

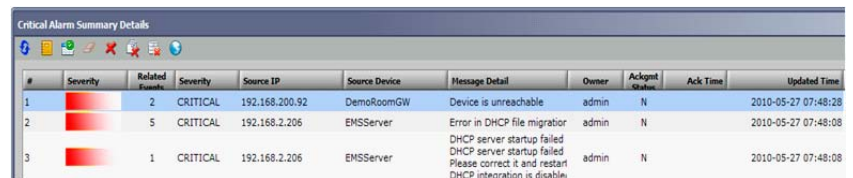
SkyPilot EMS

Element Management System for the SkyPilot Network

The SkyPilot® Element Management System (EMS) provides SNMP-based network element management capabilities. The SkyPilot EMS manages SkyPilot network devices, providing control and monitoring capabilities over the network's physical and logical connectivity, implementing a Fault, Configuration, Performance, and Security (FCPS) network management administration model for the SkyPilot wireless mesh network. The SkyPilot EMS integrates with the Google Earth plug-in service to enhance the preparation and maintenance of SkyPilot network diagrams while providing automatic and dynamic network visualization. The SkyPilot EMS automatically discovers and obtains topology information and provides complete fault management, performance tuning and monitoring, reporting, and alarm capabilities for a service provider managing a complex territory-wide SkyPilot network. These essential features, coupled with the fundamental mesh technology of the SkyPilot network, can help the service provider maximize subscriber satisfaction while sustaining a profitable business model.

Fault Management

The SkyPilot EMS delivers a robust fault management system with real-time alarm and event reporting. A color coding system visually identifies critical, major, minor and informational alarms and simplifies the handling automatic notifications to the SkyPilot network administrator. The reporting system supplied by the SkyPilot EMS provides detailed event logging and includes extensive filtering capabilities to sort and prioritize data so that network critical issues can be addressed quickly and efficiently with minimal impact to the SkyPilot network's ongoing operations. With the SkyPilot EMS, the network administrator has a systematic process for problem detection and rapid issue resolution.



#	Severity	Related Alarms	Severity	Source IP	Source Device	Message Detail	Owner	Acknit gular	Ack Time	Updated Time
1	CRITICAL	2	CRITICAL	192.168.200.92	DemoRoomGW	Device is unreachable	admin	N		2010-05-27 07:48:28
2	CRITICAL	5	CRITICAL	192.168.2.206	EMSServer	Error in DHCP file migrator DHCP server startup failed DHCP server startup failed	admin	N		2010-05-27 07:48:08
3	CRITICAL	1	CRITICAL	192.168.2.206	EMSServer	Please correct it and restart DHCP integration is disable	admin	N		2010-05-27 07:48:08

Example of the alarm management reporting function in SkyPilot EMS

Configuration Management

The SkyPilot EMS provides an efficient and centralized method of managing device configuration and network maintenance of a SkyPilot mesh network. It supports "over-the-air" automatic provisioning, configuration updates, and firmware upgrades of SkyPilot devices throughout the SkyPilot mesh network and allows these events to be scheduled at the most cost-effective and convenient times. The SkyPilot EMS allows individual service profiles to be defined and stored to specify a range of networking, security, and quality of service (QoS) parameters. Additionally, the SkyPilot EMS can provide backup and restore capabilities for specific device configurations and/or subscriber information and coordinate the scheduling of device or subscriber specific firmware upgrades from an archived list of available firmware images.

FCPS Network Management using SNMPv2c

Automated Fault Detection and Resolution

"Over-the-Air" Configuration Control & Provisioning

Performance Optimization

- GPS-based mapping services
- Enhanced network visualization
- Real-time network monitoring and reporting

Carrier-Class Network Security with User/Group Access Control

Traffic Management

- Traffic prioritization using IEEE 802.1p, protocol type, IP Port, IP DiffServ/ToS field, and/or IP address
- Traffic filtering using protocol type, IP port and/or IP address
- Traffic shaping with upstream and downstream per-user rate control

Bundled Software Applications

- MySQL database
- DHCP server (to automate IP addressing for SkyPilot devices and subscriber clients)
- FTP server (to support firmware updates)
- HTTP server (to support download of XML-based configuration files)

Supported Operating Systems

- RedHat Enterprise Linux 4
- RedHat Enterprise Linux 5
- Fedora Core 8
- Cent OS 5.5

Supported SkyPilot Devices

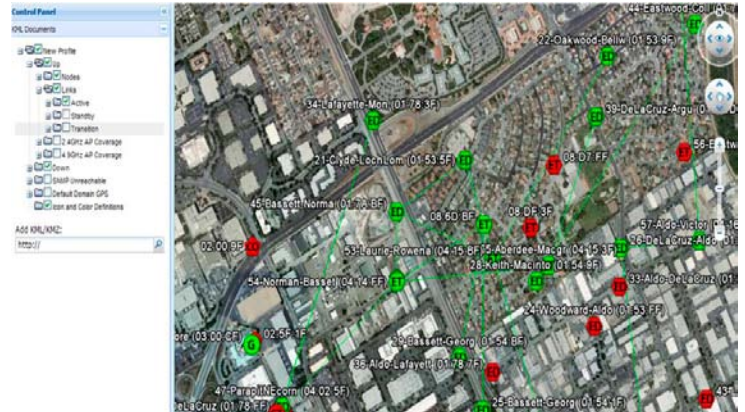
- SkyPilot Gateway products
- SkyPilot Extender products
- SkyPilot Connector products

Performance Optimization

The SkyPilot EMS offers advanced topology and graphical performance monitoring capabilities that are enhanced by integration with Google Earth mapping services. By utilizing the Google Earth Pro client software, a network administrator can leverage the GPS functionality built into each SkyPilot Gateway and Extender device to rapidly generate and update network maps. The Google Earth Pro software populates a map with GPS coordinate data for each SkyPilot device. The SkyPilot EMS then creates dynamic network diagrams that accurately overlay node locations on map terrain, display descriptive data and link performance for each device, and graphically portray link associations between the nodes in the SkyPilot mesh network. This automated feature relieves the administrator from relying on manually prepared maps that may be out of date or costly to acquire. Link associations and device types are defined graphically with the SkyPilot EMS, and frequency separation is depicted with varying colors. As a result, the SkyPilot EMS can display a feature-rich diagram that is customizable to the needs of each network administrator and deployment topology. The SkyPilot EMS seamlessly scales with network deployment and growth, automatically provides real-time updated network diagrams, enhances the accuracy of network monitoring, and collects needed data and generates reports for deployments ranging up to thousands of nodes. The SkyPilot EMS is a critical tool for efficiently managing a large-scale SkyPilot mesh network.

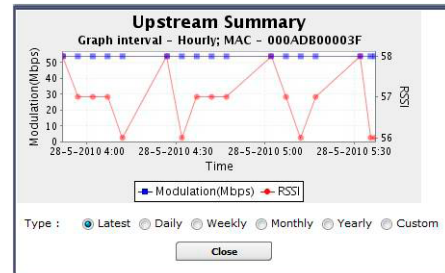
Security Management

With the SkyPilot EMS, a service provider has full control over individual and group access to the SkyPilot mesh network. The network administrator can control the creation of individual user or group accounts and can set functional access permissions at all levels. The SkyPilot network fully supports VLAN implementations to prevent rogue association with the SkyPilot wireless mesh network, using the SkyPilot EMS to control user authorizations and permissions throughout the entire network.



Example of a network topology map depicting location of SkyPilot devices that was automatically generated using GPS information from SkyPilot EMS

Field Type	Field Value	Operator	Modulation Value	Alarm severity
All	None	<=	6	CRITICAL
All	None	<=	12	MAJOR
All	None	<=	24	MINOR
All	None	<=	54	CLEARED



Example of a SkyPilot EMS screen detailing performance monitoring metrics and SkyPilot device thresholds



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