International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 2 Issue 3, March - 2013

Silent Networking Using Fuzzy Logic For Power Saving In Networked Devices

Abhijit Chavan[1], Ganesh Gadekar[2], Sonia Gandhi[3], Ankit Harodia[4]

Sinhgad College of Engineering, Pune-411041, Maharashtra

Abstract

A lot of work has been done in developing energy efficient network and user devices to reduce the power consumption of nodes and devices in networks. We propose an innovative approach using fuzzy logic for power saving and extending the life time of network nodes and user devices. [1]

Using the concept of silent networking we will define an actionable silent period. This is the period during which the network node or the user device does not expect to originate, receive or relay any traffic. The decision of switching the network interface or user devices in the silent mode depends on the history of the network activity. Secondly, if the actionable silent period is high enough, then we can switch the entire interface in power down mode leaving just the timer ON to wake up the interface at the end of silent period.

Using the history of a node and the defined threshold value the actionable silent period for interfaces is formulated. Using this approach we can save a considerable amount of energy and proportionally increase the lifetime of the networked devices. There is no need to define new protocol and it can work on any existing protocol (MAC layer or higher layer).

Keywords **–** ASP (Actionable Silent Period)

1. Introduction

Green computing is a process where design, manufacture, use and disposal involve as little environmental impact as possible. Silent networking is an idea using which one significantly increase the life time of the energy constrained nodes, networks, and mobile user devices and save a considerable amount of power, hence a step towards green computing. The concept of silent networking comes into being when the network nodes or user devices power down some or all of their network interfaces when they do not expect to originate, receive or relay any traffic through their interfaces. As power consumption in wireless network is a big problem, silent networking provides an innovative approach to deal with it. [2]

Using the concept of silent networking we will define an actionable silent period-this is the period during which the network node or the user device does not expect to originate, receive or relay any traffic.

Extending the lifetime of the devices can reduce the manufacturing of network nodes and user devices compared to what it would be if we did not use the above-proposed approach. [2]

2. Problem resolving

A. Problem Definition

Power consumption in wireless network is a big problem, as many of the times network node consumes the energy when it is not exchanging actual data packets from the network.

B. Objective

The objective of the paper is to develop an efficient system which will reduce the power consumption in wireless network and increase the lifetime of the networked devices.

3. Mathematical model

Let S be a system representing the Silent Networking System.

a] S= {……

b] Identify the inputs.
S = {N, T, TS,….
Where,
N=Number of nodes in network.
={i|'i' is number of nodes in network}
T=Nature of Packet traffic.
TS=Simulation period.

c] Identify the output as O.
S = {N, T, TS, O, …
Where,
O = {o | 'o' is metadata of various nos. of power ratio, graphs etc.}
O = {G, PC, PS}
G= Number of graphs.
PC=Power consumed.
PS=Power saved.

d] Identify the processes as P.
S= {N, T, TS, O, P, …
P= {Set of processes}
P = {P1, P2, P3,P4}
P1 =ASP Calculation.
P2 = Decision Making.
P3 = Set Timer.
P4 = Check for wake up packet.
P1={D,A,R}
Where, D is the set of Calculation of ASP and associated data.
D= {D_{ip}, D_p, D_{Op}}
D_{ip}= {i |'i' is valid input for Silent Period.}
D_P= {j | 'j' is silent mode function.}
$D_{Op} = D_p (D_{ip})$
D_{Op}= {k |'k' is silent mode output values i.e 0 or 1}

A= {A_{ip}, A_p, A_o}
A_{ip}= {a| 'a' is input terminal comparing the activity for ASP.}
A_p= {b| 'b' }
$A_p (A_{ip}) = A_o$
A_o= {c| 'c' is output values for terminal comparing activity for ASP}
R is the set of Terminal comparing activity for Graph.
R= {R_{ip}, R_p, R_o}
R_{ip}={p| 'p' is input terminal comparing activity for graph and give result in percentage ratio}
R_p= {q| 'q' }
$R_p (R_{ip}) = R_o$
R_o= {r| 'r' is output values for terminal comparing activity for graph}

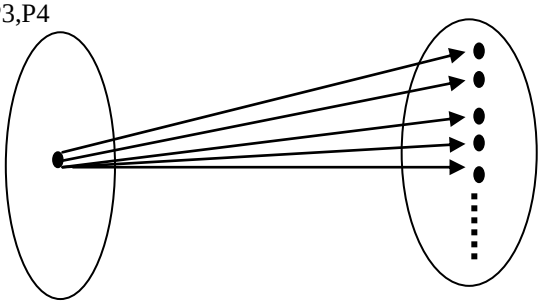
e]Identify failure cases as FL
S= { N ,T ,TS,O,P,FL…
Failure occurs when –
a) O= {Φ}
b) O= {p| 'p' is greater than standard values}

f]Identify success case (terminating case) as e:-
S= { N,T,TS,O,P,FL,e…
Success is defined as-
e= {p| 'p' is less than or equal to standard values}

g] Initial conditions as S_0
S= { N,T,TS,O,P,FL,e, S_0}
a) Initial condition for Timer – $T \neq \Phi$
b) Record in N, T file should not be null.

h] Mathematical formula for power ratio
(Pi-Ps)/Pi*100
Where,
Pi is Power consumed in normal system,
Ps is power consumed by proposed system.

Monitoring Node P1,P2,P3,P4 — End Devices



For P1,P2,P3,P4:

Monitoring Node —One To Many→ End Devices

4. Design

A. Architecture

Figure 1 represents the architecture of the proposed system, which consists of a server laptop, laptop 1 and laptop 2 as end devices all are wireless enabled, and a wireless router.

B. Software Architecture

Fig 2 represents the software architecture of the proposed system. In which ASP for a node will be calculated by the fuzzy logic and by monitoring the traffic for a node [3]. At the beginning the threshold

value of ASP is assigned to each node and if the calculated ASP i.e. Ip is greater than both the threshold value of ASP and ASP derived by the monitoring traffic at the node then the node is switched to silent mode by switching down its network interfaces and starting the timer. If the silent period for a node is over then that node is switched to active mode internally.

If the node is in silent mode and any data packet is received then the packet will be lost. But the loss will be minimum, which can be taken care by retransmission.

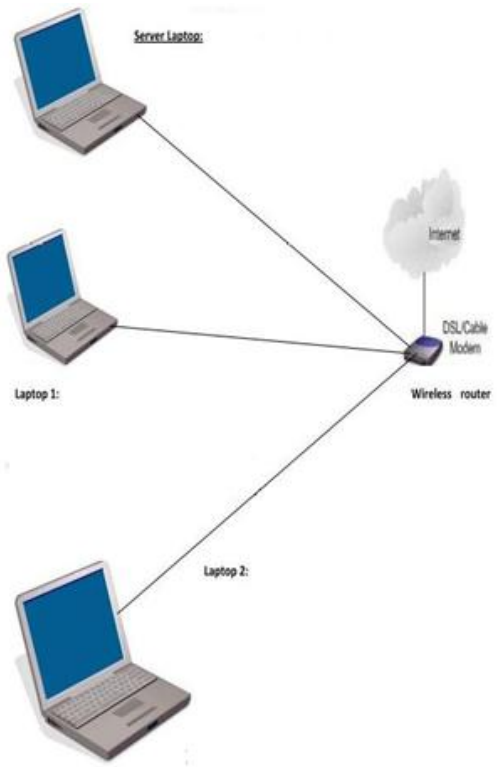


Fig1. Architecture

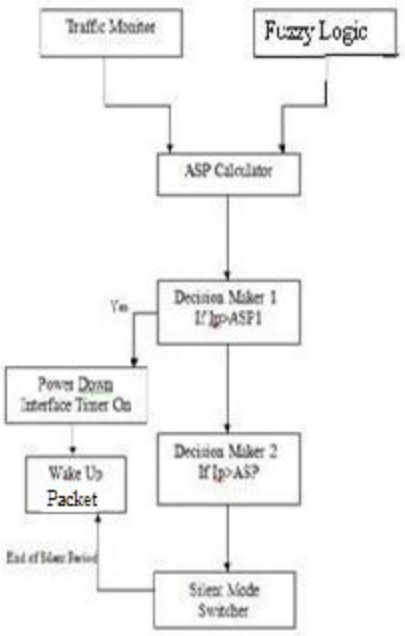


Fig 2. Software Architecture

5. Expected result

The expected result of the system is to save a considerable amount of power (40±10 %) and to increase the lifetime of a networked device without making any change in the current network.

The system to be developed is expected to solve the above formulated problem.

6. Conclusion

Thus working on the lines of traditional wireless network using the silent networking we have presented a system based on fuzzy logic.

We have also described the mathematical model of the system. All the designing constraints and feasibility analysis is carried out.

With the rapid increase in the no. of devices and the network nodes in the today's world, the amount of energy that will be saved using the concept of silent networking is relatively good.

7. Acknowledgement

This research paper cannot be considered complete without mentioning Prof. U. A. Mande. We wish to express true sense of gratitude towards his valuable contribution. We are grateful to him for his constant encouragement and guidance in the fulfillment of the project activity.

REFERENCES

1]T. Zhang *, P. Gurung, E. Berg, S. Madhani, A. Muttreja, *"Silent networking for en-ergy-constrained nodes"*; Telcordia Technologies, Piscataway, NJ 08854, USA Princeton University, NJ, USA; Available online 20 March 2006.

2]M. Stemm, R.H. Katz, *Measuring and reducing energy consumption of network in-terfaces in hand-held devices*, IEICE (Institute of Electronics, Information and Commu-nication Engineers) Transactions on Communications, Special Issue on Mobile Compu-ting, E 80B(8), August 1997, pp. 1125–1131.

3]Lofti A. Zadeh; *"Fuzzy Logic, Neural Networks, and Soft Computing";* Commu-nication of the ACM, March 1994/ vo. 37, No. 3.

4]Lotfi A. Zadeh, *"Fuzzy Logic System: Origin, Concepts, And Trends"*, Computer Science Division Department of EECS, UC Berkeley; Hong Kong; November 10, 2004;

5]W. Akkari, A. Belghith, A. Mnaouer, *"Enhancing power saving mechanisms for ad hoc networks using neighborhood information"*,IEEE 2008; 978-1-4244-2202-9/08/

6]Y. He; R. Yuan; X. Ma; Jun Li; *"The IEEE 802.11 Power Saving Mechanism: An Experimental Study"*; On page(s): 1362 – 1367; Issue Date: March 31 2008-April 3 2008; Las Vegas, NV.