

#### Power-Saving in a Mobile Ad Hoc Network

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#### MANET

Mobile Ad Hoc Networks are a collection of mobile nodes that are:

- Wireless;
- Totally temporary;
- Without Infrastructure;

#### MANET .2

A node in a MANET could be :

- Personal Digital Assistant (PDA);
- SmartPhone;
- Mobile phone;

All the devices above are **battery-constrained**!!!

#### MANET .3

Important features about mobile nodes:

- Short Transmission;
- Energy-Constrained;
- Limited Computational;
- Mobility;



#### Each device can assume transmission/receive role.

# Energy Resource

- Limited in all devices;
- Big use in Transmission session;
- It depends on the position inside the network;
- It avoids collaboration;



# Energy Resource .2



A MANET could be seen like a graph where :

- Each device like a node;
- Each arch is a possible communication;

# Energy Resource .3

Dangerous situation in a MANET



## Energy Resource .3

Dangerous situation in a MANET



#### Protocols

In Mobile Ad hoc Networks two kinds of protocols can be used:

- Proactive;
- Reactive;

The most important dynamic protocol is DSR (Dynamic Source Routing)

## DSR

When a source node wants to send a packet to destination node, it ...

- ...sends a RREQ to neighbours nodes;
- ...receives a RREP from destination node;



## DSR .2

When it is possible, DSR builds paths created by nodes which are as close as possible. This depends on :

• Distance;



• Power to transmit information;

## DSR.3

Here DSR prefers to send packets always through "A"



## DSR.3

Here DSR prefers to send packets always through "A"



## DSR.4

# The relationship between distance and energy is exponential.



Function - Energy(Distance)

## E-DSR

A modify of DSR is **Energy-DSR**. This protocol makes paths with two important characteristics:

I. Paths that use a little quantity of energy;

2. Paths that avoid passing through only bottleneck nodes

In this way E-DSR increases the lifetime of the network.



#### "Good Or Bad"

In a MANET a device could be "Good" or "Bad".

- Good: when a node uses its power for forward information.
- Bad: when a node avoids collaboration for energy-saving. (Selfish)

These behaviours are present also in p2p network!

## "Good Or Bad" .2

- It is important that a node uses its power for a good network function;
- A selfish node could break a mobile network;
- It is necessary to find a solution to avoid selfish devices;





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## "Good Or Bad" .3

In each device there are two important information:

- Amount of information transmitted;
- Amount of information forwarded;



In this way we are able to distinguish between a "good" node and a "bad" one.

With an amount of transmitted and forwarded information, we are able to introduce the "Contributo" formula:

$$Ctr_i = \frac{\#P_f}{\#P_t}$$

#P<sub>f</sub>: Amount of forwarded information from "node *i*";
#P<sub>f</sub>: Amount of transmitted information from "node *i*";

The "Contributo" value is compared to a Threshold ( $T\rho$ ).

#### While the Route Discovery works...

When a node receives a RouteRequest (RREQ), before forwarding the RREQ to its neighbour, it estimates its "Contributo":

 $<= T\rho Ctr_i > T\rho$ It waits for a time It forwards the RREQ directly proportional immediately; to its "Contributo"

value;

In this way, the "Contributo" formula avoids the passing of the information only through the "A" node.



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A Selfish node must forward information because its "Contributo" is low.



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### Switch Network

- A device could decide to switch from a network to another one;
- This is a problem for "Contributo" formula, because a bad node in a new network could reset its "Contributo";
- In a new network, a device could continue to be selfish;
- A solution for "store" original "Contributo" is a TPM (Trusted Platform Mobile);

## Switch Network .2

- A "TPM" could allow a device to start a communication with a TTP (Trusted Third Part) in the new network;
- TTP could certificate the new device and its "Contributo";
- The node, now, can join the network and start the communication with previous "Contribute";



#### Conclusions

- Power Saving in a MANET is an open problem;
- It is important to find solutions to improve the lifetime of the network;
- "Contributo" formula helps a MANET to improve its lifetime;
- The use of TPM embedded in a device will help to "store" the "Contributo" in a new network;



## Future Works

• There is still much to do...



- Trying to improve "Contributo" formula;
- Showing through empirical experiments that "Contributo" is the correct solution for Power-Saving and Selfish node;
- Finding a good protocol to allow a node to join correctly in a new network with previous "Contributo";

#### References

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