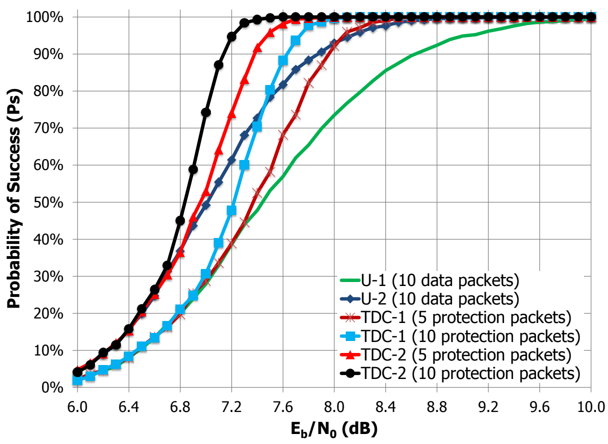


**Figure 2: Comparison of the Probability of success for Temporal Diversity Coding ($TDC-2$) and the other 3 schemes ($U-1$, $U-2$, $TDC-1$).**

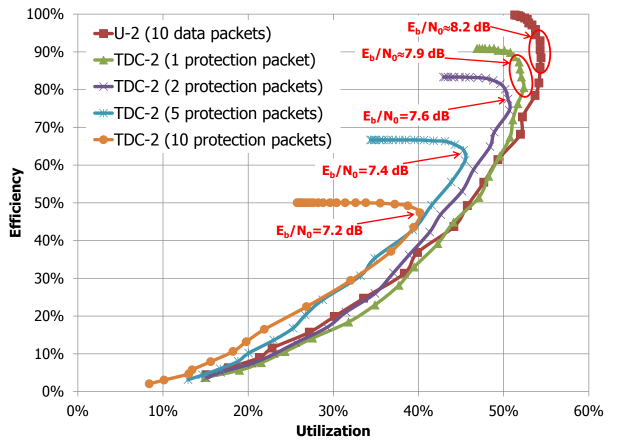


**Figure 3: Efficiency vs. Utilization for an uncoded ($U$) and Temporal Diversity Coding ($TDC$) schemes for a 2-path system.**

the number of relays that help to transmit the information towards the destination.

First, we compare the performance of the 4 schemes ($U-1$, $U-2$, $TDC-1$, $TDC-2$) as a function of the $E_b/N_0$ (Fig. 2). Temporal Diversity Coding ($TDC-2$) outperforms the other three schemes. $TDC-2$ requires about 3.6 dB less $E_b/N_0$ than the single path uncoded scheme to receive the entire message. In other words, with the same $E_b/N_0$, e.g., 7.6 dB, $TDC-2$ achieves full throughput and maximum efficiency at a 1/2 DC code rate. Also, we can see that by transmitting the packets through multiple paths about 12% improvement in throughput is achieved, Temporal Diversity Coding $TDC-1$ (1/2 DC code rate) provides about 18% improvement in throughput, and the combination of these two techniques [$TDC-2$ (1/2 DC code rate)] provides a 43% improvement in throughput. As expected, we can see in Fig. 2 that there are regions where $TDC-1$ outperforms $U-2$. That is the case when the $E_b/N_0$ is greater than 7.5 dB. Therefore, it is preferable to use Temporal Diversity Coding ($TDC-1$) instead of two paths ($U-2$). Figure 3 shows the performance, in terms of efficiency and utilization, of $U-2$ and $TDC-2$ schemes. As we can see, the efficiency of both schemes ($U-2$ and $TDC-2$) increases with the energy per bit to noise power spectral density ($E_b/N_0$). However, for $E_b/N_0$ larger than a certain value, the efficiency of $TDC-2$ remains constant. For example, for $E_b/N_0$ of 7.2 dB or larger, $TDC-2$ 1/2 achieves its maximum efficiency (50%). For the $U-2$ scheme, 100% efficiency can be achieved for $E_b/N_0$ of 9 dB or larger because all the packets transmitted by the source contain useful information (data packets). However, the $U-2$ scheme requires larger $E_b/N_0$ than $TDC-2$ to improve the performance of the system.

# 5. CONCLUSIONS

In this paper, we proposed the Temporal Diversity Coding ($TDC-K$) scheme, a novel technique that utilizes Diversity Coding in time through $K$ spatially independent paths to achieve improved network performance by increasing the network's reliability and minimizing the delay. Wireless body area networks (WBANs) are an attractive application for *Temporal Network Coding* because of the requirement for low complexity, limited power, and high reliability that this type of networks in real-time applications such as capsule endoscopy and video/medical imaging where retransmissions are not a good alternative.

The *Temporal Diversity Coding* scheme features: 1) low complexity because the Diversity Coding coefficients implicitly known to the source and destination nodes; 2) limited power consumption because smaller $E_b/N_0$ is required to recover the entire message; 3) better reliability because of the use of a cooperative relays that help to transmit the packets from the source to the destination node; and 4) real-time transmission because of the reduced complexity of the scheme, allowing processing on low-power nodes.

# 6. REFERENCES

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