An Autonomic Knowledge Monitoring Scheme for Trust Management on Mobile Ad Hoc Networks

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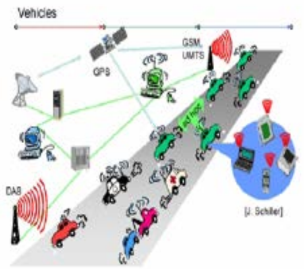
Outline

- Introduction
- Problematic
- Existing trust management frameworks
- Autonomic trust knowledge monitoring scheme (ATMS)
- Evaluation and results
- Conclusion and perspectives

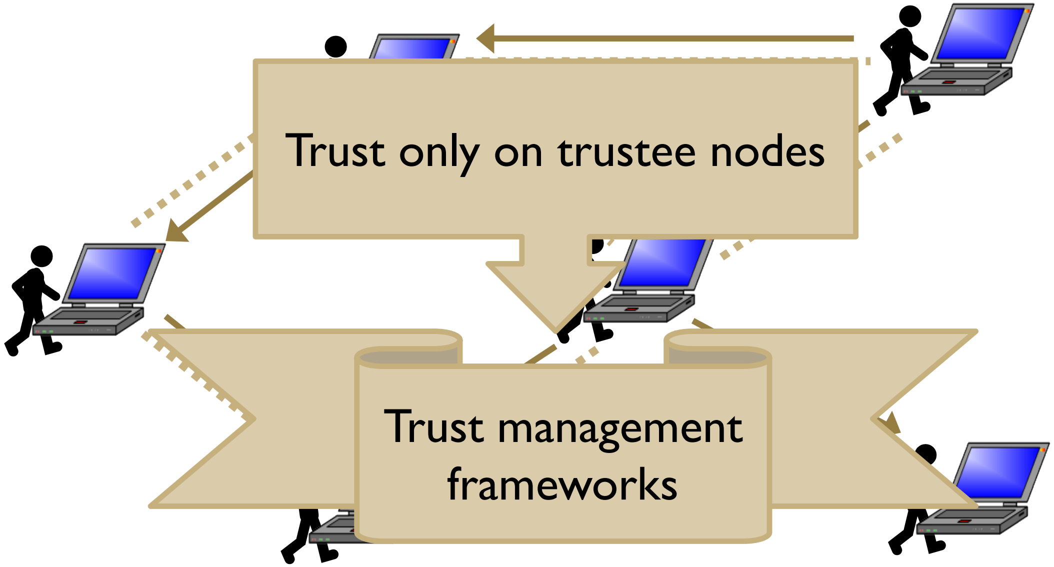
Introduction

- Mobile Ad hoc Networks (MANETs)
  - Lack of central administration
  - Mobility
  - Dynamic context
  - Wireless medium
  - Resource constrained



Introduction

- Lack of any established infrastructure → collaboration
- Self-organized nature & insufficient resources → selfish or malicious behavior (untrustworthiness)

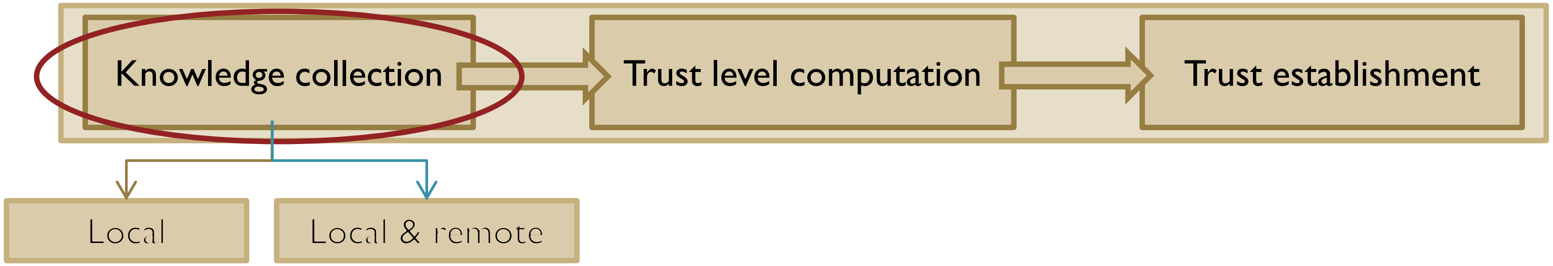


Trust only on trustee nodes

Trust management frameworks

Introduction

- Components



Knowledge collection

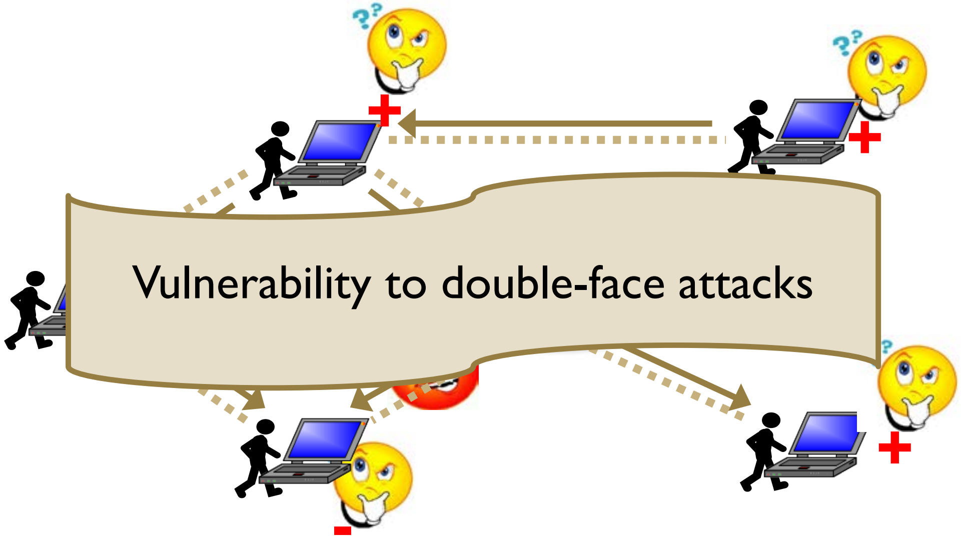
Trust level computation

Trust establishment

Local

Local & remote

- Double-face conduct



Vulnerability to double-face attacks

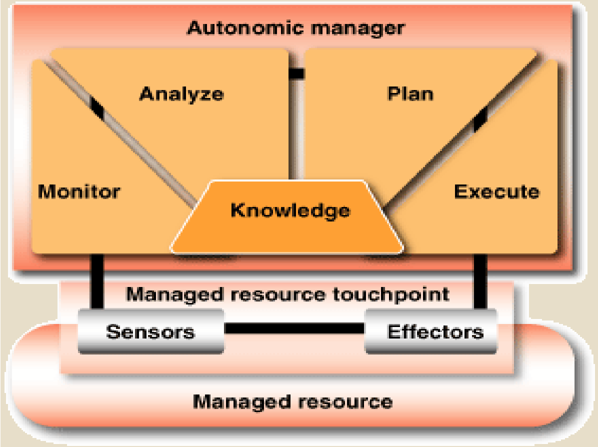
- Objective: proposing a trust management framework which ensures a uniform distribution of trust values among nodes while maintaining a minimum generated overhead trying to minimize the vulnerability to double-face attacks

Trust management frameworks

	Watchdog	OMTF	HTP	Bella
Monitored information	Local	Local & remote	Local & remote	Local & remote
Trust Monitoring	Promiscuous mode	Flooding	Recommendation Exchang Protocol	Situated view
Overhead	+ +	- -	+	-
Real-timeness	+	+	+	x
Knowledge uniformity	- -	++	-	x
Optimal ressource use	-	- -	-	-

Autonomic communication

- Autonomic communication
  - MAPE-K reference model



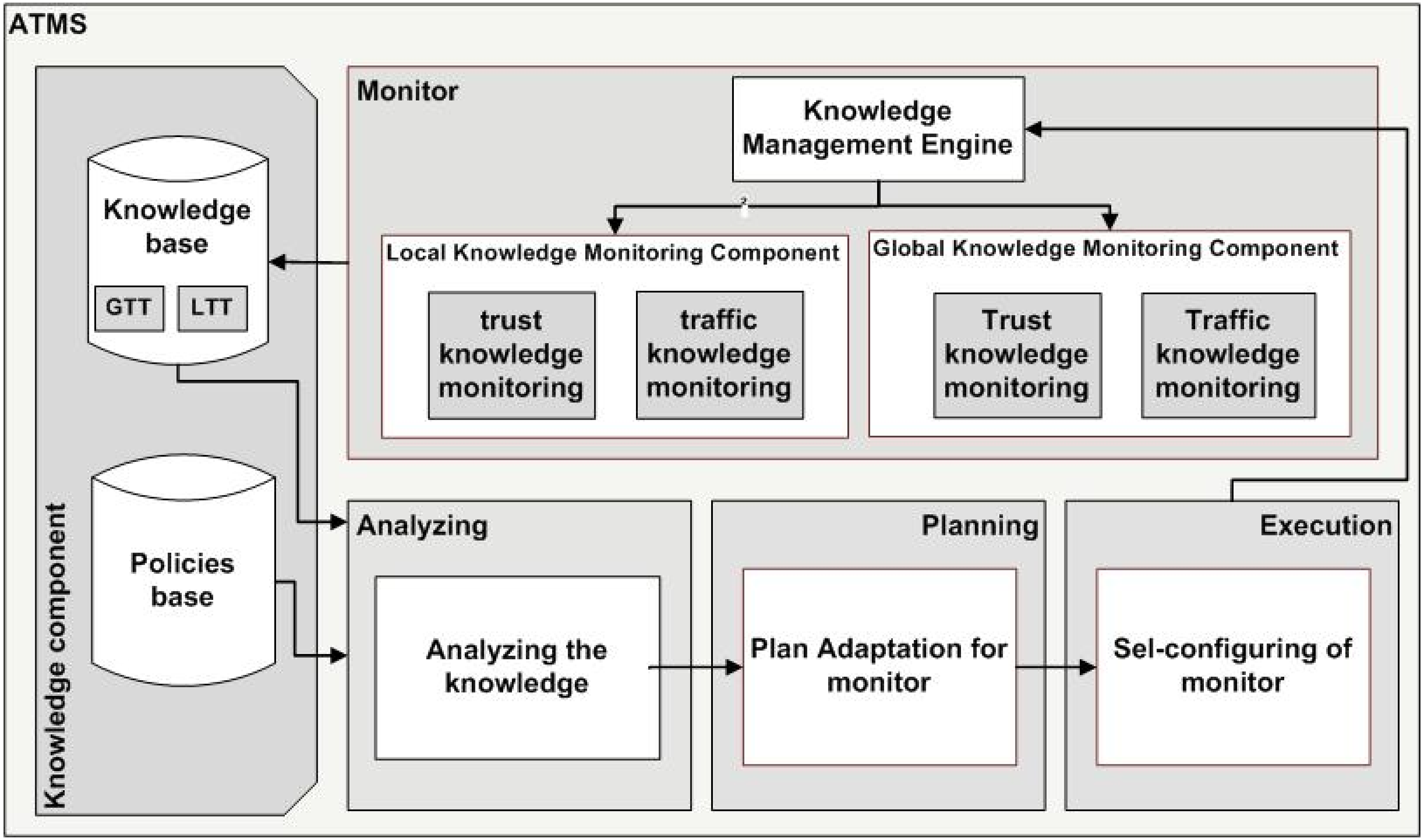
[1] IBM's MAPE-K reference model

- Complementary of autonomic computing and trust management

➢ Optimizing the use of resources according to the dynamic network context

[1] IBM white paper. "An architectural blueprint for autonomic computing", April 2003.

ATMS: Autonomic Trust Monitoring Scheme


ATMS
Knowledge component
Knowledge base
GTT
LTT
Policies base
Monitor
Knowledge Management Engine
Local Knowledge Monitoring Component
trust knowledge monitoring
traffic knowledge monitoring
Global Knowledge Monitoring Component
Trust knowledge monitoring
Traffic knowledge monitoring
Analyzing
Analyzing the knowledge
Planning
Plan Adaptation for monitor
Execution
Sel-configuring of monitor

ATMS: evaluation

- Ns-2 version 2.32
- ATMS instantiated on Bella
- ATMS compared to Bella

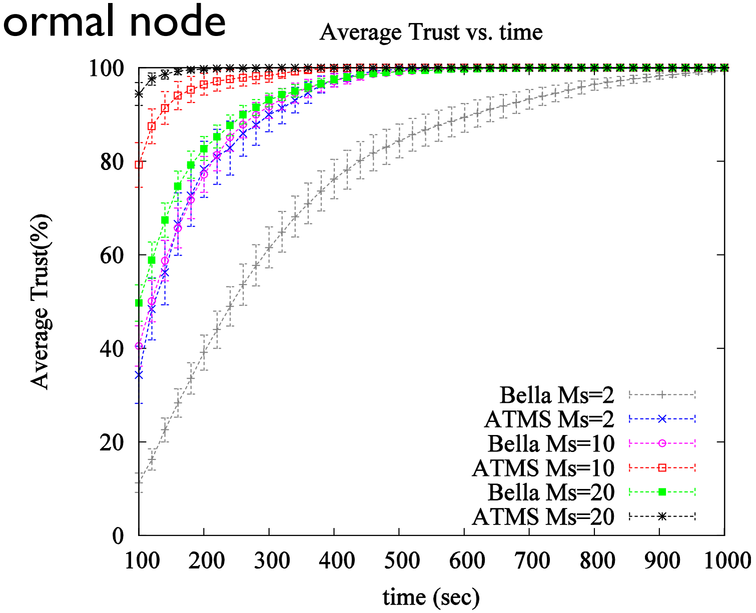
Parameter	Value
Transmission rate	11 Mbps
Propagation model	TwoRayGround
Transmission range	100m
Queue length	64 packets
Mobility model	RWP model
Network area	500m x 500m
Node number	20, 30, 50
Attacker number	10%
Application type	CBR
Packet size	512 bytes
Application rate	4 packets/s
Number of connections	5, 10
Maximum speed	2,10, 20 m/s
Pause time	5s
Simulation time	1000s
Simulation runs	30
Confidence interval	95%

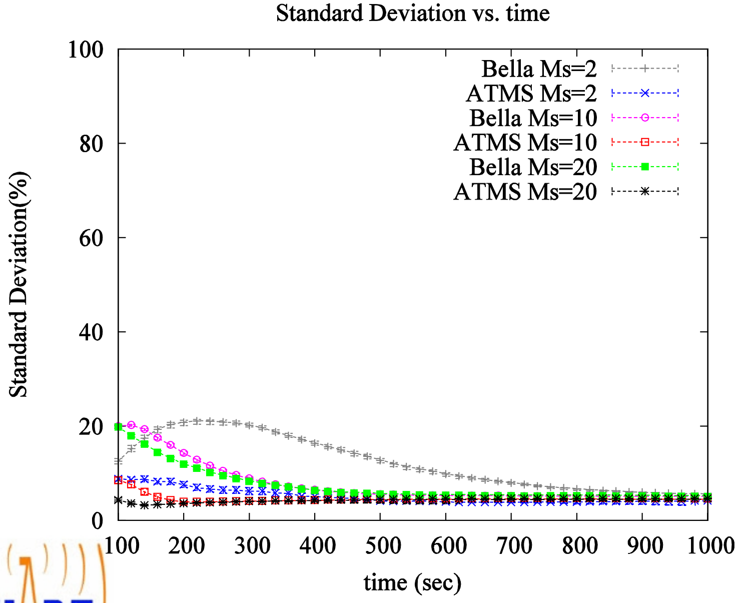
AMTS: evaluation metrics

- Network performance
  - Packet Delivery Ratio (PDR)
  - Average End-To-End Delay (AE2ED)
- Knowledge quality
  - Average trust
  - Trustworthiness standard deviation
  - Correctness

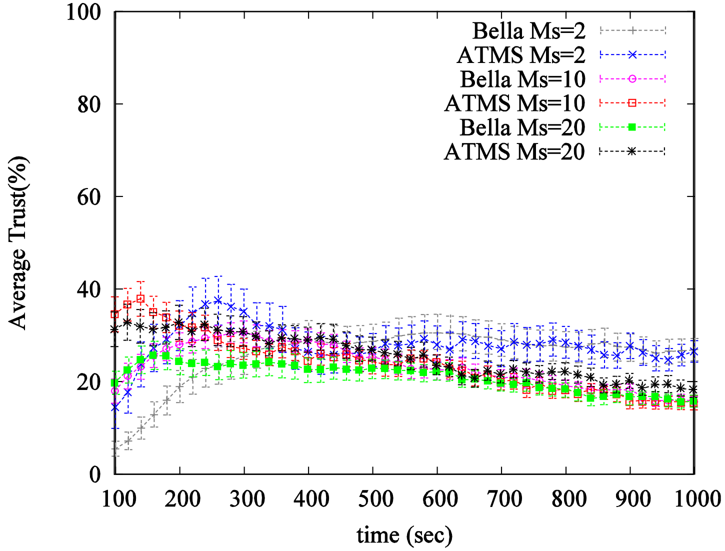
ATMS: knowledge quality results

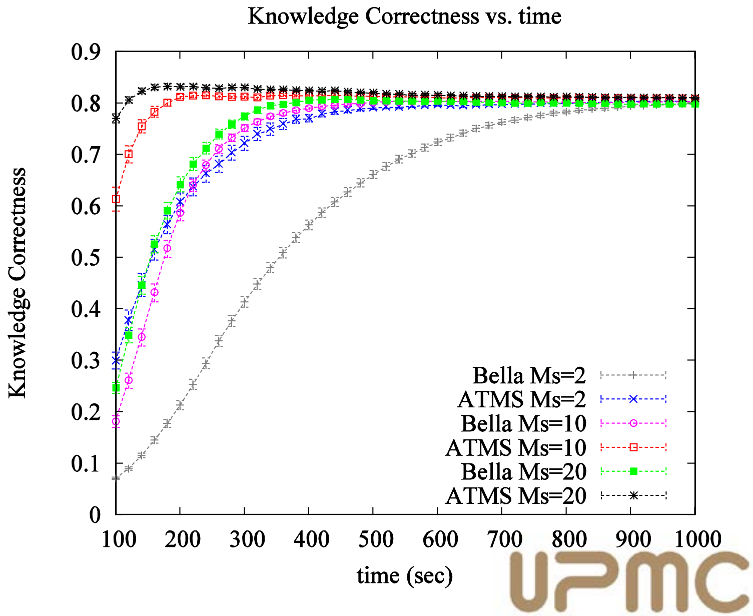
Normal node





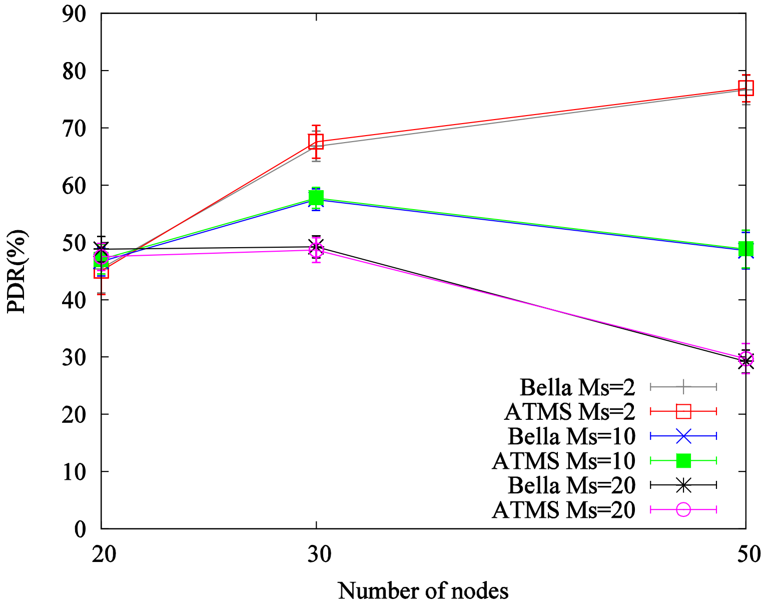
Attacker node

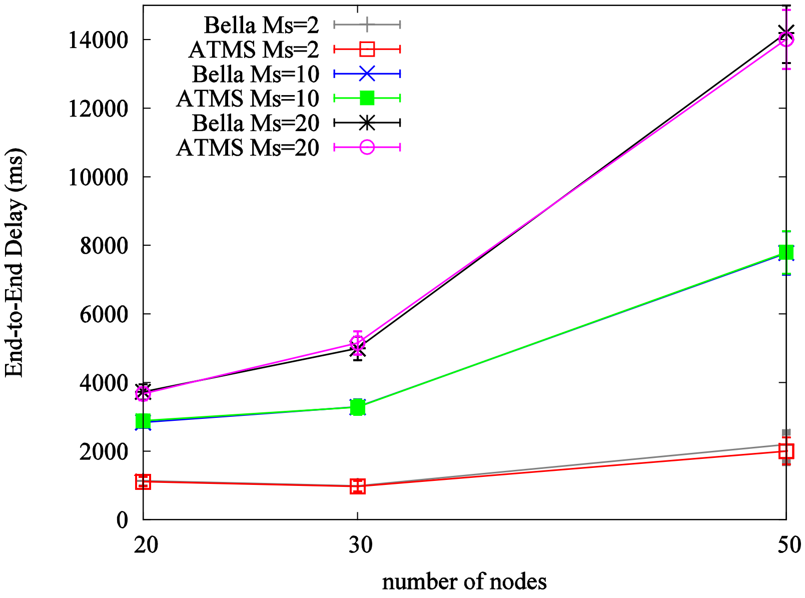




ATMS: performance results

- 10 connections





Conclusion

- ATMS is an autonomic knowledge monitoring scheme for trust management in mobile ad hoc networks
- Characteristics
  - Real-time monitoring
  - Excellent knowledge quality
  - Knowledge Uniformity across nodes
  - Reduce the impact of double-face attacks
  - Optimal use of resources
  - Minimum extra overhead
  - With neutral impact of monitoring overhead on Quality of service
  - The excellent knowledge quality implies that a relevant enhancement of QoS is expected when the knowledge is used to establish or not the trustworthiness relationship with other nodes
  - Self-adaptation
  - Protocol and trust framework independence
  - Low computational intensiveness

Perspectives

- Enhancing the network performance, using the monitored knowledge as input of a routing decision process.
- Investigate the use of more elaborated policies and their impact on our scheme