Energy and Distance evaluation for Jamming Attacks in wireless networks

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Outline

01. Introduction
02. Objectives of this study
03. System model
04. Results
05. Discussions & Conclusion

01

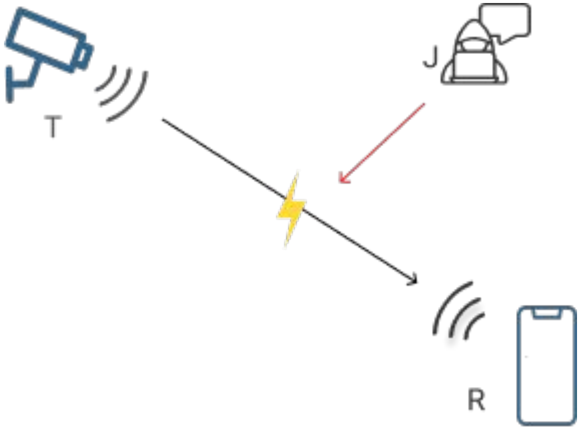
Introduction

Goal of Jamming Attack ?

“Prevent the exchange of packets between the legitimate nodes of the networks”

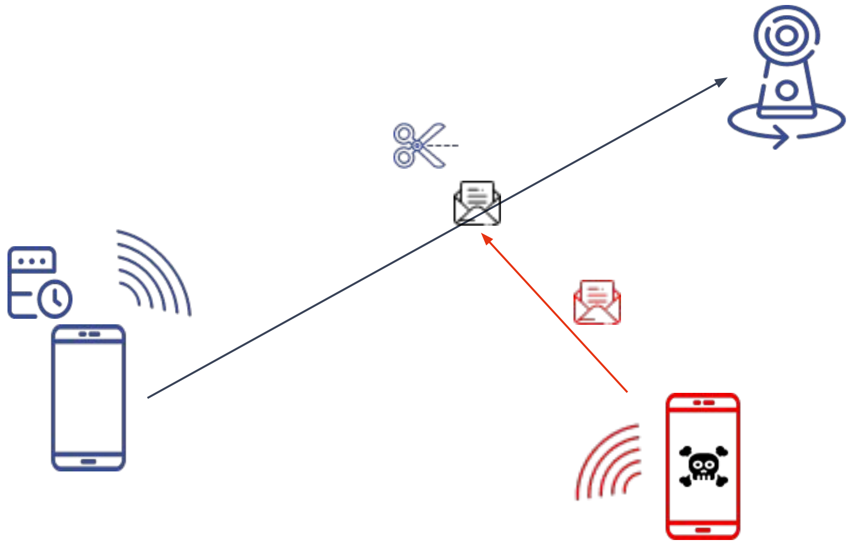
Consequences :

- A **loss** of crucial **information**, **communication**.
- The **lifetime of a device is reduced.**
- A **decrease in the Quality of Service**.
- Denial-of-Services - Denial-of-Sleep



Transmission under Jamming Attack

Two potential scenarios :



02

The objectives

The objectives of this study:

The study objectives of jamming attacks:

- Better understand jamming attacks parameters
- Create more robust communications protocols, effective detection and protection systems
- Better understand the location of jamming node problem.

Related works:

- **REF1:** Ashraf, Qazi Mamoon, Mohamed Hadi Habaebi, and Md Rafiqul Islam. "*Jammer localization using wireless devices with mitigation by self-configuration*." *Plos one* 11.9 2016 . .
- **REF2**: Panyim, Korporn, et al. "*On limited-range strategic/random jamming attacks in wireless ad hoc networks*." *2009 IEEE 34th Conference on Local Computer Networks*. IEEE, 2009.
- **REF3**: Commander, Clayton W., et al. "*Jamming communication networks under complete uncertainty*." *Optimization Letters* 2.1 (2008): 53-70.
- **REF4**: Li, Mingyan, Iordanis Koutsopoulos, and Radha Poovendran. "O*ptimal jamming attacks and network defense policies in wireless sensor networks*." *IEEE INFOCOM 2007-26th IEEE International Conference on Computer Communications*. IEEE, 2007.

Hypothesis:

Jammer node assumptions:

- Constrained in energy and resources consumption
- Optimize its impact while minimizing its energy consumption.

Evaluation of many parameters together:

- energy consumption spent
- jamming efficiency
- probabilities of being detected

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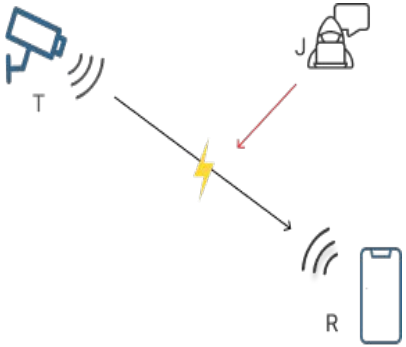
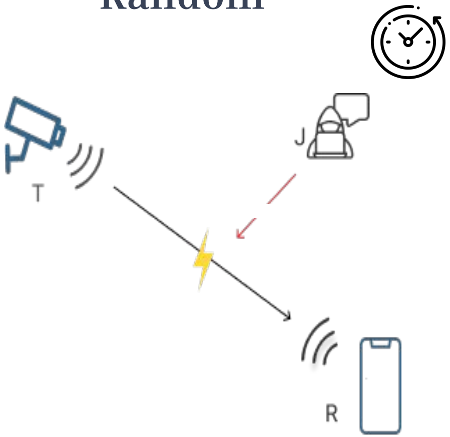
System model

Several attack strategies

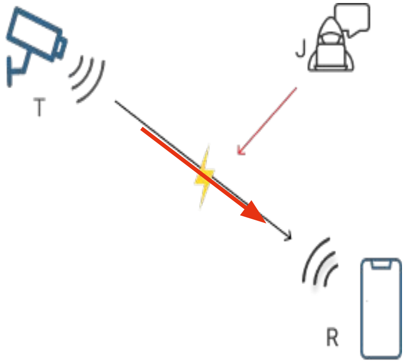
Constant



Random



Reactive



Simulation Details

Strategies of Jamming attacks:

Parameters	Constant Jammer	Random Jammer	Reactive Jammer
Send interval(ms)	Continuously	Between 100 and 1	Send interval of the legitimate node

Factors taken into account:

- energy
- detection time
- impact on the networks
- the distance between the transmitter and the attacker
- the distance between the transmitter and receiver.

@image ns3: https://www.google-melange.com/archive/gsoc/2014/orgs/ns3/logo-200.png

Impact of the network:

Metric used :

- Packet Delivery Ratio(**PDR**) on the transmitter side with ACK packet:

$$\text{PDR} = \frac{\text{Total packets successfully received}}{\text{Total packets send}}$$

Detection Method:

- **Detection using a threshold :**
  - If the PDR metric is lower than the defined threshold, an attack is detected
  - Number of observations

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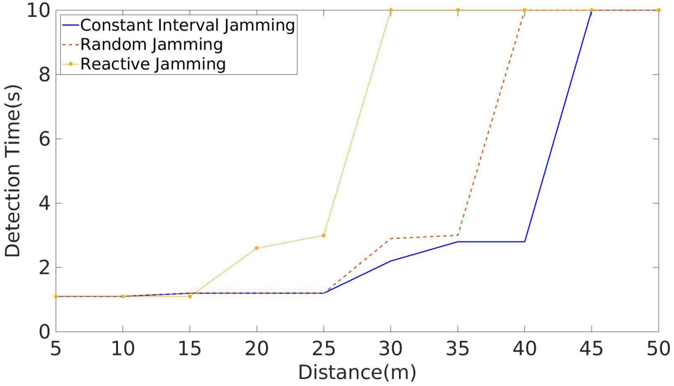
Results

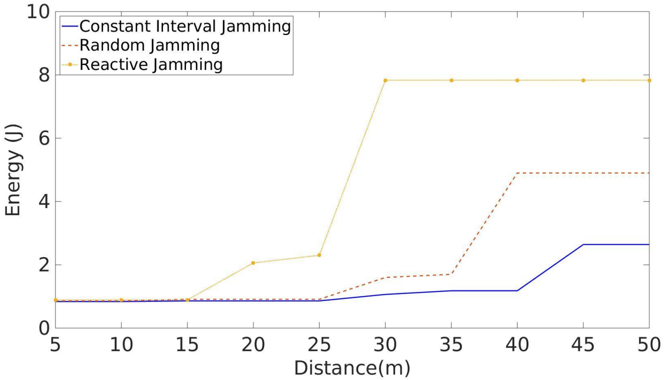
Results

Distance between transmitter and receiver	20 m
Detection threshold	99%
Start time of detection and jamming attack	1 s

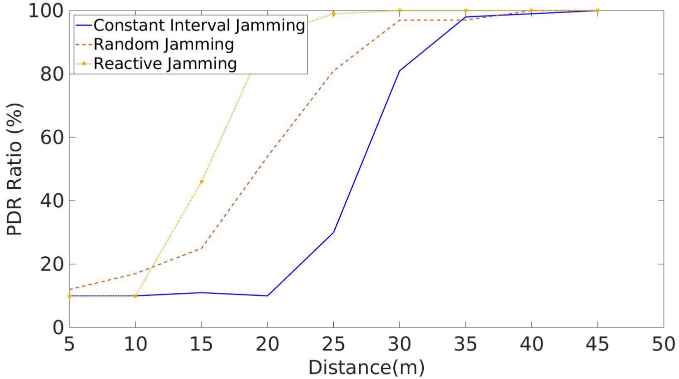
Detection time as a function of distance



Total energy spent until detection as a function of distance

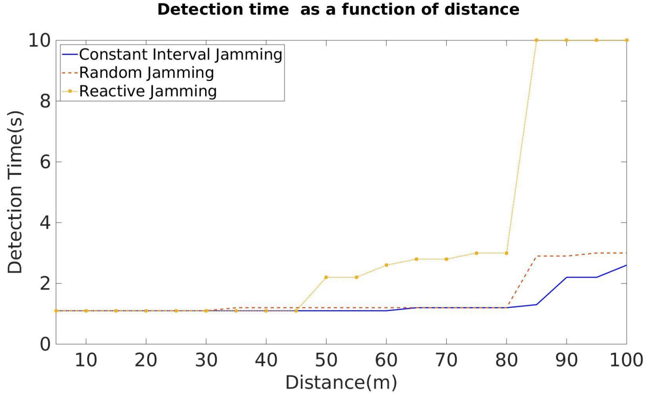


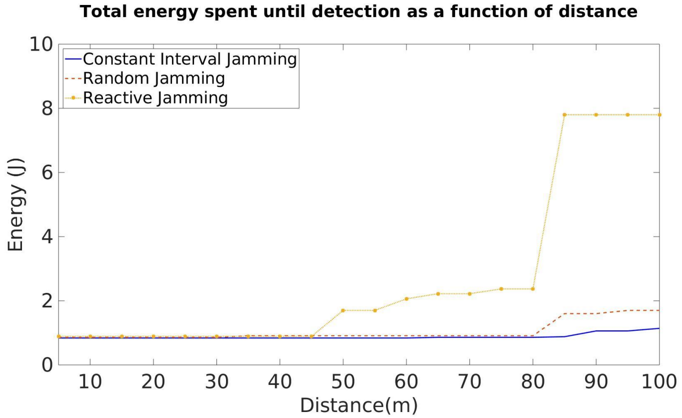
PDR ratio as a function of distance after 10 seconds of simulation

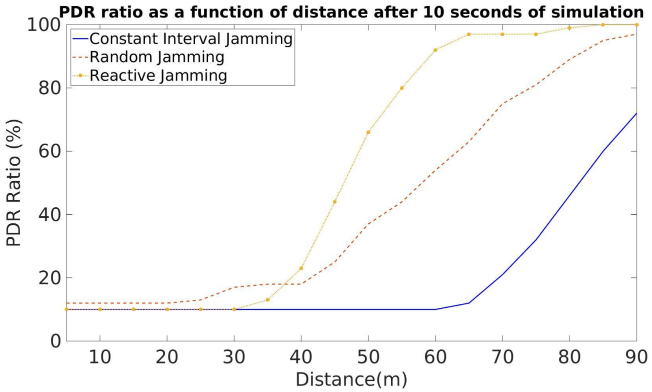


Results

Distance between transmitter and receiver	60 m
Detection threshold	99%
Start time of detection and jamming attack	1 s


Detection time as a function of distance


Total energy spent until detection as a function of distance


PDR ratio as a function of distance after 10 seconds of simulation

Results:

The choice of optimal strategy depends on several parameters:

- Position of the jammer
- Energy consumption
- Detection probability

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Discussion & Conclusion

Discussion & Conclusion

Work completed:

- The choice of optimal strategy depend on several parameters evaluated together

Future works:

- Simulation performed under optimal conditions: detection threshold 99%.
- Conduct the same evaluation with a multitude of victim nodes
- Creation of “intelligent” jammer which chooses strategy according to evaluated parameters

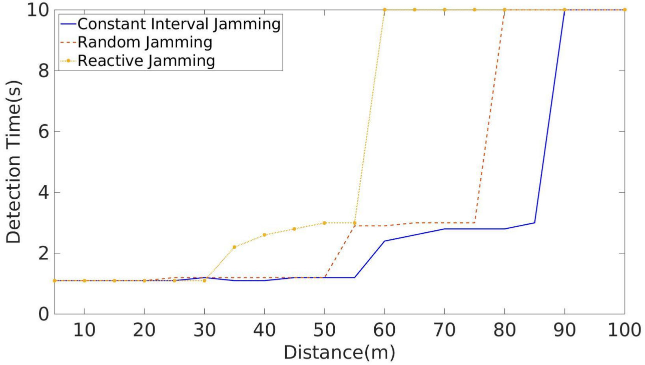
Thank you !

Any questions ?

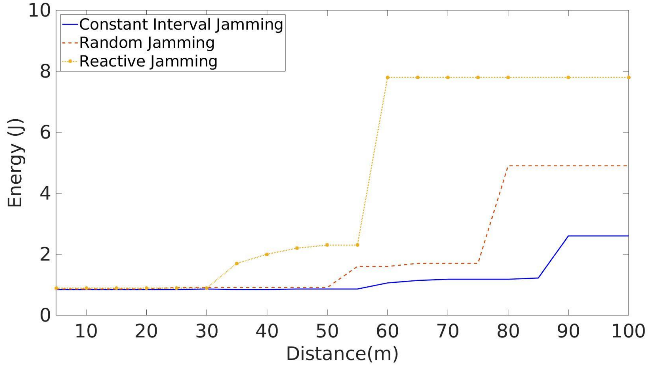
Results

Distance between transmitter and receiver	40 m
Detection threshold	99%
Start time of detection and jamming attack	1 s

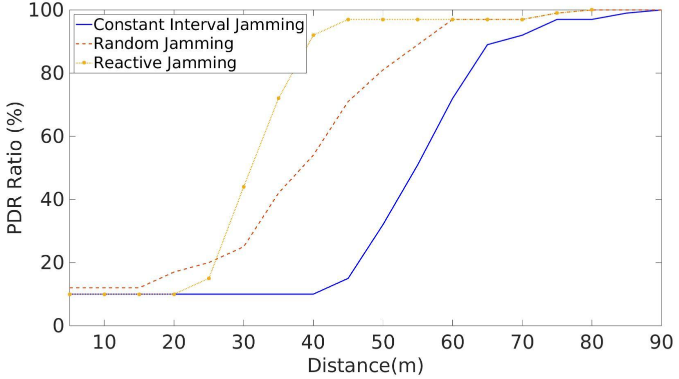
Detection time as a function of distance



Total energy spent until detection as a function of distance



PDR ratio as a function of distance after 10 seconds of simulation


Constant Interval Jamming
Random Jamming
Reactive Jamming
PDR Ratio (%)
Distance(m)