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ike for wsn security
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Status of this Memo

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Abstract
This document specifies an internet key exchange(ike) protocol for wireless sensor network.IKE is a component of IPsec used for performing mutual authentication and establishing and maintaining security associations.This document preassumed that readers are familier with basic concept of sensor network.

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1 Introduction

In wsn providing secure communication between two nodes or between nodes and BS is major issue. This document helps in identifing faulty nodes and separate them from the rest of the network and create tunnel for secure communication , so that the acquired data remains reliable. So for secure communication and protecting network from vulnerable node we used ike.

2 Terminology

2.1 SA: Security Association
2.2 encp: Encryption
2.3 DH: Diffie-Hellman key exchange
2.4 Auth: Authentication
2.5 WSN: Wireless Sensor Network
2.6 IKE: Internet Key Exchange
2.7 Node: Sensor nodes
2.8 BS: Base Station
2.9 Reci: Receiver

3 Ike intoduction

Ike is used in conjunction with IPsec to dynamically and automatically create SA.IKE performs mutual authentication between two parties and establishes an IKE SA that includes shared secret information that can be used to efficiently establish SAs for Encapsulating Security Payload (ESP) [RFC 4303] and/or Authentication Header (AH) [RFC 4302] and a set of cryptographic algorithms to be used by the SAs to protect the traffic that they carry. for more details see [RFC 7296].

3.1 Ike message flow

IKE message flow always consists of a request followed by a response.It is the responsibility of the requester to ensure reliability. If the response is not received within a timeout interval, the requester needs to retransmit the request

3.1.1 IKE phase one

The first request/responce of an IKE session negotiates security parameters for the IKE_SA, sends nonces, and sends Diffie-Hellman values.

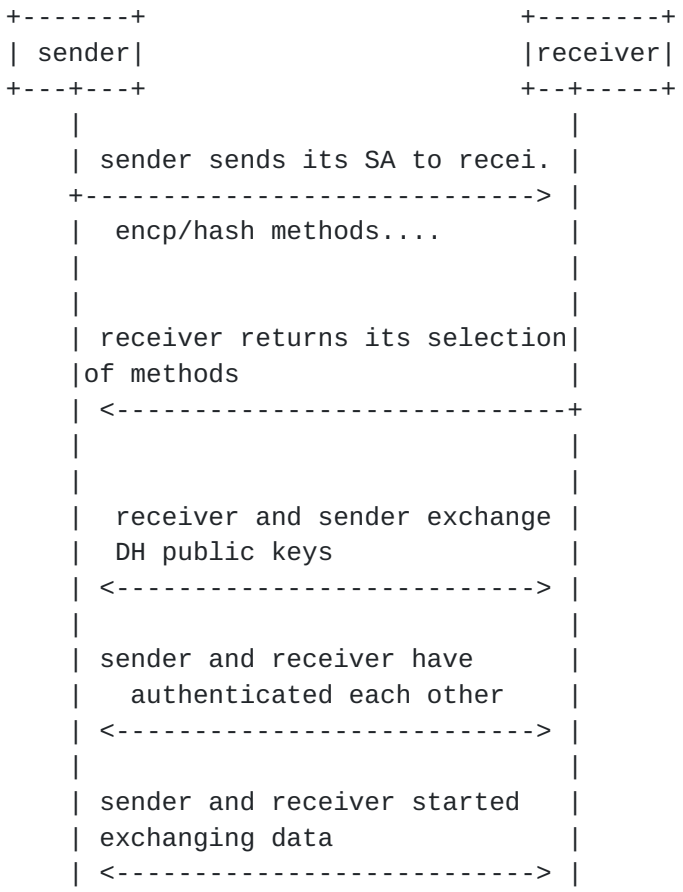

fig.1 IKE phase one process

3.1.2 IKE phase two:

The second request/response (IKE_AUTH) transmits identities, proves knowledge of the secrets corresponding to the two identities, and sets up an SA for the first AH and/or ESP CHILD_SA.

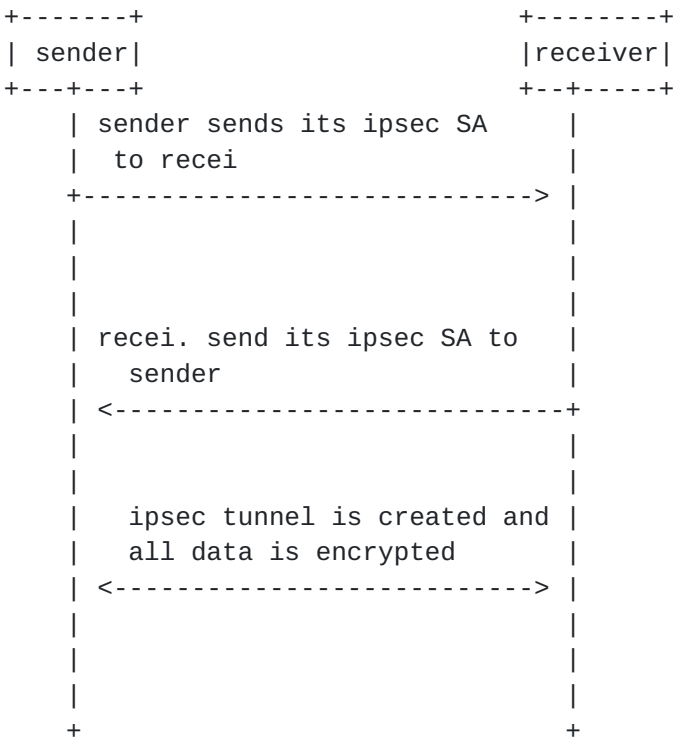

fig.2 IKE phase two process

4 IKE protocol variations :

IKE uses RSA as public key cryptography algorithm that is based on Diffie-Hellman (DH) see 9.2[1] key exchange which is very heavy, in term of arithmetic operations, for very constrained resources devices such as the case for WSNs. So that's why we use other protocols for encp/auth/integrity instead of RSA and DH.

some of these protocols are:

a) LEAP
b) SPINS
c) Minisec
d) Tinysec

4.1)LEAP(Localized Encryption And authentication Protocol):
key management protocol for Sensor Networks designed to support secure communications in these networks. It provides authen and confidentiality.

LEAP has following features:

1)LEAP provides four types of keys for each sensor node- an individual key shared with the base station, a pairwise key shared with other Sensor Node, a Clustered key shared with multiple neighbouring nodes, and a group key shared by all nodes in the network.

2)LEAP includes use of one-way key chains for local broadcast authentication.

3)Key sharing mechanism of LEAP supports in- network processing Thus LEAP can prevent or make it complex to attack nodes on the sensor network.

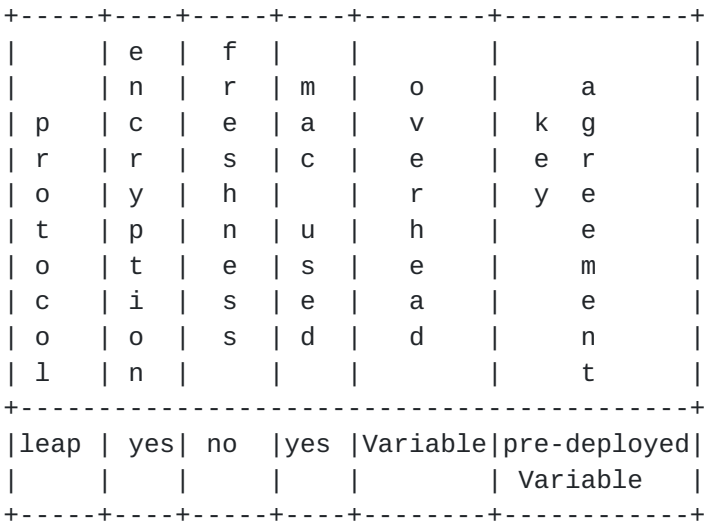

fig.3 LEAP PROTOCOL

4.2) SPINS(Security Protocols for Wireless Sensor Networks):
SPINS see 9.2[2] consists of two main protocol:

1)SNEP: In SNEP, plain text block is encrypted with a counter using CTR encryption algorithm. The counter is not included in the message.Each message has a MAC computed with CBC-MAC see 10.2[4] nalgorithm in the encrypted data. The MAC is computed once for each package

SNEP has following advantages:
a.SNEP uses a shared counter so it need not to be transmitted with the message.
b.It adds only 8 bytes to a message.
c.It offers following kind of security to the data in transit
Semantic Security
Data Authentication
Replay Protection
Weak Freshness
Low communication overhead

2) mueTESLA: In this protocol a node stores the packet in the buffer till the key is disclosed. The time when the key is disclosed , the base-station broadcasts verification key to all the receivers, which the node can use to authenticate the packet stored in its buffer. Each MAC key is a sequence of keys generated by one way function F. The sender chooses last key Kn and repeatedly applies F to compute the keys Ki = F(Ki+1)

fig.4 SPINS PROTOCOL

4.3) Minisec:
MiniSec see 9.2[3] is a secure network layer protocol that have lower energy consumption than TinySec but level of security matches with that of Zigbee. It uses offset Codebook Mode(OCB) as its block cipher mode of operation. Two passes are required for secrecy and authentication.OCB mode for faster MAC + ciphertext.

	encr	frsh	mac	overhead	key
protocol	yes	yes	yes	4+3Bytes	any
minisec	yes	yes	yes	4+3Bytes	any

fig.5 MINISEC PROTOCOL

4.4) Tinysec: It provides all the services provided by SNEP like authentication,message integrity,confidentiality and replay protection.Major difference is that no counters are used in TINYSEC.
Two variants of TINYSEC are available
TINYSEC-AE(authentication Encryption)
TINYSEC-Auth(Authentication Only)

	encr	frsh	mac	overhead	key
protocol	yes	no	yes	4 Bytes	any

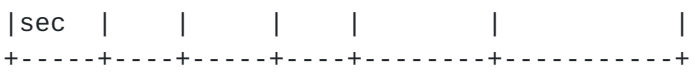

fig.6 TINYSEC PROTOCOL

5 Solutions:

As we already discribed in section 4 we have different protocols for encp,auth,integrity and freshness in wsn. So during the phase one of the ike sender and receiver shoule aggred upon one of the protocols stated above. Sender send its SA proposal to receiver and after that receiver reply with the selection of methods. Then sender and receiver auth each other. so with this authentication between sender and receiver the problem which we discussed in section 1 (faulty node identification) is resolved bcoz before communication started each node needed to be authenticated. After completion of phase 1[fig 1] ,phase 2 [fig 2] started in that phase also sender and receiver exchage their SA. when the exchange of SA is completed then a secured tunnel is created between twop nodes. nodes can be either two sensors or may be sensor and base station. And the communication through this tunnel is secure.

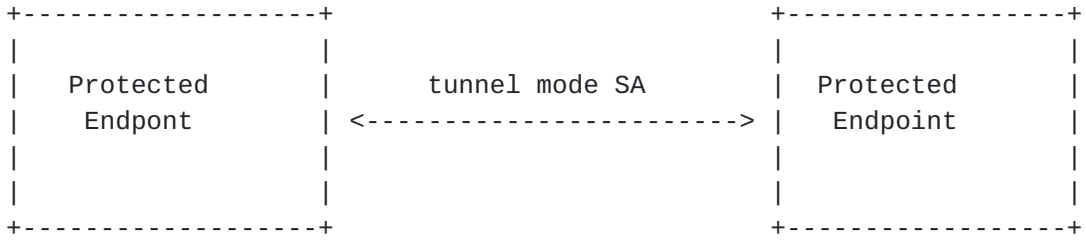

fig.7 Tunnel Created

6 comparision between protocols used:

	LEAP	SPINS	Tinysec	Minisec
Overhead (Bytes)	Variable	8	4	4+3
Encryption	yes	yes	yes	yes
Mac Used	yes	yes	yes	yes
Freshness	no	yes	no	yes
Key Aggrement	pre-Dep loyed	symmetric Delayed	Any	Any

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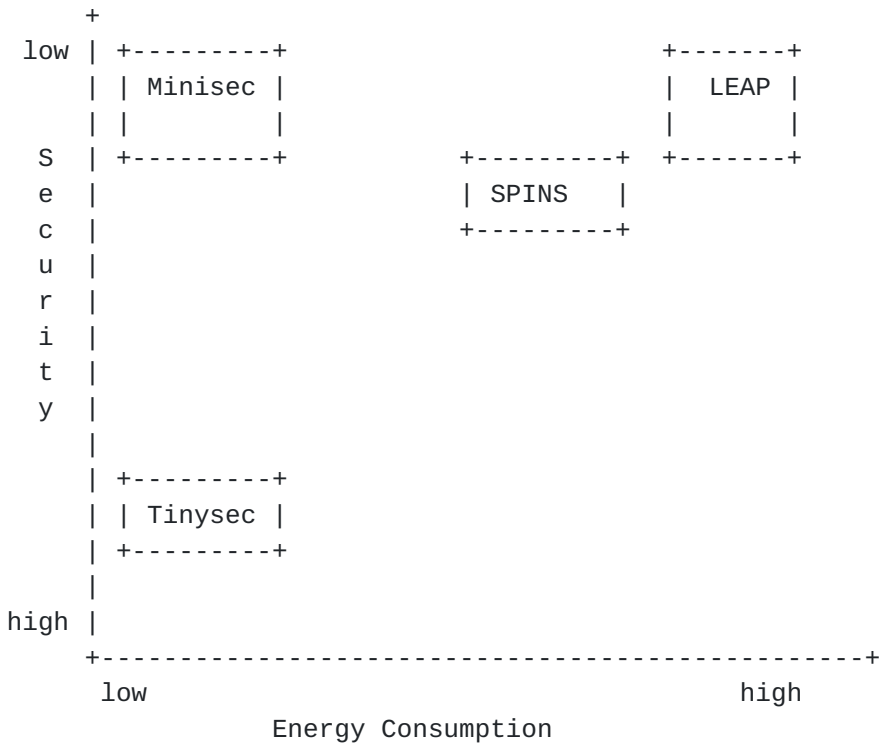

7 IANA Considerations

Nil

8 Security considerations

Generally IKE is protocol of ipsec protocol suite.
IKE provides the following benefits for IPsec:
a)Automatically negotiates IPsec parameters.
b)Performs DH exchanges to calculate shared keys, making sure each SA has a key that is independent of other keys, encrypt keys.
c)Automatically negotiates SAs when the sequence number in the AH or ESP header overflows, making sure IPsec can provide the anti-replay service by using the sequence number.

In our proposed method we used Ike for wsn security and auth for the solutions we discussed in sec.5 we can use any protocol.
At the time of SA sender and receiver choose energy efficient and secure protocol as comparision discussed in section 6.

9 Conclusion

This document is mainly focussed over the security in wsn. Sensor nodes are constraints in term of size, power consumption, memory processing power. Due to limited battery and processing power. This document implemented IKE with energy efficient protocls used for sensor network instead of RSA and DH as discussed in sec 4. With the scheme proposed by this document we can encrypt data and auth nodes and create a secured tunnel for further communication.

10 References

10.1 Normative References

[RFC 4302] https://www.rfc-editor.org/rfc/pdfrfc/rfc4302.txt.pdf
[RFC 4303] https://www.rfc-editor.org/rfc/pdfrfc/rfc4303.txt.pdf
[RFC 7296] C.Kaufman,Ed. "Internet Key Exchange(IKEv2)Protocol"

10.2 Informative References

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[2] https://link.springer.com/content/pdf/10.1023%2FA%3A1016598314198.pdf
[3] https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4379708
[4] https://www.rfc-editor.org/rfc/pdfrfc/rfc3610.txt.pdf

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This document is prepared for M. Tech 2nd year Major Project in National Institute of Technology, Delhi.

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