Recent Updates on Zigzag Decodable Codes-based Raptor Coding for Active Safety Transportation (ZEBRA-CODES)

Khoirul Anwar, Muhammad Ary Murti, I Nyoman Apraz Ramatyana, and Bambang Sumajudin

Center for Advanced Technologies (AdWiTech), Telkom University,
Jl. Telekomunikasi No. 1, Terusan Buah Batu, Bandung, 40257 INDONESIA
E-mail: anwarkhoirul@telkomuniversity.ac.id.

***Abstract*—This paper reports the recent updates on Zigzag decodable codes-based Raptor coding for active safety transportation (ZEBRA-CODES) for the first year of total three years. This project is targeting: (1) a decoding schemes ZEBRA-CODES, (2) optimal degree distribution for Raptor coding for transportation, and (3) New modulation scheme suitable for multiple access providing different level of priorities.**

***Index Terms*—Coded random access, Zigzag decodable codes, stopping sets, active safety transportations.**

I. Introduction and System Model

ZEBRA-CODES is motivated by three factors, i.e., (i) the development of the fifth generation (5G) of telecommunications, (ii) the development of coding theory, and (iii) the need of good transportation for Indonesia. Self-driving cars and other mission critical applications are becoming the target of applications of 5G networks.

The reliable communications for any dynamic channel is possible by applying rateless codes, of which the example is Raptor coding schene, where the coding rate is adaptive to the channels by keeping the coding rate R and channel capacity C always satisfy $R \leq C$.

This application is urgently required in Indonesia, especially to avoid congestion and accident, while prioritizing the emergency applications, such as ambulances and fire trucks. According to Biro Pusat Statistik (BPS) of Indonesia, the number of accidents suddently increased from 20,000 to 90,000 in 2005. This number is kept high until 2016 reaching about 110,000 number of accidents.

We consider a system model of communications of transportation as shown in Fig. 1, where different user has access to different total number of time-slots. The two levels of coding schemes construct a Raptor coding scheme in the network, although usually Raptor codes are only designed for physical layer instead of network layer.

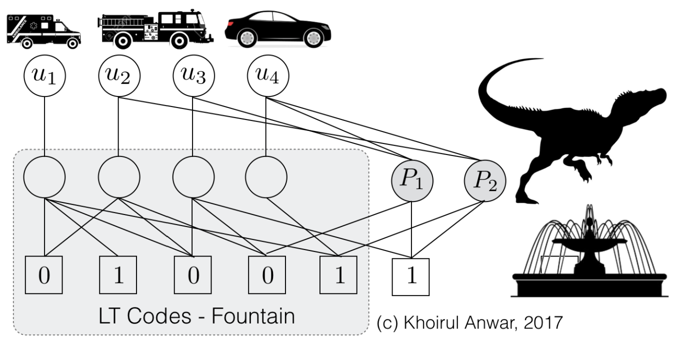

Fig. 1. Proposed Raptor coding scheme for communications of transportation.

Fig. 2 explains how the stopping set is resolved by zigzag decoding. With this scheme, all probability of stopping set predicted in [1] can be resolved. However, the speed of resolutions should be optimized.

II. Project Management and Recent Results

To acchieve these goals, this project divide the work package into five work packages (WPs) as shown in Fig. 3, i.e., WP1

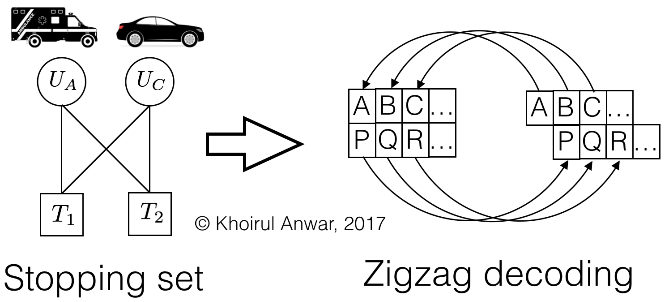

Fig. 2. Proposed zigzag decoding for stopping set appearing in random transportation communications in highly dense area.

Coding scheme for public and private cars, WP2 Coding scheme for emergency cars, WP3 Optimization of degree distribution, WP4 New modulation scheme supporting the transportation systems, and WP5 Coordination and dissemination.

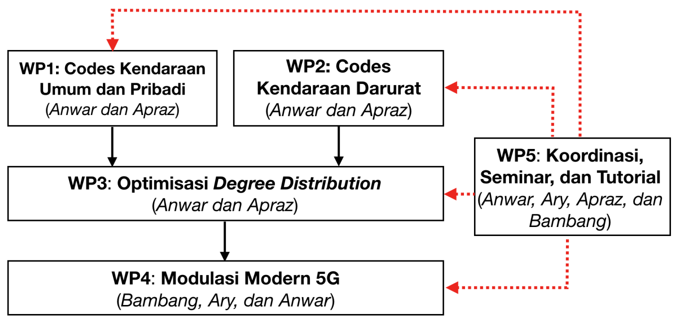

Fig. 3. WP allocations for ZEBRA-CODES.

In the Year I, we have obtained 3 papers, i.e., (i) IEICE General Conference 2018, Japan [2] (ii) TAFGEN 2018, Repetition codes [3], (iii) TAFGEN 2018, MDS Codes [4]. We have also received BEST Paper IEEE TAFGEN for MDS CODES.

III. Conclusions

In the Year I, we have reached several milestone especially for WP1, WP2, WP4, and half of WP5. We are expecting that in the Year II, 80% target is achievable, prior to 100% in Year III.

This research is supported in part by the RistekDikti under the project of ZEBRA-CODES, 2018–2020.

References

[1] K. Anwar, “Decoding for wireless super-dense networks and its finite-length analysis for practical applications (invited paper),” in *Int. Symposium on Electronics and Smart Devices (ISESD)*, Bandung, Nov. 2016.

[2] ——, “Spatial coupling-based class prioritization for iot networks using coded random access,” in *IEICE General Conference*, Tokyo, March 2018.

[3] K. Niaamah, I. N. A. Ramatyrana, and K. Anwar, “Coded random access prioritizing human over machines for future iot networks,” in *2nd International Con- ference on Telematics and Future Generation Networks (TAFGEN)*, Kuching, Malaysia, July 2018.

[4] S. Larasati, I. N. A. Ramatyrana, and K. Anwar, “High-rate coded ran- dom access for non-orthogonal multiple access with human priority,” in *2nd International Conference on Telematics and Future Generation Networks (TAFGEN)*, Kuching, Malaysia, July 2018.