitoring and reporting options possible.

## Performance Monitoring and Reporting Options for RAN Sharing

For RAN sharing to be effective, uniform SLA reporting is required to provide the same level of visibility to both partners. When reporting per service or asset class is possible, carriers can offer multiple tiers of shared assets (e.g. 2G/3G/LTE towers, or high/best effort availability).

Two main options exist for meeting the monitoring needs of the operators:

- **SLA Performance Monitoring (PM)** - Use the most cost-efficient means of gaining one-way, per-service visibility into packet loss, availability, latency, and delay variation over Layer 2 and 3 to each cell site.
- **SLA PM + Bandwidth Utilization** - Added monitoring and reporting of usage per circuit using one of these two methods:
  - Centralized bandwidth metering.
  - Distributed metering of each shared endpoint as well as handoff locations to identify I/O performance in both directions (requires instrumentation at all shared assets).

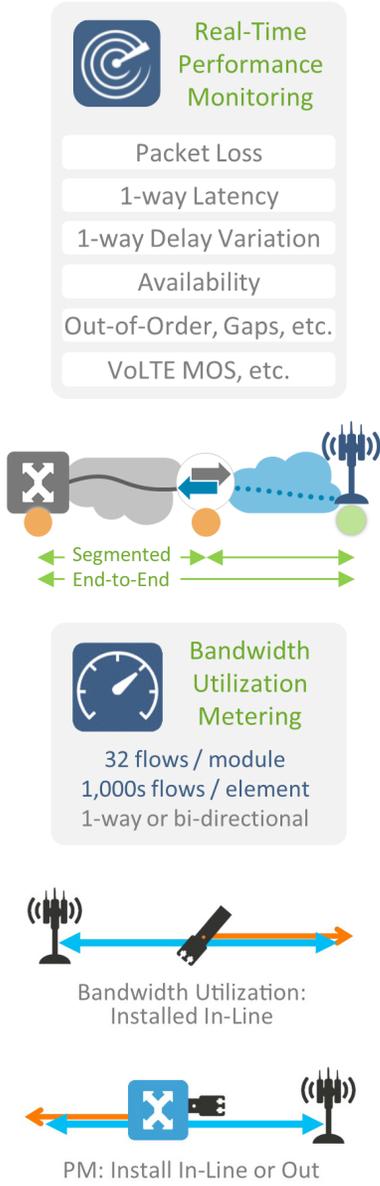


Figure 1 below shows the components and setup involved with two operators using SLA performance monitoring with RAN sharing.

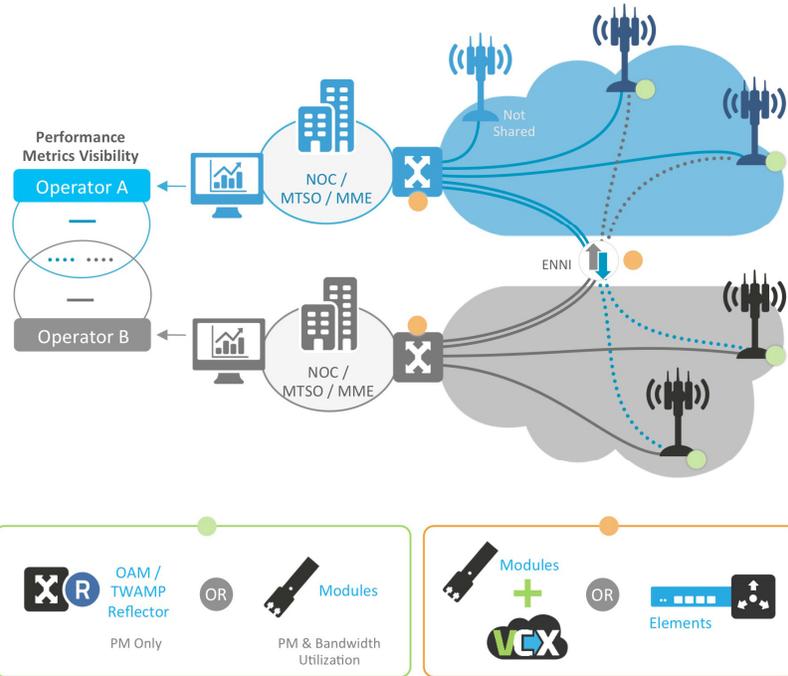


Figure 1: RAN sharing performance monitoring solution components and setup

For example, if bandwidth utilization and capacity monitoring is critical and each operator wants its own test solution, but only Two-Way Active Measurement Protocol (TWAMP) can be used, that eliminates the option of having a shared Nano installed at the base station, since it can only act as a TWAMP reflector and not a method of measuring bandwidth utilization.

The method of determining *available* bandwidth used here is:

- Measure bandwidth utilization and packet loss. If packet loss is high, capacity may be approaching the maximum: analyze long term trends of these two metrics together to assess correlation.
- If a problem is detected, run throughput test (e.g. RFC-2544 / Y.1564) on that link to measure the actual link capacity. Methods can be employed to do this non-disruptively, in-service, if the appropriate instrumentation is installed.

This method is relatively easy to do on fiber links, and more complicated with wireless where conditions can change on the fly. Proper analytics and reporting tools are required in either case.

## Use Cases: Reporting and Deployment Options for RAN Sharing

**Reporting** and deployment options for RAN sharing fall into two main use cases:

- *Privately Managed* - Each operator instruments their own network with similar tools, and then provides a real-time monitoring feed of shared assets to the other operator, who reports / views data from shared and owned assets using a single tool. (See Figure 2 below.) This arrangement can use already-installed instrumentation (if it exists) and each operator can choose a solution based on their overall needs. But, based on the resources of each operator, it provides non-uniform coverage with varying levels of precision and metrics collected. Privately managed performance reporting makes it difficult to share and exchange like-kind metrics, and is costly both in terms of CapEx and OpEx.

## Accedian Professional Services

Accedian has extensive experience and industry knowledge that can be applied to monitoring and running your network at peak performance. Accedian offers a portfolio of Professional Services that optimize network QoS and configuration, and can assist in the design, deployment and ongoing monitoring of best-in-class networks and services.



### Network Audit

Audit of end-to-end circuits across vendors, technologies & carriers, and verification of customer defined SLAs.



### Performance Monitoring & Fault Isolation

Continuous, real-time KPI monitoring, fault isolation, analysis & reporting using Y.1731 & TWAMP standards.



### Network Deployment

Global installation, configuration, performance validation and optimization.



### System Turn-Up & Testing

End-to-end service & circuit validation & birth certificate reporting using RFC-2544 & Y.1564 standards and our advanced test suite

Learn more at [Accedian.com/services](http://Accedian.com/services)

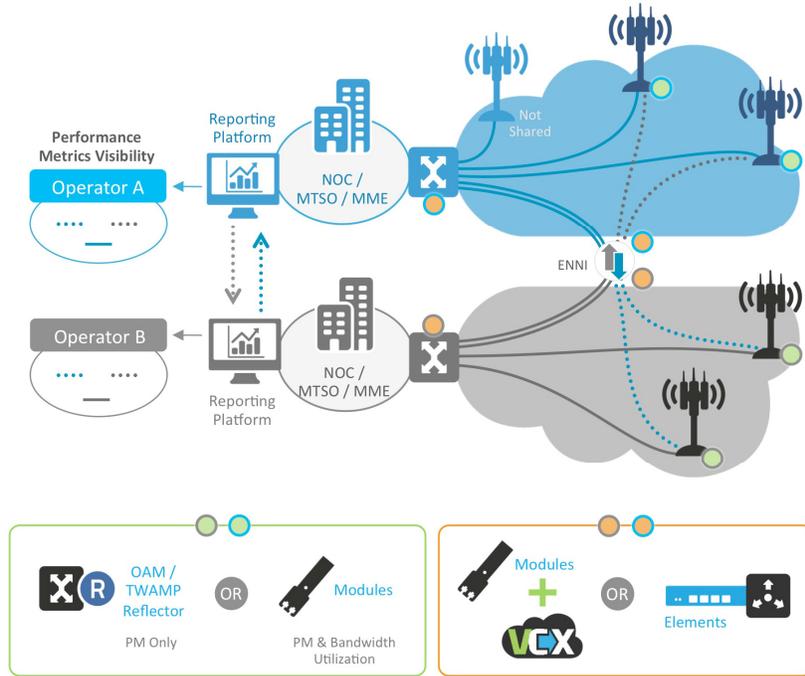


Figure 2: Privately managed performance reporting

- Monitoring-as-a-Service** - A neutral third party (which has access to all performance info, as well as end-to-end and segmented views) instruments both networks, and then provides a centralized network operations center (NOC) for reporting to each operator, while also providing trending and troubleshooting insight. (See Figure 3 below.) Third-party managed performance reporting minimizes costs and provides a uniform, consistent set of metrics, and permits sophisticated SLAs that ensure equal value is shared or fairly compensated between the operators.

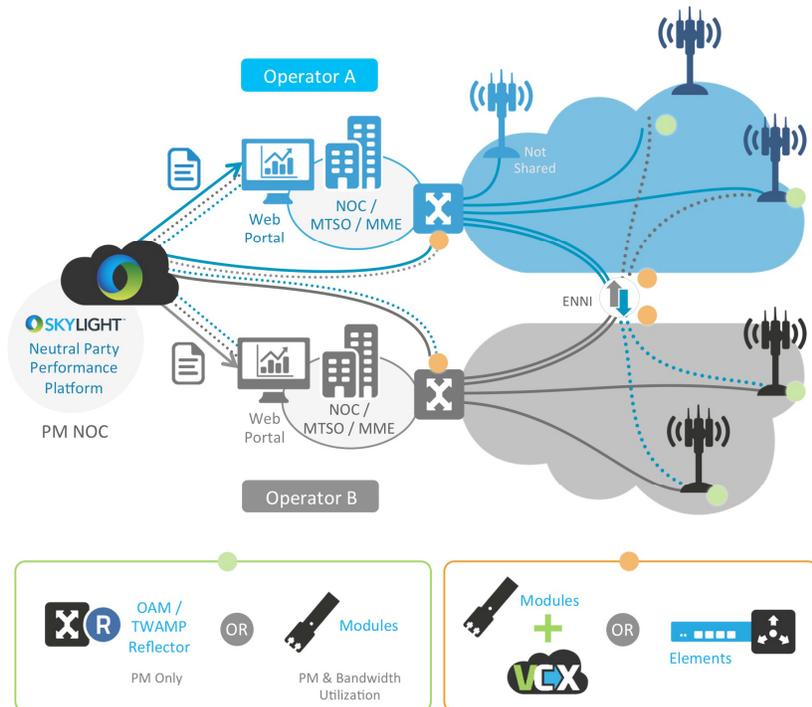


Figure 3: Third party managed performance reporting

## RAN Sharing Categories and Levels

Broadly speaking, RAN sharing can be divided into two main categories:

- *Passive RAN sharing*, in which operators share only physical cell sites and passive network elements like masts and power supplies.
- *Active RAN sharing*, in which operators share passive equipment as well as transport infrastructure, radio spectrum, and baseband processing resources. They may also have joint decision-making about investments and operations.

Three levels of RAN sharing are also defined by 3GPP to describe how integrated the operators involved are with one another:

- *Multi-Operator RAN (MORAN)* is where only equipment is shared.
- *Multi-Operator Core Network (MOCN)* is where both equipment and spectrum are shared.
- *Gateway Core Network (GWCN)* is where equipment, spectrum and some core network elements are shared.

See Diagram  
Next Page

In each case operators benefit from performance visibility of their own services over their own as well as shared resources. The hosting operator also sees usage and performance of their shared resources from the other operators' perspective. This allows efficient troubleshooting and segmented monitoring to ensure each operator benefits from the shared arrangement without impacting their own services.

Each operator can also choose to instrument to sites outside the sharing arrangement to gain wider network performance visibility for real-time quality of service (QoS) and Quality of Experience (QoE) assurance, reporting, capacity planning and troubleshooting.

## Solution Components

Depending on deployment option chosen and specifics of each operator's network, a tailored RAN sharing solution can be created using Accedian Performance Elements, Modules and Controllers, complemented by visualization tools for real time data collection and reporting.

### Solution Components Overview



#### Network Performance Platforms

Platforms such as Accedian's SkyLIGHT™ Director and Reporting Module automate, orchestrate and visualize performance assurance in real-time, with open integration into existing operational support and network management systems.



#### Network Performance Elements

Elements allow full line-rate turn up, monitoring and hierarchical QoS (H-QoS) enforcement with unrivaled accuracy, granularity, and scale.



#### Network Performance Modules

Hardware-precise, programmable test, monitoring and OAM endpoints are cost efficient, programmable test points for base stations, small-cells, locations requiring segmented visibility throughout the enhanced packet core (EPC).



#### Network Performance Controllers

The SkyLIGHT VCX Controller provides the Network Functions Virtualization (NFV) that powers Modules to become virtualized equivalents of Accedian standalone Performance Elements.

### Implementation of Components

Performance Monitoring (Refer to Figure 1)

- At endpoints in each operator's domain, OAM/TWAMP reflectors (performance monitoring only) or ant/Nano Modules (PM plus bandwidth utilization) report metrics back to the Platform orchestrating performance assurance.
- At demarcation point between the operator network and NOC, the SkyLIGHT VCX Controller with virtualized Modules, or standalone Performance Elements, acts as a head-end PM actuator (or probe) to conduct, analyze and deliver metrics from performance monitoring sessions back to the reporting platform.

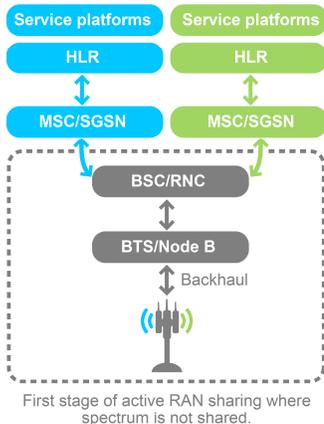
Privately Managed Performance Reporting (Refer to Figure 2)

- Each operator collects performance metrics from their own network's instrumentation (per above).

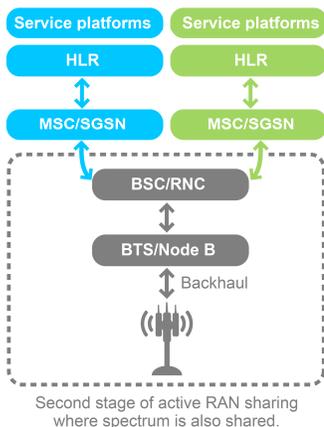
## RAN Sharing Categories & Levels

...continued

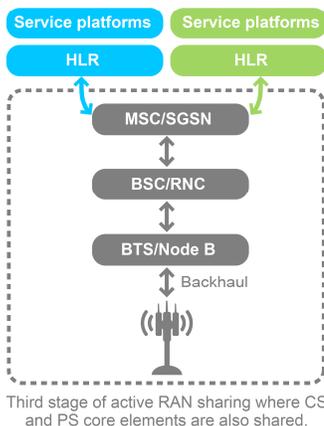
### MORAN



### MOCN



### GWCN



■ Operator A    ■ Operator B    ■ Shared Element

HLR = Home location register  
 MSC = Mobile switching centre  
 SGSN = Serving GPRS support node  
 GPRS = General packet radio service  
 BSC = Base station controller  
 RNC = Radio network controller  
 BTS = Base station

- Operators have (limited) visibility into each other's networks by controlling KPI exchange using their Platforms as "metrics gateways" to relevant traffic flow monitoring statistics. Each operator has a reporting platform that allows them to:
  - fully visualize and report on their own traffic, as well as the other operators usage of shared resources, and,
  - see the performance of their services as carried over shared resources in the other operator's network.

### Neutral, Third Party Performance Reporting (Refer to Figure 3)

- Here, the neutral third party performance platform securely collects performance metrics from both operators' networks, aggregating them at a single Performance Platform—such as the Accedian SkyLIGHT Director—along with the Accedian Reporting Module at a secure NOC, delivering appropriate information directly to each operator's NOC through a web portal.
- Those metrics are obtained via bypassing the operator NOCs, connecting directly to the network domain using either Modules or Elements.

## Conclusion

RAN sharing without segmented, per-operator usage and performance monitoring is at best an informal relationship that is limited by its ability to properly express and exchange the value of shared resources each operator offers and maintains. Gaining real-time visibility of each party's network, service and resource performance is a critical element of RAN sharing that can expand these relationships, build trust through accountability, and deliver sophisticated SLAs and reporting that allow equitable sharing and increased revenue opportunities for all involved.

Instrumentation also permits both operators to share in troubleshooting and rapid fault isolation, plan network capacity and improve their own offerings' QoS and QoE, ultimately making them each more competitive in their core offerings, increasing opportunities for revenue and distinguishing their networks as highly reliable and higher performing than competitors' offerings.

The methods used depend on each carrier's architecture and priorities, as well as capabilities desired by the end customer. Each set of choices comes with its own ramifications. A neutral third party approach may offer the most benefits, as the capital and operational expenditure related to instrumenting, monitoring and reporting on all shared service flows can be time consuming and an added cost to expanding coverage while seeking to benefit from the economies of RAN sharing. As a result, performance monitoring and reporting as-a-service often ends up being the lowest cost, most effective option for governing the performance, accountability and value of resource sharing models.

© 2015 Accedian Networks Inc. All rights reserved.

Accedian Networks, the Accedian Networks logo, SkyLIGHT, AntMODULE, Vision EMS, Vision Suite, VisionMETRIX, Vision Collect, Vision Flow, Vision SP, V-NID, Plug & Go, R-FLO, Network State+, Traffic-Meter, FlowMETER & airMODULE are trademarks or registered trademarks of Accedian Networks Inc. All other company and product names may be trademarks of their respective companies. Accedian Networks may, from time to time, make changes to the products or specifications contained herein without notice. Some certifications may be pending final approval, please contact Accedian Networks for current certifications.