

# Information System Security Operation Integrating Security and Quality of Service in Mobile Ad-hoc Networks

## Designing Wireless Networks to Support Next-Generation Services and Applications with Security, High Quality and Reliability

### Overview

The SEQUOIA (SEcurity-and-Quality-Of-Service-In-Mobile-Adhoc-Networks) project, currently underway, is pursuing research to improve the routing, security and the quality of the services delivered in mobile adhoc wireless networks (MANETs) so as to support next-generation applications. Currently, the main application of ad-hoc networks is in military tactical operations; for example, military units (i.e., troops, tanks, etc.) equipped with wireless communication devices form an ad-hoc network as they roam in a battlefield. Other applications of ad-hoc networks include disaster management settings that involve emergency, law enforcement, and rescue missions in terrains lacking a readily accessible communications infrastructure.

MANETs today provide no assurances on the quality of service (QoS) that that can be provided and even when QoS protocols are utilized, they are divorced from any security considerations. Thus the broad goal of SEQUOIA is to promote security as an integral part of the QoS that can be specified in MANETs and to fulfill this by designing algorithms and mechanisms to enable the routing and delivery of messages in a secure and reliable manner so as to meet the demands of next-generation applications that involve real-time video, voice, etc.

The project is exploring three foundational themes:

- How do we integrate security and QoS requirements into routing protocols for

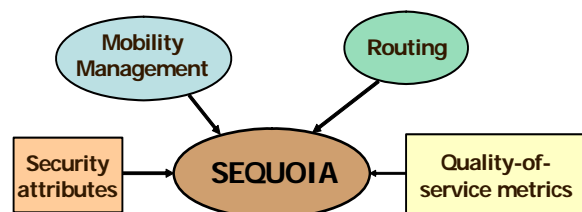
MANETS?

- How can we meaningfully tradeoff security and QoS?
- How can security and QoS-aware routing be optimized through the use of mobility information?

### Rationale and Approach

As ubiquitous connectivity and pervasive computing become more widespread, it is inevitable that users would want assurances on the security properties (i.e., confidentiality, integrity, and availability) of information exchanged over the various constituent mobile ad-hoc wireless networks. This raises the fundamental question of how such security assurance requirements can be specified as part of the service requirements of an overall quality of service (QoS) framework and how such service requirements can be met with the help of the underlying routing and mobility management services. Unfortunately, today's routing and QoS management protocols are designed to optimize well known QoS requirements related to network performance such as minimum required bandwidth, latency, loss rate and throughput and this may conflict with the goal of meeting the required security-relevant service requirements.

The project is currently pursuing the following innovations as part of the technical approach to address security and QoS in MANETs.



The SEQUOIA Framework

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- A framework for the integration of security into a broader notion of QoS,
- Investigations into how security interacts with other service tradeoffs,
- An adaptive framework for QoS-based and security-aware routing,
- Metrics driven management of QoS within routes,
- Use of mobility information to improve security inclusive QoS performance.

### Current Status

The project is currently investigating and making progress on several technical issues such as:

- Extensions to routing protocols so that routing is aware of security attributes of mobile nodes,
- Metrics to study security and performance tradeoffs and represent a composite security-inclusive QoS posture,
- Development of an adaptive framework for route management,
- Development of realistic simulation models to measure the behavior and performance of our algorithms,
- Development of multi-tiered mobility models that capture both individual node mobility as well as group mobility, so as to enable

realistic and more accurate modeling of mobility and more efficient mobility estimation,

- Analysis of the vulnerability of currently published QoS signaling protocols for MANETs.

### Summary

In summary, the SEQUOIA project is addressing the issue of how to integrate security as one aspect of QoS in MANETs. To date, routing and QoS have been addressed in isolation. In the future, as MANETs become pervasive, there will be an increased demand to deploy critical services across multiple MANETs in an interoperable fashion. Examples of this include disaster management networks that interconnect rescue, law enforcement and medical personnel so as to provide coordinated response to scenarios on the scale of the Sept. 11, 2001 terrorist attacks. In such a setting, the security and QoS posture that can be supported by individual networks and their member nodes will vary considerably. The vision of SEQUOIA is to provide the mechanisms to enable both intra-network and inter-network integration of security and QoS into the routing and delivery of critical communications. Applications will be able to specify the desired level of security and service priority so that critical communications will take precedence over non-critical messages.

