Annual review FLORENCE 2013

WP4 – Network: prototypes

WP4 prototypes

- Task 4.1 Smart SPD driven transmission
  - P1: SPD-driven Smart Transmission Layer
- Task 4.2 Distributed self-x models
  - P2: Recognizing and Mitigating DoS Attacks
  - P3: Model-based Framework for Dependable Distributed Computation
- Task 4.3 Reputation-based resource management technologies
  - P4: Reputation-based Secure Routing
  - P5: Intrusion Detection System
- Task 4.4 Trusted and Dependable Connectivity
  - P6: Link Layer Security
  - P7: Network Layer Security
  - P8: Access Control in Smart Grid Networks

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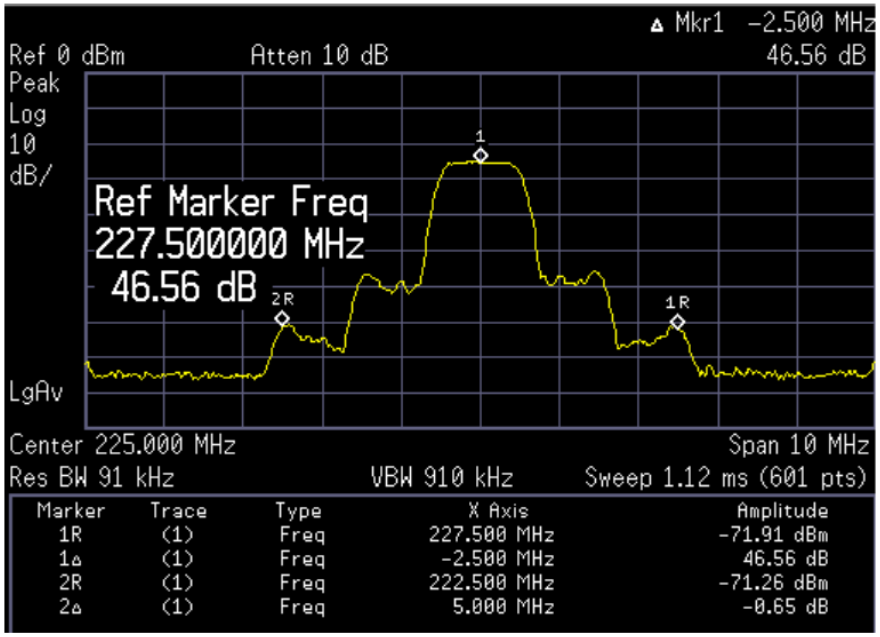
SPD-driven Smart Transmission Layer (1)

- Test bed prototype consists of:
  - 2 SDR-capable nSHIELD Power Nodes (OMBRA v2)
  - 2 SE HandHeld devices
  - Auxiliaries

SPD-driven Smart Transmission Layer (2)



- Four functionalities have so far been implemented and studied:
  - Remote control of the radio
  - Waveform analysis
  - Interference detection
  - Spectrum sensing

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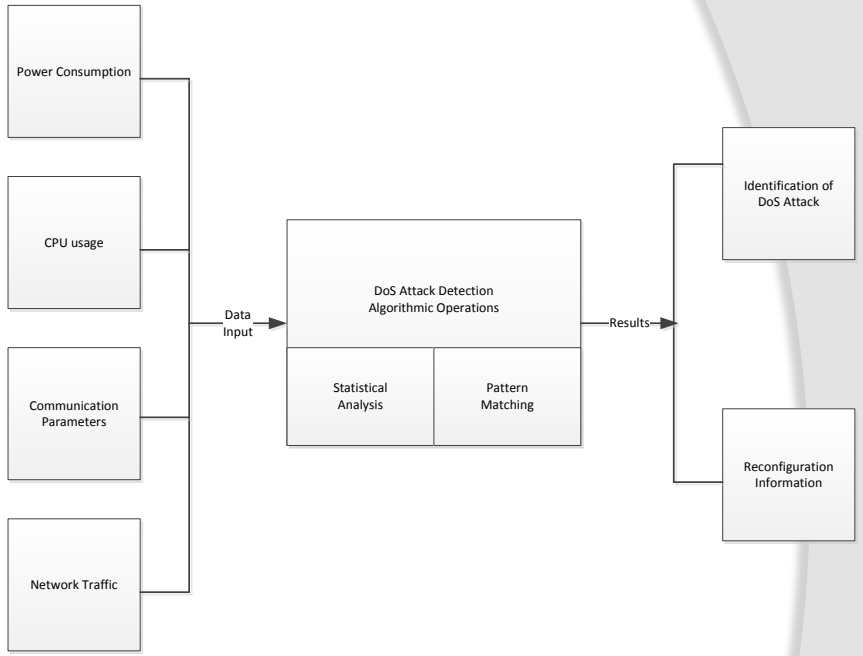
Recognizing DoS attacks (1)

- Statistical analysis and pattern matching algorithms analyze power consumption, CPU usage and network status
- Correlation of all inputs can detect abnormal situations (DoS attack notification)
- Correlated Patterns can be matched to database of normal and abnormal scenarios



- The main output of the algorithm is the detection alarm but reconfiguration commands can be issued with proper training

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Recognizing DoS attacks (2)

	CPU abnormalities	Power abnormalities	Traffic abnormalities
Detection Accuracy	70%	60%	50%
False positives	15%	20%	15%

- Algorithms and network simulated in OMNET++ and MiXiM platforms
- Initial simulations point to a good detection accuracy although real world implementation needed
- Porting to the BeagleBone family of platforms under way

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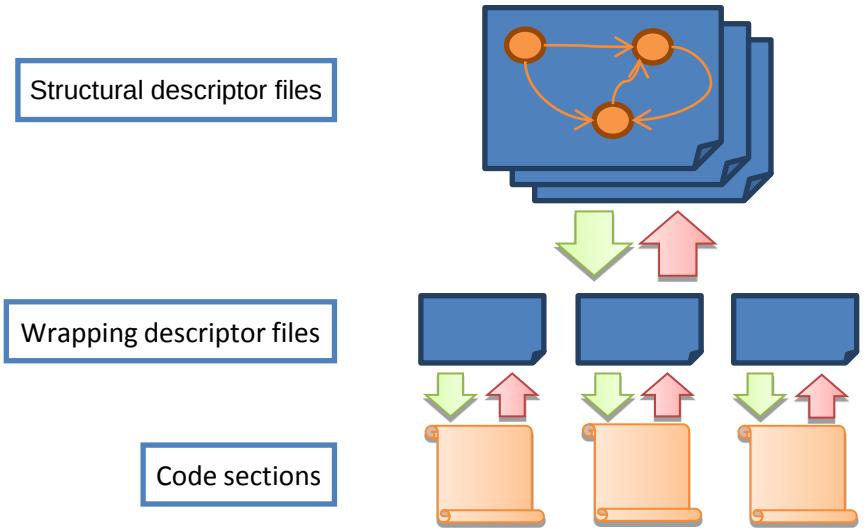
Model-based framework for dependable distributed computation (1)

- Abstracts an application using a dataflow metamodel
- Enables mixed-language mixed-architecture distributed processing
- Simplifies safe component reusal



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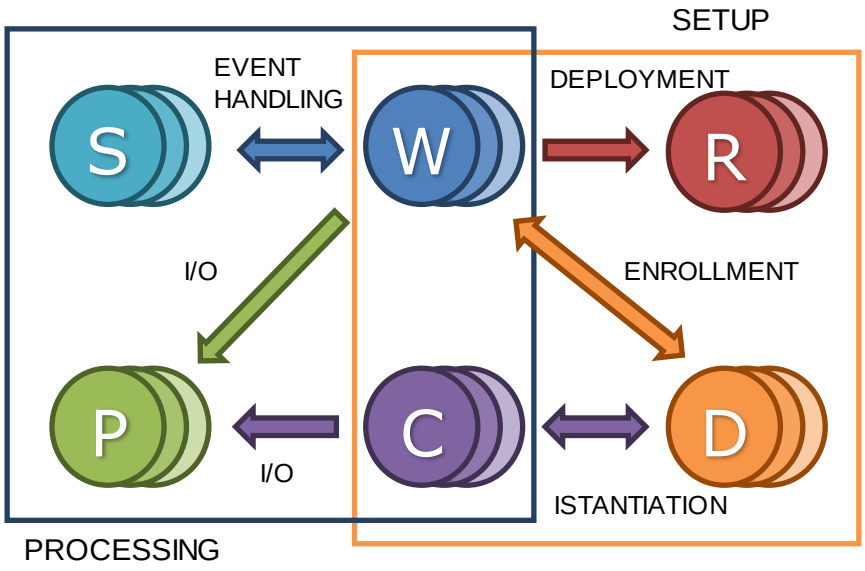
Model-based framework for dependable distributed computation (2)

- There exist multiple *roles*, with possibly multiple nodes taking each one
- The worker (W) role is taken by embedded devices
- All roles except the client (C) may be taken by server(s)



Reputation-based Secure Routing (1)

- Distributed ad-hoc systems: each entity depends on its neighbors to accomplish full communication among all participants.
- Trust and Reputation: important mechanisms for correct routing behavior
- Counter action against several routing attacks: Black-Hole, Gray-Hole, Bad mouthing

Reputation-based Secure Routing (2)

- Hardware Platform: Memsic IRIS
- Operating System: TinyOS 2.x
- Routing Protocol: Greedy Perimeter Stateless Routing
- Trust Module: configurable SPD Level

SPD Level	Nano
1 (lowest)	-
2 (low)	DT (Direct Trust)
3 (medium)	Weighted DT (Direct Trust) + ID (Indirect Trust)
4 (high)	Weighted DT + ID + Beta distribution

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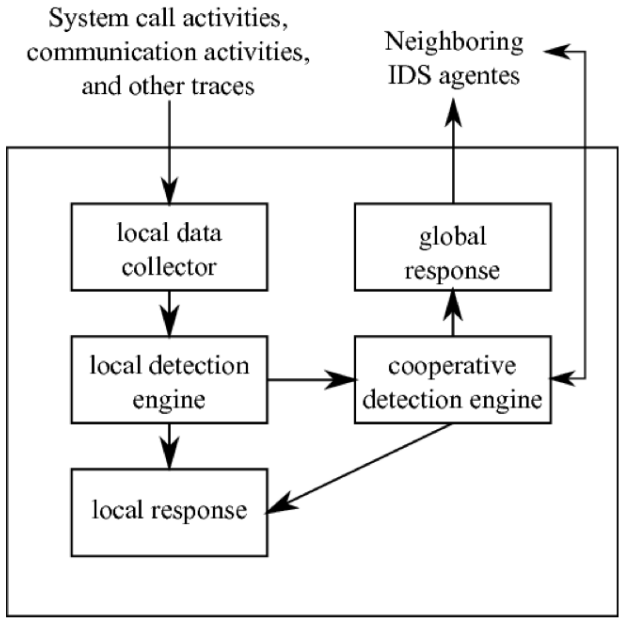
Intrusion Detection System (1)

- Local detection uses Specification-based and Reputation and Trust detection techniques
- Cooperative detection uses Reputation and Trust techniques only.



- Reputation and Trust techniques use direct (first-hand) and indirect (second-hand) information.
- Using a Bayesian model for Reputation and Trust management.

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Intrusion Detection System (2)

- A considered IDS is based on nodes' cooperation in a fully distributed environment

REPUTATION TABLE		
Node ID	α	β
⋮	⋮	⋮
Node ID	α	β

FIRST-HAND INFORMATION TABLE		
Node ID	α	β
⋮	⋮	⋮
Node ID	α	β

TRUST TABLE		
Node ID	α	β
⋮	⋮	⋮
Node ID	α	β

- Proposed IDS prototype consists of a number of wireless sensors sending information to the base station via gateway
  - Platform of choice is Zolertia Z1 running Contiki

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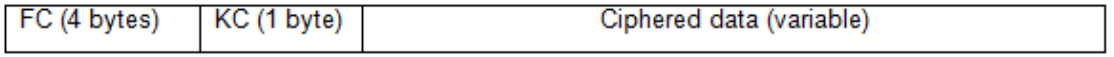
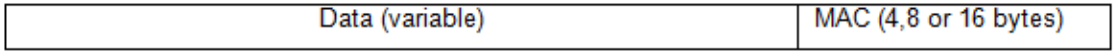
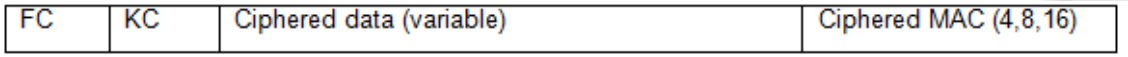
Link layer security (1)

- 802.15.4 provides four basic security services:
  - Access control
  - Message integrity
  - Message confidentiality
  - Replay protection
- Security algorithms supported
  - CTR
  - CBC-MAC
  - CCM

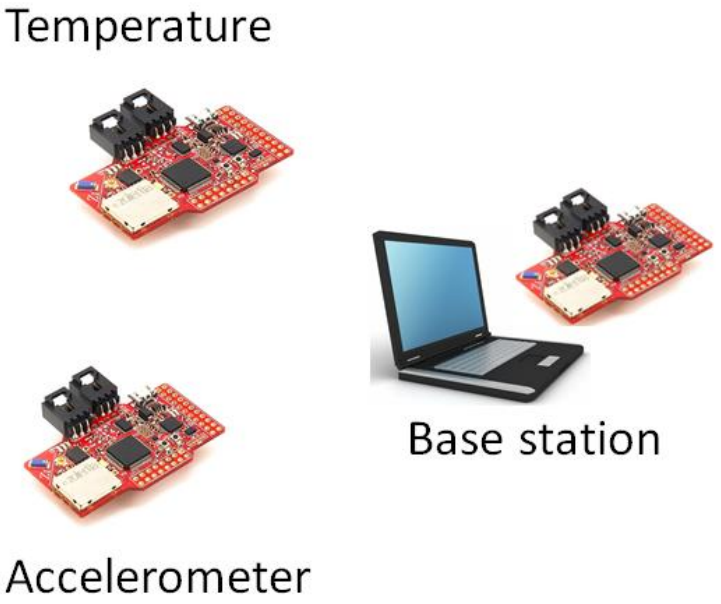


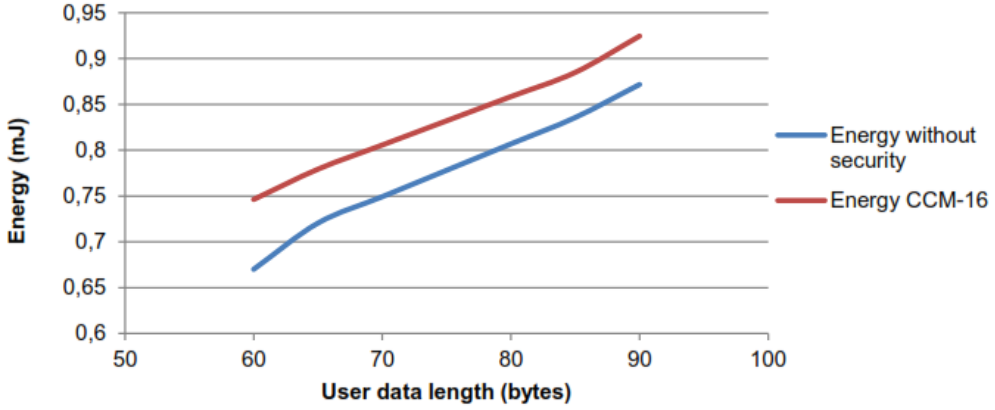




Link layer security (2)

- Two sensors sending information to the base station
  - Without security
  - TinyOS hardware security CCM-16



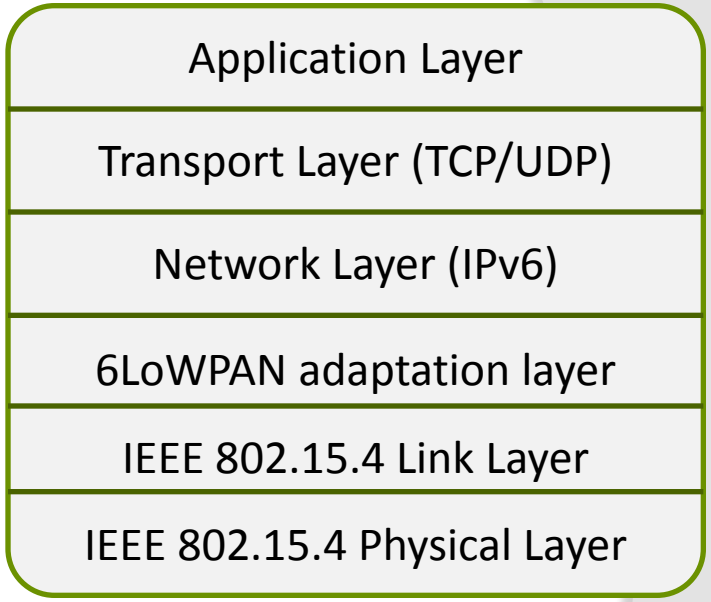


Network layer security (1)

- IPSEC can be the solution for securing messages at the IP layer for
  - Routing protocols
  - End-to-end security where DTLS would not apply, e.g. TCP-based cross-boundaries communications
  - Any application
- IPSEC provides:
  - Confidentiality
  - Message authentication
  - Message integrity

Network layer security (2)

- 6LoWPAN adaptation layer
  - requires **header encoding**
- IPsec utilizes underlying AES_CCM* (found on IEEE802.15.4 chips)
  - CCM (Counter with CBC-MAC) is an **authenticate-and-encrypt** block cipher mode
  - Authenticated ESP. No need for AH overhead
  - Also provides encryption-only and integrity-only capabilities



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Access control in Smart Grid Networks

- Smart grids – fundamental infrastructure for energy distribution across cities

- Access control and encryption are studied in order to ensure security in network layer within low voltage domain

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The END

That’s all folks!

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