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Development and Application of Outdoor Router Cost Estimation with Parametric Modelling Technique

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***Abstract*— Internet development is a challenging issue among Internet Server Providers (ISPs) and researchers due to high investment cost and unforeseen risk. The internet accessibilities of those rural areas are low and seem disconnected from the society. Rural areas unable to enjoy the benefits from high-speed Internet. Rural internet development is not prioritized because of low population density and return of investment from urban area development is more favorable. Outdoor equipment such as router, antennas and access points are the main components in Internet development. The accuracy of various cost estimation model is depending on the availability of raw data and data analysis techniques. There is no accurate model that allow ISPs to estimate the cost of outdoor routers for Wireless Fidelity (Wi-Fi) transmission. Those estimations can assist ISPs in risk management and reduce the total project cost. Therefore, this paper aimed to produce and demonstrate a suitable outdoor router cost estimation model. Friis transmission equation and link budget equation were used in this model. Suitable key parameters were selected by using P-value regression analysis. Original key parameters and calculated unique key parameters were utilized in this model to provide better performance and realistic estimated cost. This paper also demonstrated the usage of outdoor router cost estimation model under long-range and short-range wireless data transmission.**

Keywords—Internet Development, outdoor routers, cost estimation model, P-value regression analysis, application.

I. INTRODUCTION

Internet connectivity can be implemented though wired technology such as optic cables or wireless technology such as Wireless Fidelity (Wi-Fi). The wired technology refers to cable connections from one end to another end through optic cables or coaxial cables. The wireless technology uses radio waves as the medium for data transmission. The installation process for wireless backhaul technology is faster and more flexible than wired backhaul technology. The wireless backhaul technology also able to transmit further with a single tower when compared with wired technology. Therefore, wireless technology will also eliminate some initial investment and minimise cabling cost [1].

High-speed Internet with more reliable and stable performance is getting more attention among the researchers [2, 3]. Global communications and more business opportunities can be obtained through high-speed Internet. Malaysia constantly improving their network infrastructure such as telecommunication towers to improve the Internet performance [4, 5]. Network development always labelled as project that consist of unforeseen risk and low return of investment especially on rural areas [6]. Financial sustainability, reputation and risk management are the main concerns of ISP for every project. Wireless transmission often encounters multiple issues such as signal blocking, signal fading and Fresnel zone requirement. Therefore, ISPs are forced to use stronger and better routers for wireless transmission. The extra initial investment for the project will be paid by their customers who might suffer higher subscription or product fees. A suitable outdoor router cost estimation model can provide essential information for the ISP and implement necessary risk management plan [7]. Therefore, this paper aimed to develop and demonstrate a suitable outdoor router cost estimation model that can provide cost estimations for ISPs under different situations.

Parametric modelling was used in this paper to develop a suitable outdoor router cost estimation model. Suitable key parameters and Cost Estimation Relationship (CER) are the key factors in developing a parametric model [8-10]. P-value regression analysis was used to select suitable key parameters for the model. The changes for independent variable will highly affect the dependent variable when its P-value is lower than certain significant level. Therefore, only independent variables with low P-value will be used in

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