A novel approach for distributed power control with retransmission facility in multi-hop energy harvesting links

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Abstract - In this project we proposed to develop a novel distributed power control based energy harvesting link for multi-hop transmission with automatic repeat request for undelivered packets and an online packet retransmission facility with restored power levels. In many prototypical Internet-of-Things (IOT) applications, measurements are taken by remote sensor nodes, and are conveyed to a central fusion center over multiple short-range hops. Often, these sensors and relays are powered by energy harvested from the environment, to ensure long lifetime of the network and reduce maintenance overheads such as battery replacement.

IndexTerms – Energy harvesting,ARQ,Multi-hop links,Packet drop probability,Geometric programming,Battery size,Reciever

I.INTRODUCTION

In many prototypical Internet-of-Things (IoT) applications, measurements are taken by remote sensor nodes, and are conveyed to a central fusion center over multiple short-range hops [2], [3]. Often, these sensors and relays are powered by energy harvested from the environment, to ensure long lifetime of the network and reduce maintenance overheads such as battery replacement [4], [5]. In this scenario, conveying measurements reliably and in an up-to-date fashion while operating within the power constraints imposed by the random and sporadic nature of energy availability at the nodes is an important challenge.

Retransmission schemes such as the automatic repeat request (ARQ), along with power control, is a popular approach for ensuring reliable packet delivery. They are part of various low power communications standards such as IEEE 802.15.4 and the bluetooth low energy specification [6], [7]. Further, in EH networks, retransmission protocols extenuate the impact of both small scale fading and the randomness of energy availability [8]. In this paper, we consider an ARQ based retransmission protocol for communication between EH nodes (EHNs) of a multi-hop link, and propose nearoptimal power control policies that minimize the packet drop probability (PDP). When the energy cost of decoding a packet at a receiver is non-negligible, the power control policies are coupled across the nodes.1 This makes the design of optimal power policies significantly more challenging than designing policies for point-to-point EH links [9].

II.LITERATURE SURVEY

sylvia romaszko et al. displayed the three calculations progressively selecting a lower, upper or both limits of the cw interim. all these methodologies beat the IEEE 802.11 dcf standard regarding all out nUMBer of bundles got, the quantity of crashes, the lifetime of the system, the dead of the principal hub, and somewhat the normal deferral. the slwuppbd, which aLTErs a dissemination of both a lower and upper bound of the cw interim beats aLTErnate plans. in [38], the effective burden adjusting calculation is examined.
patel, s. et al. proposed a planning and asset assignment plot that permits base station to serve a blend of ongoing and best-exertion clients. the proposed plan acknowledges probabilistic QOS ensures over brief time scales to continuous clients while misusing both intra-and between class advantage crosswise over clients. the adequacy of the proposed methodology is accepted by reenactment comes about. the proposed plot likewise got rid of the customary methodology of giving QOS by tuning relative weights among clients.
jin, n. et al.explored whether clog based estimating can be utilized to control total movement into every code indicate by rousing clients pick the code-focuses fitting for every application. they first request that what data needs be traded; they state that both cost and QOS data must be accessible for clients to decide. they then ask how successful clog based valuing in diffuser can be; they find that it is achievable just for systems with adequately high data transmission to ensure that QOS can be immediately measured.

III.EXISTING SYSTEM

We consider a monitoring system, where a sensor node takes periodic measurements which are to be delivered to a destination over a multi-hop link formed between EHNs. Each relay node in the multi-hop link operates in a decode-and forward manner. In addition, the packet transmission over each hop follows the ARQ protocol to deliver a given packet to the next node, with a predetermined number of slots allocated to it. For each attempt of the packet, the receiving node sends an acknowledgment (ACK) or negative ACK (NACK) to indicate the success or failure of the previous attempt, respectively.
Once the transmitter receives an ACK for the current packet, it goes to sleep till it is time for it to receive the next packet from the preceding node. A node in the sleep mode does not consume energy, but continues to harvest energy from the environment.
Packets that are not delivered to the destination before the next measurement is taken are dropped. Thus, a packet is dropped if and only if any node fails to deliver it to the next node within its allocated number of slots. A packet failure may happen either due to the energy outage at the transmitter or receiver, or due to channel fading/noise at the receiver.

IV.PROPOSED SYSTEM

In many prototypical Internet-of-Things (IoT) applications, measurements are taken by remote sensor nodes, and are conveyed to a central fusion center over multiple short-range hops . Often, these sensors and relays are powered by energy harvested from the environment, to ensure long lifetime of the network and reduce maintenance overheads such as battery replacement. Retransmission schemes such as the automatic repeat request (ARQ), along with power control, is a popular approach for ensuring reliable packet delivery.

They are part of various low power communications standards such as IEEE 802.15.4 and the bluetooth low energy specification. Further, in EH networks, retransmission protocols extenuate the impact of both small scale fading and the randomness of energy availability . In this paper, we consider an ARQ based retransmission protocol for communication between EH nodes (EHNs) of a multi-hop link, and propose nearoptimal power control policies that minimize the packet drop probability (PDP). When the energy cost of decoding a packet at a receiver is non-negligible, the power control policies are coupled across the nodes.

To this end, we first derive an expression for the PDP in terms of the RIPs at the nodes. Next, when the energy cost for decoding a packet is negligible, we obtain closed form expressions for the optimal RIPs.We also extend the results to the case where the peak transmit power is constrained. When the energy cost of decoding is non-negligible, we present a geometric programming based iterative algorithm to obtain near-optimal RIPs.

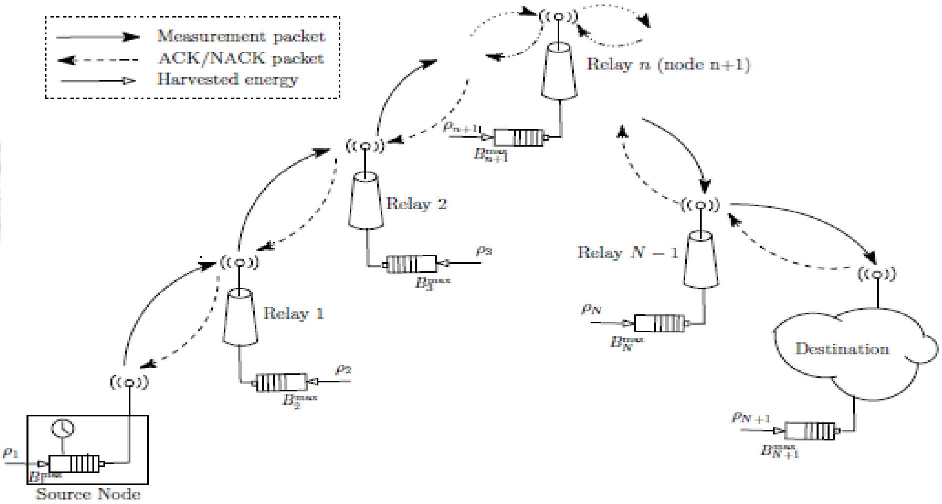


Figure:System model. Each node transmits and receives in its assigned subframe.

Energy harvesting model:

$$B_{s+1}^{n} = \min\left(\left(B_s^n + \mathbb{1}_{\{\mathcal{H}_s^n\}} - E_\ell^n \mathbb{1}_{\{\mathcal{E}_{t,s}^n\}} - R\mathbb{1}_{\{\mathcal{E}_{r,s}^n\}}\right)^+, B_n^{\max}\right)$$

$$U_s^n \triangleq \begin{cases} -1 & \text{ACK received,} \\ \ell & \ell-1 \text{ NACKs received, } \ell \in \{1,\ldots,K_n\}. \end{cases}$$

Channel model:

$$P_e(E_\ell^n, \gamma) = \exp\left(-\frac{E_\ell^n \gamma}{N_0}\right)$$

Packet drop probability:

$$G_{a,b}(\gamma) \triangleq \Pr\Big[(B_{s+1} = B_b, U_{s+1} = U_b, s+1) \mid (B_s = B_a, U_s = U_a, s), \gamma\Big]$$

$$P_{\mathrm{D}} = \sum_{B} \pi(B)\mathbb{E}_\gamma \left\{P_D\left(K | B, U = 0, \gamma\right)\right\}$$

$$\pi = \left(\mathbb{E}\left[G'(\gamma)\right] - I + A\right)^{-1} \mathbf{1}$$

Packet drop probability minimization:

$$\min_{\{\mathcal{P}^n\}_{n=1}^N} \sum_B \pi(B)\mathbb{E}_\gamma \left\{P_D\left(K|B, U=0, \gamma\right)\right\}, \text{ (14a)}$$

$$0 \le E_\ell^n \le E_{\max} \text{ for all } 1 \le \ell \le K_n \text{ and } 1 \le n \le N. \text{ (14b)}$$

$$\Pr[n] \triangleq \prod_{m=1}^{n-1} \mathbb{E}_\gamma \left(1 - \prod_{i=1}^{K_m} \mathrm{P}_e(E_i^m, \gamma)\right)$$

$$\max_{\{\mathcal{P}^n\}_{n=1}^N} \Pr[N+1], \text{ subject to}$$

$$\Pr[n] \left(\sum_{\ell=1}^{K_n} E_\ell^n \mathbb{E}_\gamma \left\{\prod_{i=1}^{\ell-1} P_e(E_i^n, \gamma)\right\}\right) \le K\rho_n, \forall 1 \le n$$

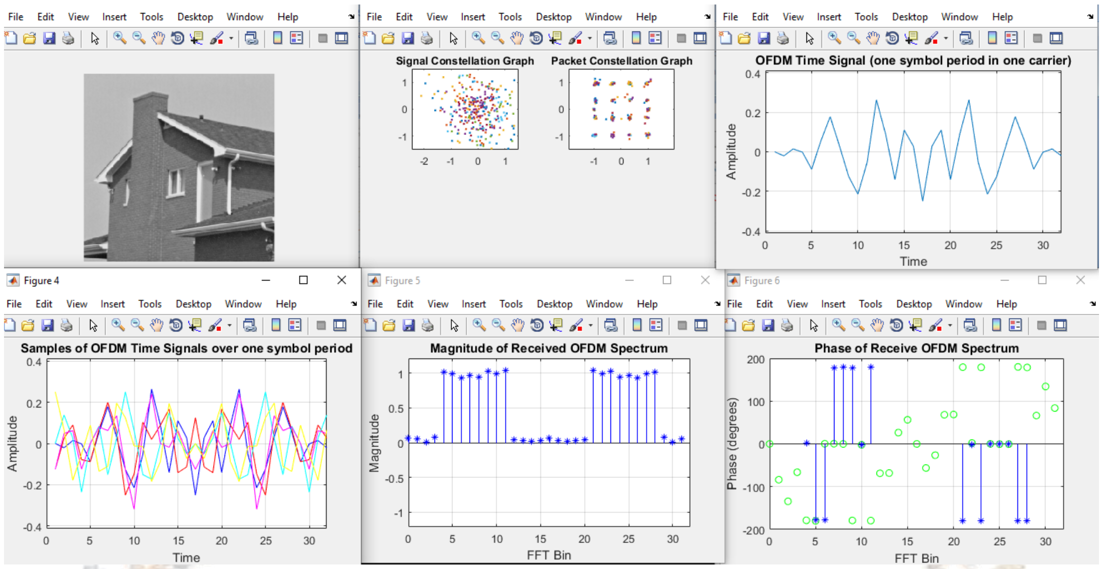
$$0 \le E_\ell^n \le E_{\max} \text{ for all } 1 \le \ell \le K_n \text{ and } 1 \le n \le N.$$

$$\min_{\mathbf{E}^n = \{E_1^n, \ldots, E_{K_n}^n\}} \mathbb{E}_\gamma \left\{\prod_{\ell=1}^{K_n} P_e(E_\ell^n, \gamma)\right\},$$

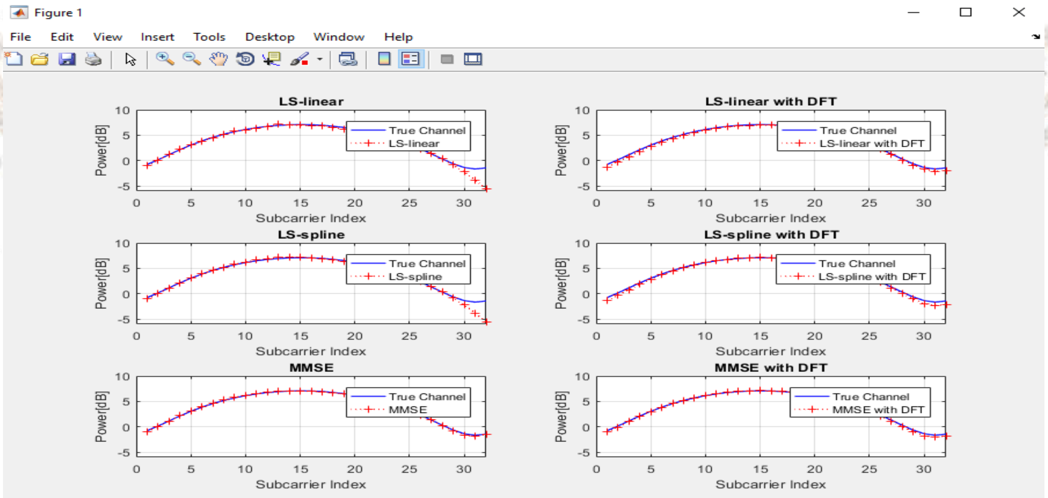
$$\text{subject to } \Pr[n] \left(\sum_{\ell=1}^{K_n} E_\ell^n \mathbb{E}_\gamma \left\{\prod_{i=1}^{\ell-1} P_e(E_i^n, \gamma)\right\}\right) \le K$$

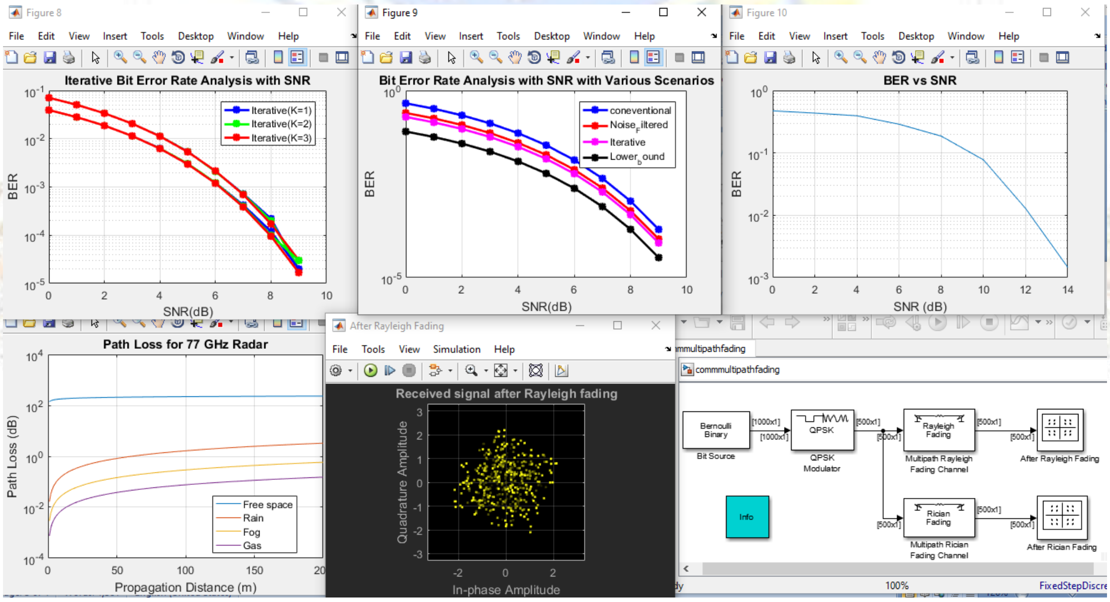
$$0 \le E_\ell^n \le E_{\max} \text{ for all } 1 \le \ell \le K_n.$$

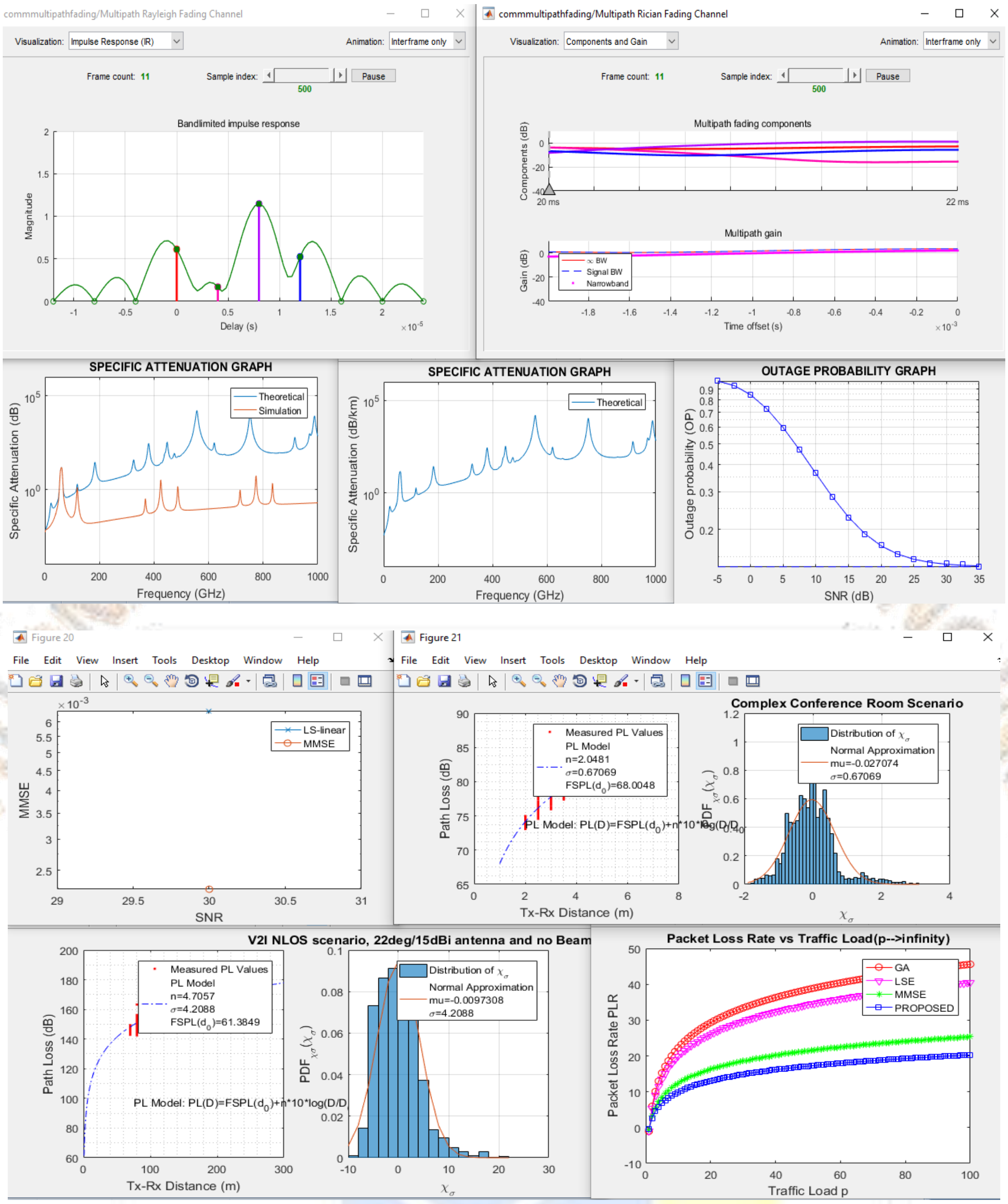
Input parameters:



Output parameters:







V.CONCLUSION

In this paper, we designed PDP-optimal RIPs for ARQbased multi-hop EH links. To this end, we first derived closed-form expressions for the PDP of multi-hop EH links. Using the derived expressions, we setup a RIP optimization problem, which was solved in two different scenarios. First, we considered a scenario when the energy cost for reception is negligible, and derived closed-form expressions for the optimal RIPs. Next, we presented an iterative geometric programming based solution to the RIP optimization problem under nonnegligible energy reception cost. Through simulations, we illustrated that our proposed policies significantly outperform equal power policies and achieve a performance close to the lower bound. In addition, our results provided interesting insights into the trade-offs in the system parameters and highlighted the coupled nature of the problem. Future extensions of this work can consider the design of RIPs for multi-hop links with time-correlated channels, and under different quality of service requirements.

VI.REFERENCES

[1] M. K. Sharma and C. R. Murthy, “Near-optimal distributed power control for ARQ based multihop links with decoding costs,” in Proc.IEEE ICC, May 2017.
[2] A. Bader and M. S. Alouini, “Localized power control for multihop large-scale internet of things,” IEEE Internet Things J., vol. 3, no. 4,pp. 503–510, Aug. 2016.
[3] M. Centenaro, L. Vangelista, A. Zanella, and M. Zorzi, “Long-range communications in unlicensed bands: the rising stars in the IoT and smart city scenarios,” IEEE Wireless Commun. Mag., vol. 23, no. 5, pp.60–67, Oct. 2016.
[4] S. Ulukus, A. Yener, E. Erkip, O. Simeone, M. Zorzi, P. Grover, and K. Huang, “Energy harvesting wireless communications: A review of recent advances,” IEEE J. Sel. Areas Commun., vol. 33, no. 3, pp. 360–381, Mar. 2015.
[6] “IEEE standard for local and metropolitan area networks–part 15.4:Low-rate wireless personal area networks (LR-WPANs),” pp. 1–314,Sep. 2011.
[7] M. K. Sharma and C. R. Murthy, “Packet drop probability analysis of dual energy harvesting links with retransmissions,” IEEE J. Sel. Areas Communication., vol. 34, no. 12, pp. 3646–3660, Dec. 2016.

[8] B. Medepally, N. B. Mehta, and C. R. Murthy, “Implications of energy profile and storage on energy harvesting sensor link performance,” in Proc. IEEE Globecom, Dec. 2009, pp. 1–6.
[9] Q. Tan, Y. Liu, Y. Han, W. An, S. Ci, and H. Tang, “Energy harvesting aware topology control with power adaptation in wireless sensor networks,” in Proc. WCNC, Apr. 2014, pp. 2722–2727.
[10] C. Tapparello, O. Simeone, and M. Rossi, “Dynamic compressiontransmission for energy-harvesting multihop networks with correlated sources,” IEEE/ACM Trans. Netw., vol. 22, no. 6, pp. 1729–1741, Dec,2014.