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RESEARCH ARTICLE

CCLAEEO: CLUSTERING BASED CROSS-LAYER AIDED ENERGY-EFFICIENT OPPORTUNISTIC ROUTING SCHEME IN MOBILE AD HOC NETWORKS

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Abstract— The major features of CCLAEEO Routing scheme are centralized recovery process, deterministic (as opposed to probabilistic) peer-to-peer recovery, and ability to trade off recovery with latency. The link excellence similarity of wireless channels has been a difficult issue in data connections until current plain investigation in utilizes this characteristic. The matching broadcast communication may be perceived radically in a different way, and generally by you, by receivers at different geographic locations. Furthermore, even the same stationary receiver may experience drastic link quality fluctuation over time. A key component of CORA (Conditional Orientation Reflex Audiometry) is the Cached Packet Distance Vector (CPDV) protocol for local peer-to-peer loss recovery. CPDV finds and retrieves the nearest copy of the missing packet while providing other useful NACK aggregation features. We use simulation experiments to demonstrate the effectiveness of CORA and explore the tradeoffs of CPDV localized recovery benefits versus memory and processor overhead. In a typical simulation experiment with mobile nodes CORA yields up to 99% release ratio as compared to 95% delivery ratio by idle talk. This expansion is achieved with small overhead.

Key Terms: - Cooperative communication; Forwarder list update; Local retransmission; Mobile ad hoc networks; Opportunistic routing; Opportunistic forwarding; Proactive source routing

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I. INTRODUCTION

A mobile ad hoc network (MANET) is a self-organizing mobile network formed by peer nodes using wireless radios. With or without the wired infrastructure, it can establish an instant communication structure for civilian and military applications. The wireless sensor networks refers to an assorted system consisting of numerous recognition stations called sensor nodes with a infrastructure transportation wished-for to watch and documentation circumstances at miscellaneous locations. Also sensor networks are answerable for sensing and communication of data. A mobile ad hoc network (MANET) is a self-organizing mobile network formed by peer nodes using wireless radios. With or without the wired infrastructure, it can Establish an instant communication structure for civilian and military applications.

Its minimal requirement on deployment time and space is particular useful in a hostile environment, where preexisting infrastructure cannot be easily acquired or may be damaged/destroyed at any time. Key applications in these scenarios include teleconferencing, disaster relief, data dissemination, and battlefield operations which are group-oriented and mission-critical, requiring both high data reliability and timeliness guarantees. Undoubtedly, reliable multicast is a critical building block to support these applications, even in the presence of random node mobility, frequent route outages, and random external interference. Applying peer-to-peer recovery in MANETs is however not straightforward. The design choices underlying wired reliable multicast protocols using peer-to-peer recovery mechanism are not apposite for MANETs due to their unique characteristics Including mobility, limited bandwidth, random packet errors, and frequent outages. If these wired protocols are applied to MANETs directly, they will Incur excessive

The CCLAEEO schemes [2] to be fitted in wireless ad hoc networks. Cross layer-style approaches, the packet recovery are performed in a peer-to-peer fashion. A receiver attempts to recover lost packets with the aid of a random set of members in the group.

We use a lightweight proactive source routing protocol so that each node has complete knowledge of how to route data to all other nodes in the network at any time. When a flow of data packets are forwarded towards their destination, the route information carried by them an IP packet is transmitted at one end of the Ethernet cable and received at the other. However, in wireless networks,

When a packet is transmitted over a physical channel, it can be detected by all other nodes within the transmission range.

On that channel. For the most part of the research history, overhearing a packet not intended for the receiving node had been considered as completely negative, *i.e.*, interference. Thus, the goal of research in wireless networking was to make wireless links as good as wired ones. Unfortunately, this ignores the inherent nature of broadcasting of wireless communication links. For mobile ad hoc networks to truly succeed beyond labs and test beds, we must tame and utilize its broadcasting nature rather than fighting it. Cooperative Communication is an effective approach to achieving such a goal.

Energy is predetermined and cannot be charged; hence ability to use energy inefficiently is a major factor to be well thought-out while deceitful routing protocol. To huge measure of sensor nodes, recharging the batteries in WSNs are infeasible task [1]. Hence, network natural life is a most important concern in sensor network drawing. In regulate to make longer the network lifetime, several routing protocols exists. These routing protocols are confidential into two types depending on network topology: unexciting direction-finding protocols and Hierarchical routing protocols. Since flat routing protocols necessitate maintaining routing table data and cannot aggregate the information, they are not appropriate for large weighing machine sensor networks. Hierarchical routing protocol can solve this question to some extent.

A wireless sensor network (WSN) consists of a huge numeral of sensing devices, called sensor nodes, which are consistent all the way through wireless links to carry out disseminated sensing tasks. WSNs have establish many functional applications for mechanical data collecting, such as surroundings monitoring, armed forces examination, and objective tracking, for monitoring the behavior of opponent defense force or expensive material goods, in danger of extinction animals. When a sensor node detects a combatant or an endangered living thing, it reports the event to the data collector called the Sink. This data transmission may occur via multichip transmission, where the sensor nodes act as routers. In this paper, we consider habitat monitoring applications where the WSN is deployed for monitoring pandas. For example, a WSN has been deployed by the while pandas move in the network, their presence and activities are periodically sensed by the sensor nodes and reported to the go under the exterior.

II. RELATED WORK

The energy-consumption-based OF and the optimal broadcast power of both the TR and of the OR, let us now characterize the reasonable system performance in terms of: Normalized energy consumption. The total energy consumed by all the data packets transmitted through the network is normalized by the successful end-to-end reception probability. However, we do not consider the energy consumed by the control packets and the energy dissipated at the receiver nodes by signal processing.

End-to-end throughput (bit/s): The number of data it's successfully delivered to the destination in a second, while neglecting the bits of the control packets. Delay PDF: The probability distribution of the end-to-end delay.

The common parameters of the following simulations are listed in Tab I. Example 1: Let us first analyze the performance of a single hop route. The maximum number of MAC retransmissions is Nr = 7. The distance between S and D is 1000 m. The other Simulation configurations are listed in Tab I. The NEC E total and the end-to-end throughput Re2e of the OR are compared both in terms of simulation and theoretical results.

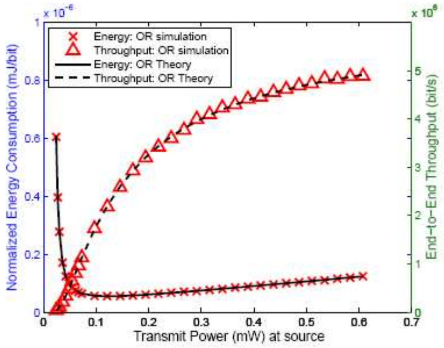


Fig. 4. The NEC $\overline{E}_{total}$ and the end-to-end throughput R_{e2e} versus the transmit power P_{t_0}.

Fig.1 Transmit Power At Source

Fig. 1 shows that the NEC decreases first and then increases beyond the transmit power of 0:12 mW, where 0.12 mW is the optimal transmit power and the NEC achieves the lowest. The optimal transmit power 0.12 mW is obtained by Eq. (17). The end-to-end throughput increases upon increasing the transmit power at S. Observe that the simulation results closely match the theoretical curve. Example 2: Let us now analyze the performance of the two-relay assisted network.

The positions of S, D, R1 and R2 are (100; 100), (900; 100), (500; 500) and (300; 400), respectively. The other simulation configurations are listed in Tab I. The NEC Etotal and the end-to-end throughput Re2e are shown in Fig. 5 and Fig. 6 as a function of the maximum number of MAC retransmissions Nr. We also investigate the theoretical NEC bound of both TR and OR, which is found by the exhaustive search of all the routes from S to D. Fig. 5 shows that the performance of the energy consumption OF based algorithm is close to the theoretical bound, especially in the case of a large Nr. Both Figs. 5 and 6 show that our energy-efficient OR outperforms the energy efficient TR and all the simulation results closely match the theoretical curves. Moreover, the NEC Etotal decreases upon increasing Nr. However, the end-to-end throughput Re2e of OR is more stable. The end-to-end throughput for TR is infecting higher than that of OR for Nr = 1 and 2, but it is lower for Nr 4. This is because in case of a low number of MAC retransmissions, the direct near-line-of-light route from S to D in the TR has a more dominant priority than the other routes.

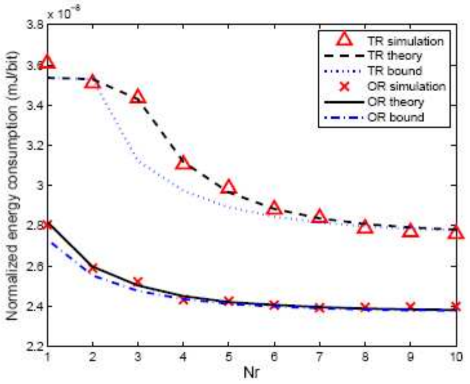


Fig. 5. The NEC $\overline{E}_{total}$ versus the maximum number of MAC retransmissions N_r.

Fig.2 MAC Retransmission

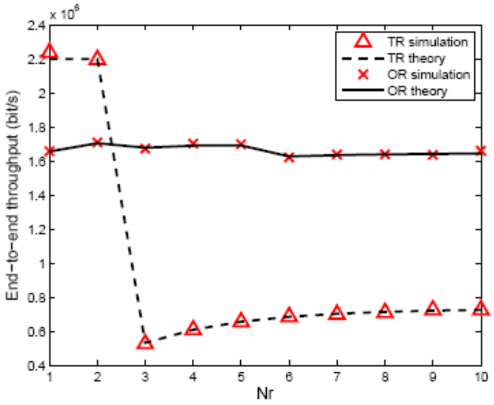


Fig.3 End-To-End Throughput

Is still not received by D successfully, it will be discarded, hence its delay contribution is not counted towards the end to-end delay De2e. Fig. 7 shows that the proposed energy-Efficient OR algorithm has a lower end-to-end delay than the TR algorithm, since the delay PDF curve of the OR algorithm reaches its peak probability at the delay of about 2 TSs, while that of the TR algorithm at 6 TSs.

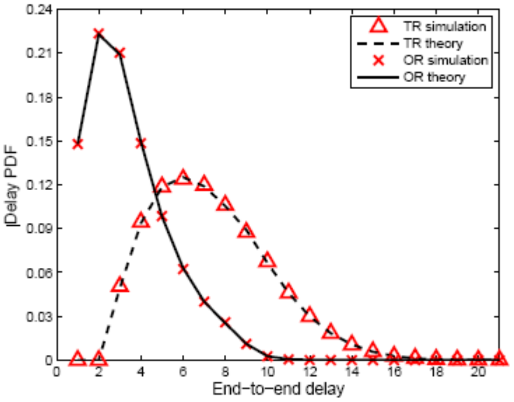


Fig. 7. The delay distribution.

Fig.4 The Delay Distribution

III. ROUTING ALGORITHMS

A. TR algorithm

The performance of the single-hop route and of an idealized network was characterized in Subsections II-A and II-B, which may be readily extended to existing routing protocols, such as the DSR (Dynamic Source Routing), AODV (Ad hoc On-demand Distance Vector) and DYMO (Dynamic Manet On-demand) routing protocols. During the route discovery process, the routing packets are used for gathering the necessary information and for feeding it back to the source. Then the source makes the final decision required for sending the data packets. The most important feature of traditional routing is that the route is selected first, and then the packets are always delivered along this particular route, until it is broken, for example due to node-mobility. At that moment, a sub-optimal candidate route is chosen by route-repair, or the route rediscovery process will be re-activated for finding a totally new route.

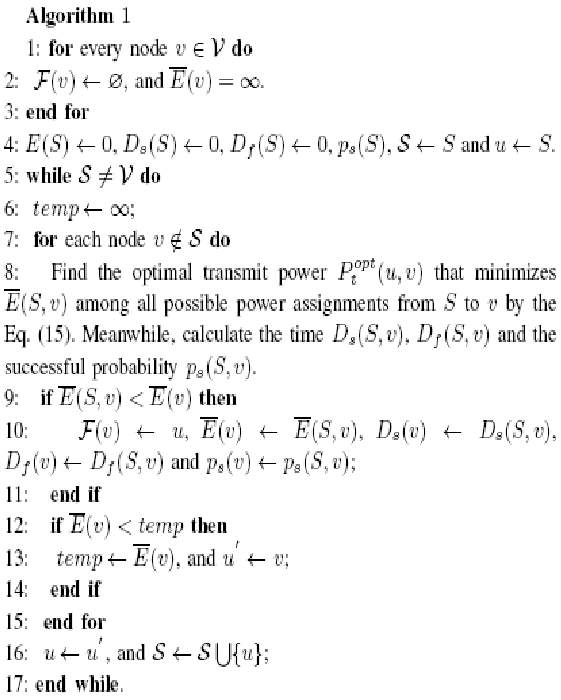
The idealized multi-hop network of Fig. 1 may be extended to a more realistic random network relying on Dijkstra's routing algorithm [28] and invoking the NEC Etotal for route selection. The routing algorithm is described below. We assume that V is the vertex set, v is a node in the set V. F(v) denotes the predecessor set of nodes in the route before the node v, while E(v);E(S; v) denote the NEC Etotal and ps(v); ps(S; v) represent the successful probability of a packet from the source S to the node v. Furthermore, Ds(v) and Ds(S; v) denote the delay encountered by a packet delivered successfully from the source S to the node v, while Df (v) and Df (S; v) represent the delay of a packet that was dropped before reaching the node v. Specifically, E(S; v), ps(S; v), Ds(S; v) and Df (S; v) are the intermediate values of E(v), ps(v), Ds(v) and Df (v), respectively. Moreover, S represents the set of selected nodes, while Popt t (u; v) denotes the optimal transmit power of node u assigned for transmission to node v.

The source S employs Algorithm 1 for identifying that particular route, which has the lowest NEC Etotal. At the same time, it also determines the delay Ds(S), namely, the end-to-end delay De2e of the selected route. Finally, the end to- end throughput Re2e may be calculated by Eq. (36) based on Ds(S), Df (S) and ps(S). For reasons of conciseness we specify the routing procedure in Algorithm 1.

B. OR algorithm

The minimum NEC is obtained by finding the optimal power allocation. Although the network topology has only two hops, this algorithm may be extended to a large network, where the OR principle is employed for each hop. Meanwhile, the optimal transmit power of each node is found for the sake of minimizing the NEC required for the passage of a packet from that node to the destination. Here, E(v);E(v;D) denotes the NEC Etotal necessitated for transmission from node v to the destination D.

We denote the potential set of the receiver nodes by R. Furthermore, Popt t (u) is the optimal transmit power, which minimizes the NEC required for transmission from node u to the destination D, while Ds(u);Ds(u;D) denotes the vector of probabilities for each particular integer delay in terms of TSs, when a packet is delivered successfully from node u to the destination D. For example, a single-hop route has the vector of delay probabilities given by Ds(S;D), where the number of elements is Nr. The elements of Ds(S;D) are given by (1 □ ps)nrps, where pS is the probability of a packet being successfully delivered to the destination D and nr = 1; :::;Nr is the number of MAC retransmissions. Furthermore, Dnr s (u) denotes the delay probability vector of a packet, which is delivered from node u to the destination D, when the number of MAC retransmissions is nr. By contrast, Df (u);Df (u;D) denotes the delay probability vector of a packet, which is dropped before reaching the destination D. Let us denote the probability of a packet being successfully delivered from node u to node m by ps(u;m) and the probability of a packet, which is dropped before reaching the destination by pf (u); pf (u;D).



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Algorithm 1
for every node $v \in \mathcal{V}$ do
    $\mathcal{F}(v) \leftarrow \varnothing$, and $\overline{E}(v) = \infty$.
end for
$E(S) \leftarrow 0, D_s(S) \leftarrow 0, D_f(S) \leftarrow 0, p_s(S), \mathcal{S} \leftarrow S$ and $u \leftarrow S$.
while $\mathcal{S} \neq \mathcal{V}$ do
    $temp \leftarrow \infty$;
    for each node $v \notin \mathcal{S}$ do
        Find the optimal transmit power $P_t^{opt}(u,v)$ that minimizes $\overline{E}(S,v)$ among all possible power assignments from $S$ to $v$ by the Eq. (15). Meanwhile, calculate the time $D_s(S,v)$, $D_f(S,v)$ and the successful probability $p_s(S,v)$.
        if $\overline{E}(S,v) < \overline{E}(v)$ then
            $\mathcal{F}(v) \leftarrow u$, $\overline{E}(v) \leftarrow \overline{E}(S,v)$, $D_s(v) \leftarrow D_s(S,v)$, $D_f(v) \leftarrow D_f(S,v)$ and $p_s(v) \leftarrow p_s(S,v)$;
        end if
        if $\overline{E}(v) < temp$ then
            $temp \leftarrow \overline{E}(v)$, and $u' \leftarrow v$;
        end if
    end for
    $u \leftarrow u'$, and $\mathcal{S} \leftarrow \mathcal{S} \bigcup \{u\}$;
end while.
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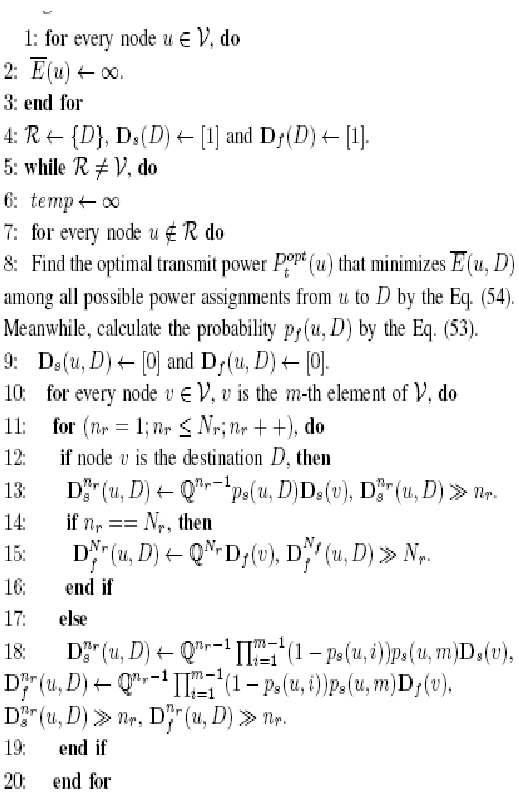

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for every node $u \in \mathcal{V}$, do
  $\overline{E}(u) \leftarrow \infty$.
end for
$\mathcal{R} \leftarrow \{D\}$, $\mathbf{D}_s(D) \leftarrow [1]$ and $\mathbf{D}_f(D) \leftarrow [1]$.
while $\mathcal{R} \neq \mathcal{V}$, do
  $temp \leftarrow \infty$
  for every node $u \notin \mathcal{R}$ do
    Find the optimal transmit power $P_t^{opt}(u)$ that minimizes $\overline{E}(u, D)$ among all possible power assignments from $u$ to $D$ by the Eq. (54). Meanwhile, calculate the probability $p_f(u, D)$ by the Eq. (53).
    $\mathbf{D}_s(u, D) \leftarrow [0]$ and $\mathbf{D}_f(u, D) \leftarrow [0]$.
    for every node $v \in \mathcal{V}$, $v$ is the $m$-th element of $\mathcal{V}$, do
      for $(n_r = 1; n_r \leq N_r; n_r++)$, do
        if node $v$ is the destination $D$, then
          $\mathbf{D}_s^{n_r}(u, D) \leftarrow \mathbb{Q}^{n_r-1} p_s(u, D)\mathbf{D}_s(v)$, $\mathbf{D}_s^{n_r}(u, D) \gg n_r$.
          if $n_r == N_r$, then
            $\mathbf{D}_f^{N_r}(u, D) \leftarrow \mathbb{Q}^{N_r}\mathbf{D}_f(v)$, $\mathbf{D}_f^{N_f}(u, D) \gg N_r$.
          end if
        else
          $\mathbf{D}_s^{n_r}(u, D) \leftarrow \mathbb{Q}^{n_r-1} \prod_{i=1}^{m-1}(1 - p_s(u, i))p_s(u, m)\mathbf{D}_s(v)$, $\mathbf{D}_f^{n_r}(u, D) \leftarrow \mathbb{Q}^{n_r-1} \prod_{i=1}^{m-1}(1 - p_s(u, i))p_s(u, m)\mathbf{D}_f(v)$, $\mathbf{D}_s^{n_r}(u, D) \gg n_r$, $\mathbf{D}_f^{n_r}(u, D) \gg n_r$.
        end if
      end for
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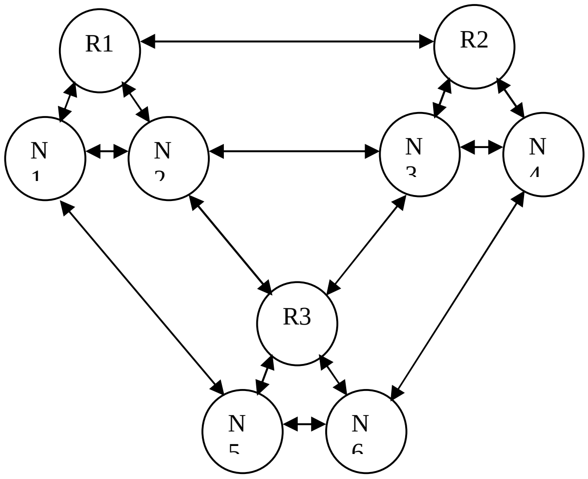

Fig.5 Clustering based Cross-Layer Aided Energy-Efficient Opportunistic Routing Architecture

Here R1, R2, R3 are the clustering nodes, N1, N2, N3, N4, N5, N6 are routing nodes.

IV. CONCLUSION

A Clustering based cross-layer action aided energy efficient OR algorithm for Ad Hoc networks and an energy consumption-based OF collective with power distribution, which is in employment both for finding an academic bound and for transmission the packets throughout the network. The energy consumption- based OF and the associated algorithms are relevant to both conventional routing and to our opportunistic routing. They also perform close to the respective bounds found by an exhaustive search and match the simulation results quite closely. The end-to-end throughput, the end-to-end delay and the delay allotment of the system were also analyzed hypothetically. In conclusion, the OR outperforms the TR.

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