Sending On demand Stress signals (SOS)

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Motivation(On-campus crime stats)

Criminal Offenses - On campus

Criminal offense	Total criminal offenses on campus		
	2005	2006	2007
a. Murder/Non-negligent manslaughter	11	8	46
b. Negligent manslaughter	2	0	4
c. Sex offenses - Forcible	2,722	2,717	2,699
d. Sex offenses - Non-forcible (Include only incest and statutory rape)	47	45	38
e. Robbery	2,055	1,981	1,962
f. Aggravated assault	2,906	3,034	2,844
g. Burglary	31,318	32,259	30,295
h. Motor vehicle theft	5,947	5,594	4,944
i. Arson	1,024	966	790

Source: US department of Education

Process Model

Process Model `Trust Model`

Input

On-Line — (i) Location Info / (ii) Encounter Info

Off-Line — (i) Encounter Database / (ii) Eigen Vector Profile Info

`Localization`

Plan A - GPS Usage
Plan B - Non GPS Location Info
Plan C - Location Info using Blue Towers
Plan D - Access Point Campus Map

Ist Decision Factor

Timing Comparision Based on Localization Approach

`Offline Architecture`

Offline Server for Encounter Database Updation and Trust Evidence Establishment

Plan A - Encounter Based Trust
Plan B - Eigen Vector Based Trust

IInd Decision Factor

Timing Comparision Based on Trust Evidence

Output

Trusted Node -> Relay SOS Message

Second/Third Hop Relay of SOS Message

GeoCast SOS Message

Flood SOS Message

Assured Help - Estimated Time - (4-5) Min + 45 Sec

Trust Transitivity & Eigen Vector Profile Match

'Geocast' - Protocol to be Finalized

Assured Help - Estimated Time - (4-5) Min + 45 Sec

IIIrd Decision Factor

Timing Comparision Based on Relay Method

IVth Decision Factor

Comparision based on Transitivity Approach

Vth Decision Factor

Comparision based on GeoCast Protocols
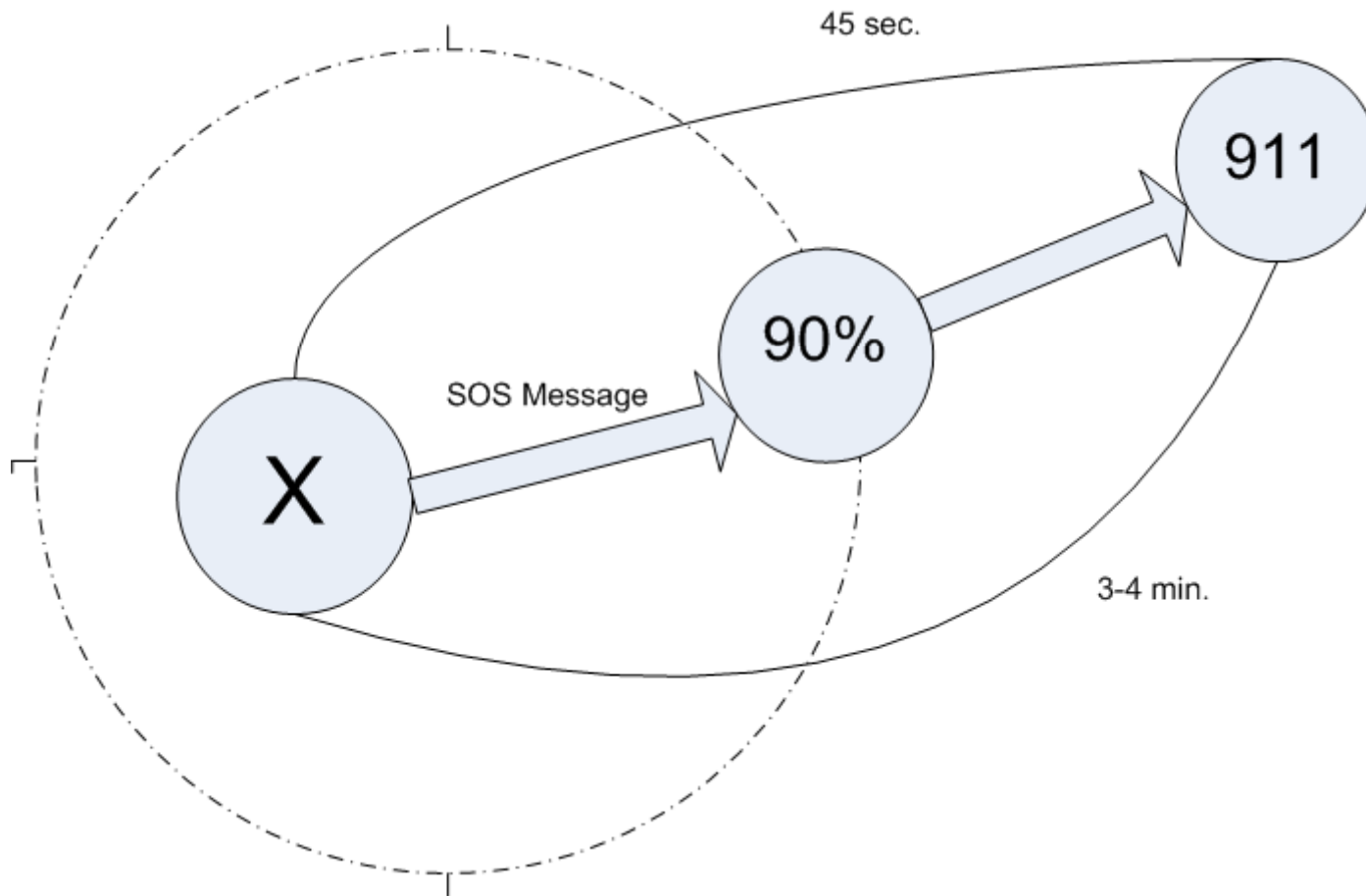
Trusted Nodes

- Search for trusted nodes in your vicinity
- Once found, transmit the SOS message.
- Assumptions:
    - Trusted node availability
    - 911 Response time: 3-4 Min from the Time of Report.
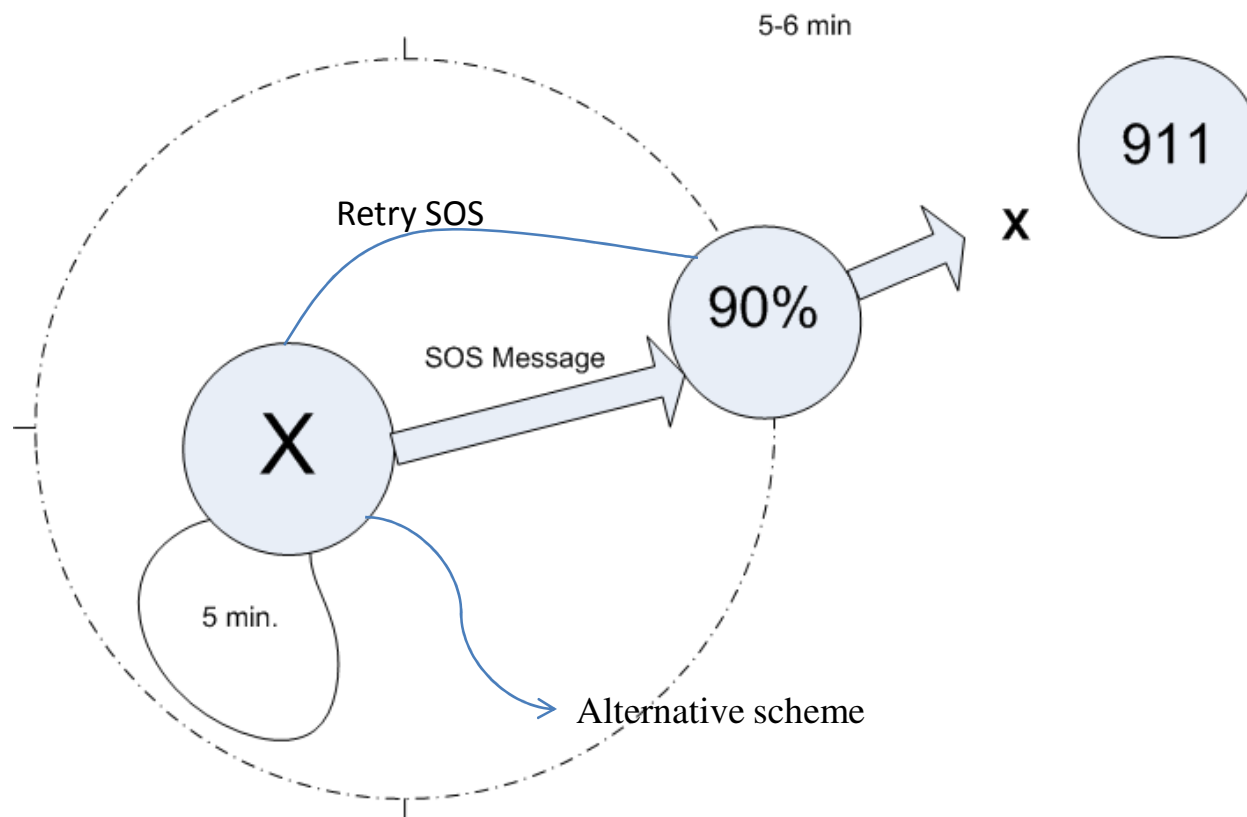   - Mobility should not be too high – should not exceed Neighbor Scan Cycle.

Scenario 1

Scenario 1 – Analysis

- Worst case time estimate: 5 minutes

- (45 – 60 Seconds) : SOS Relay + Receiver Reaction Time

- (3 – 4 Minutes) : 911 Response

Scenario 2 – Lets complicate Scenario 1

Scenario 2 – Lets complicate Scenario 1

- What if Trusted Node does not Respond to SOS Message?

- Mobility vs Acknowledgements

  - Acknowledgements make protocol robust.

    Node need not wait for timeout.

  - No Acknowledgement reduces the effect of Mobility on performance.

    Even if Neighbor goes out of coverage, help will come.

Scenario 3 – Lets complicate Scenario 2
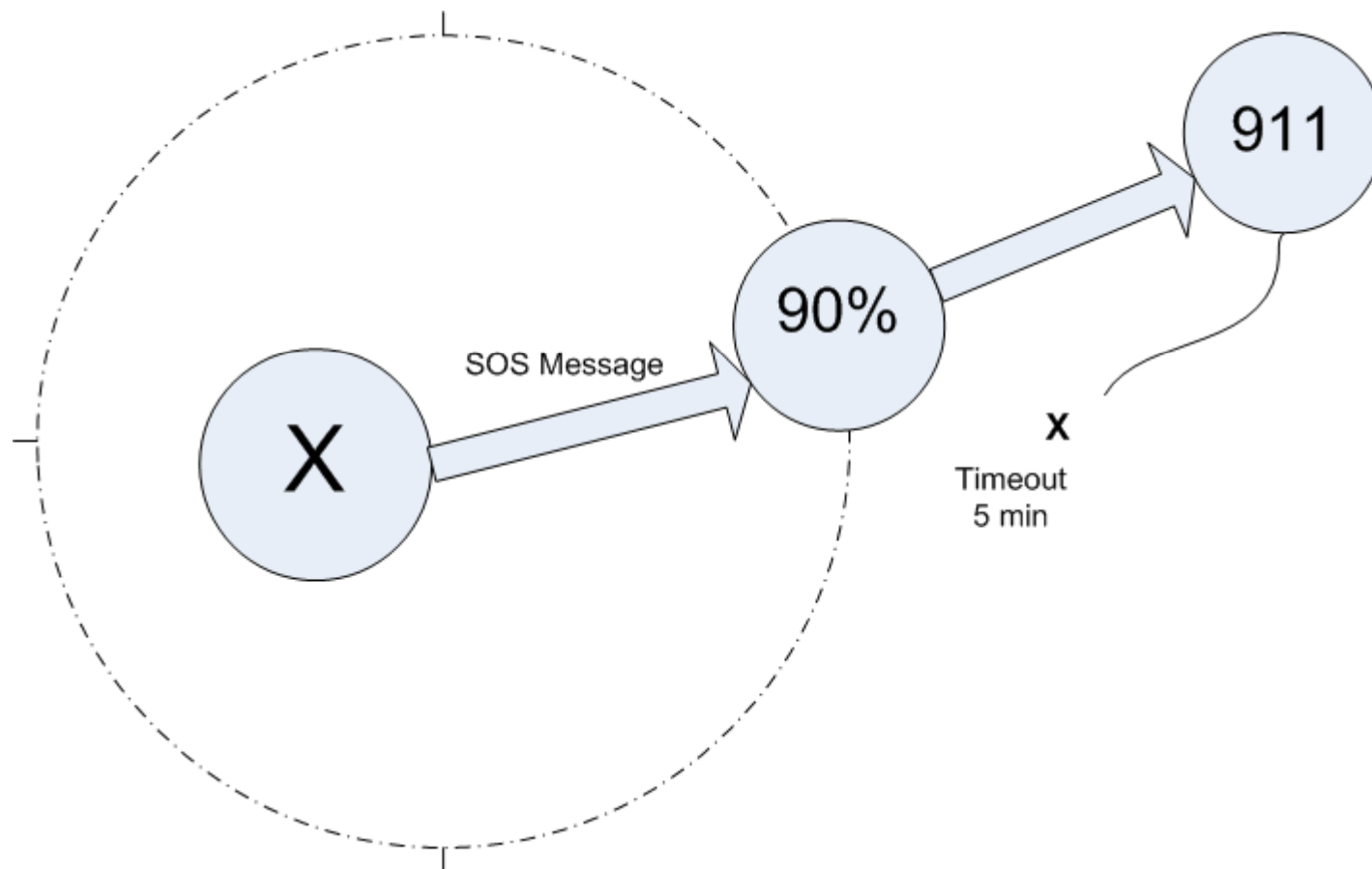
Scenario 3 – Lets Complicate Scenario 2

- Location Information Inconsistency
  - Response – Timeout & Re-analyze

- Delay in 911 Response – Change of Node Location in the meantime.
  - Response – Timeout & Re-analyze

- Frequent change in Location – Node in Motion
  - Response - Breadcrumbs

Second/Third Hop SOS Relay

- Two Schemes
  - Using Encounter traces
  - Using Eigen Vectors
- Assumptions
  - No **Trusted** nodes in the vicinity(sender's range)
  - Nodes are not highly mobile.
  - Relay message sent only to highest trusted node among neighbors.
  - Each intermediate node will relay limited by the number of hops supported by protocol.

Scenario 4- Trace Database

- For 1 and 2-Hop Neighbor
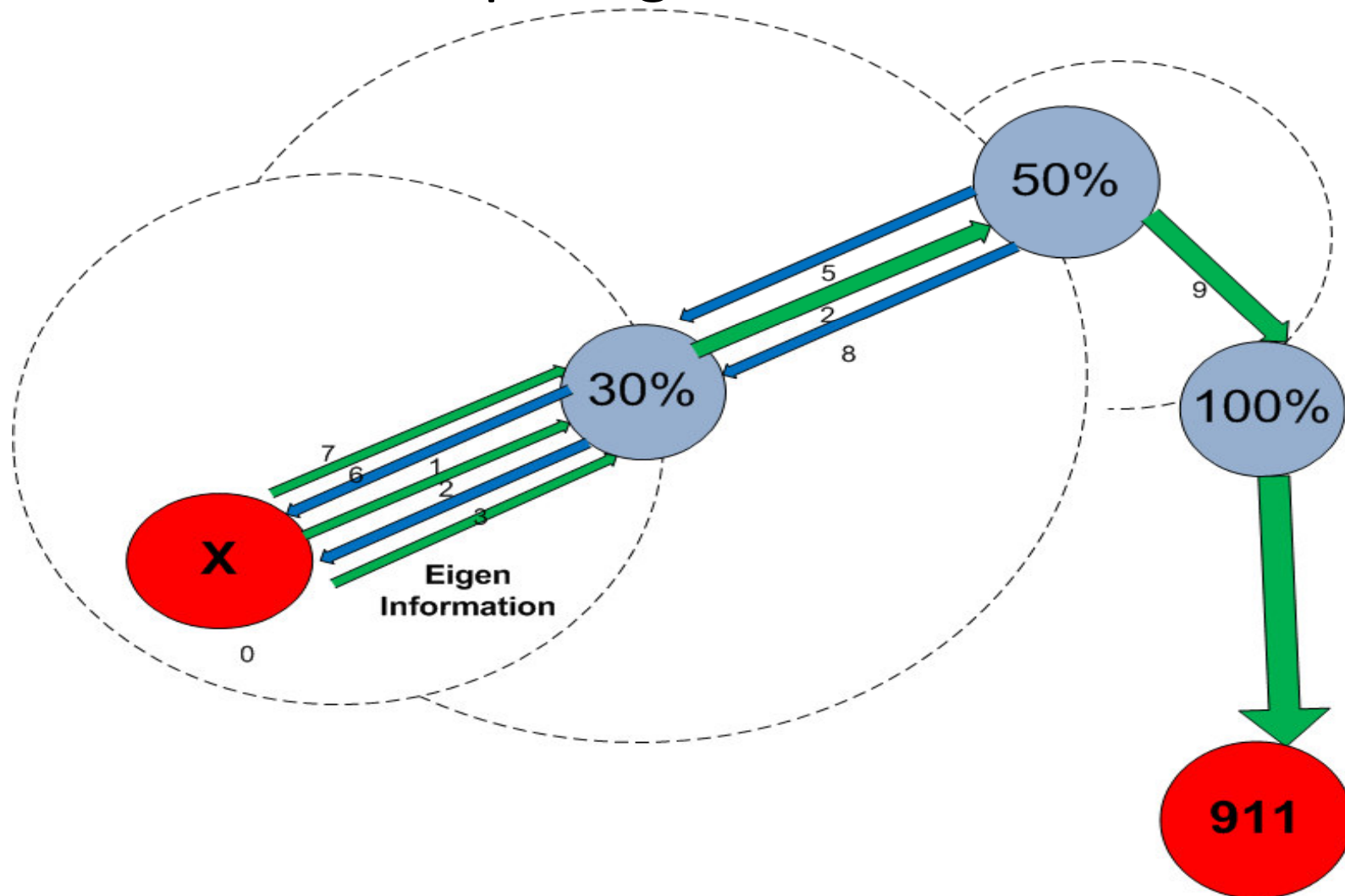
Scenario 4 Analysis

- Effect of Mobility: Breaks in the chain can lead to failures
- Protocol Complexity: High due to the increasing number of hops (esp. true for two or more hops)
- Security Issues – Node refuses Info. Delivery
- Worst case response time: Difficult to Estimate (Will be obtained after exp 3 and simulations)

Scenario 5 – Eigen Vector

- For 1 & 2-Hop Neighbor
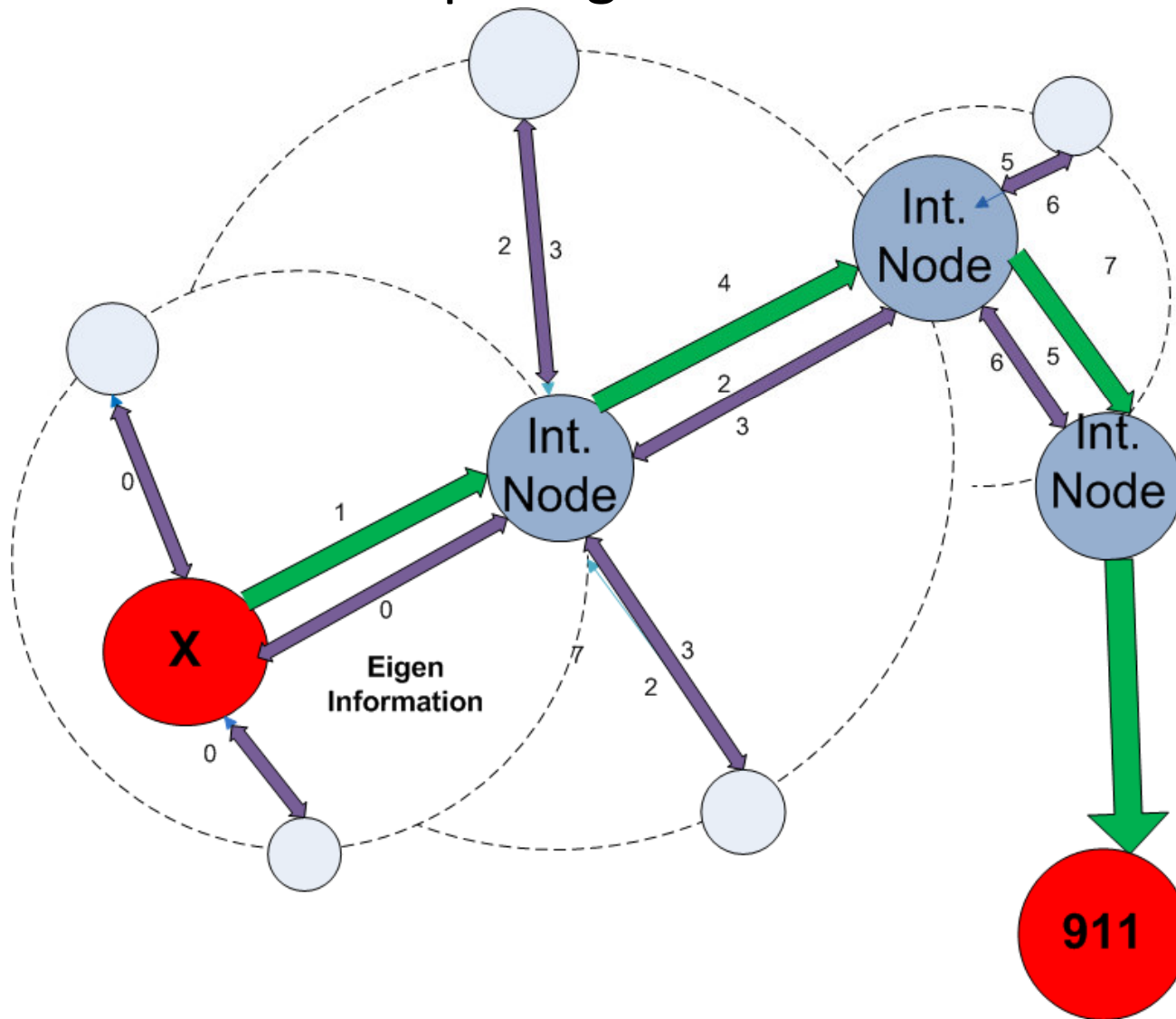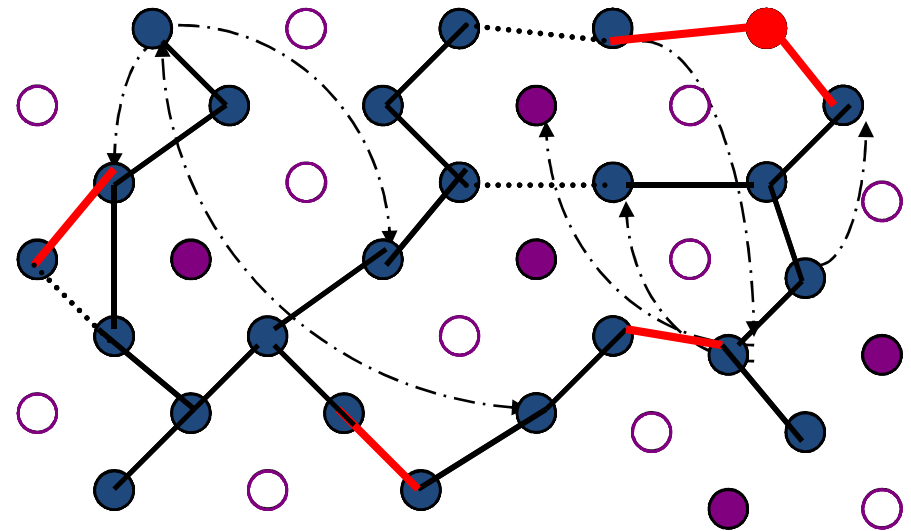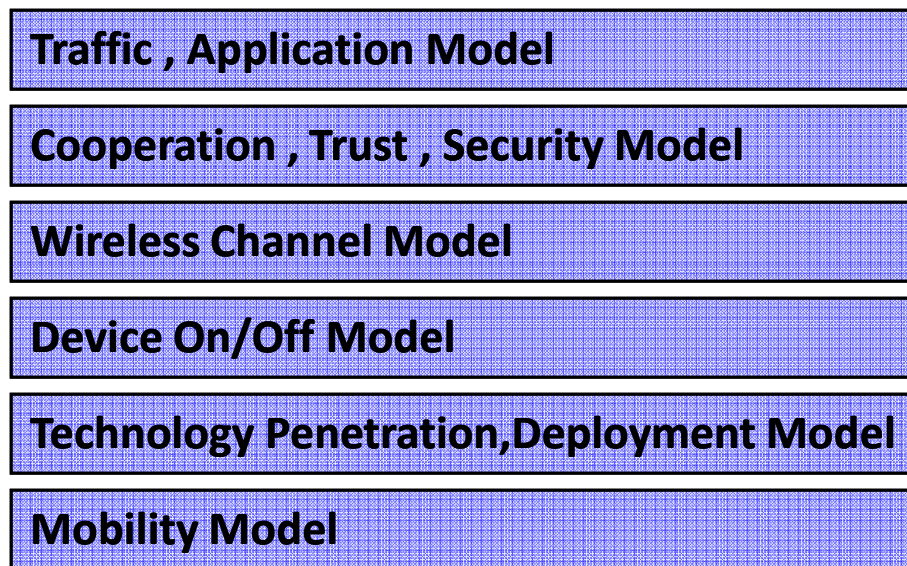
Scenario 5- Analysis

- Assumptions:
  - Eigen vector creation methodology must be standardized
  - When no match possible, acks must be returned

- Effect of Mobility: Higher probability to succeed as fewer messages are exchanged.

- Protocol Complexity: Justified in order to increase Success probability.

- Security concerns: Node refuses to collaborate, etc.

Scenario 6 - Geocast/Flood
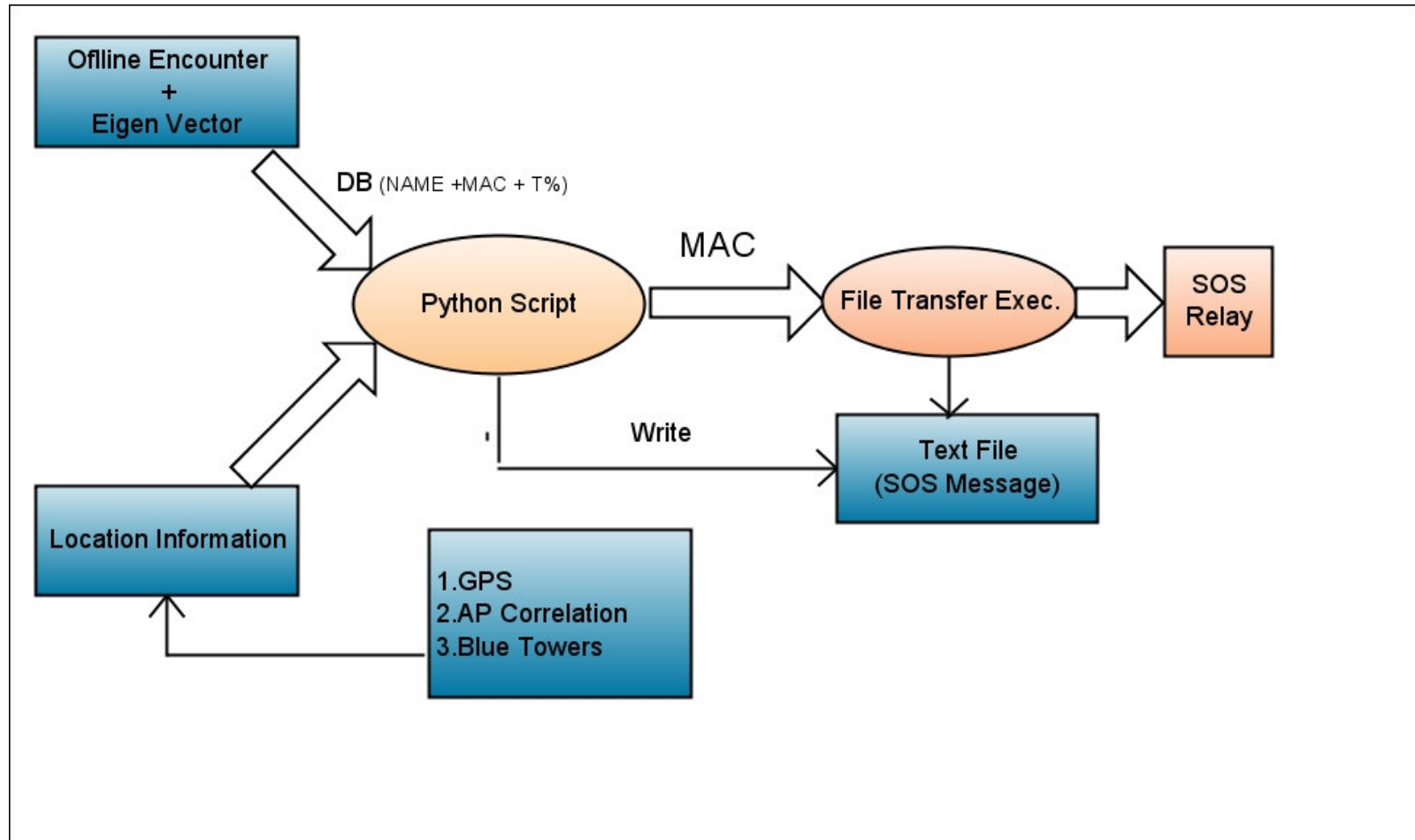
Scenario 6 - Analysis

- Concerns with gaps: Choose appropriate geocast implementation accordingly(future work)

- Effects of Mobility:
  – Can improve the situation or can make matters worse

Effective Layered Mobile Networking Model – Closer to reality

Traffic , Application Model
Cooperation , Trust , Security Model
Wireless Channel Model
Device On/Off Model
Technology Penetration,Deployment Model
Mobility Model

Actual connectivity graph results from the interaction of all these layers

Implementation Details

Simulation Progress

- Decision Factors
  - Timing comparison of Localization approaches
  - Timing comparison of Trust methods (Trace vs Eigen vectors)
  - Timing comparison relay methods(hops vs Geocast)
  - Comparison based on Transitivity approaches(Eigen vector processing method)
  - Comparison of Geocast protocols

- Parameter Space
  - Node Density
  - Bandwidth
  - Message Size
  - Location Info.

- Evaluation Metrics
  - Connection time
  - Expected response time
  - Average/maximum outage time
  - Hit/miss ratio

Future Works

- Emergency Blue Tower
  - Currently use GIS and database to notify selected recipients(cell-phones, PDAs, fax, etc..)
  - If equipped with Bluetooth sensors, can be incorporated into our project to enhance location info and alert
- Extension to applications beyond SOS
  - Can vary protocols according to emergency levels
  - 1 and 2 hop, geocast can be used for info queries

THANK YOU!

- Questions?
- Suggestions?