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ROBUST LEARNING AND ACCURATE PREDICTION OF WIRELESS TRAFFIC USING IMPROVED NEURAL NETWORK

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Abstract: The proposed system introduces a novel Deep Metric Algorithm as a cornerstone for enhancing the feasibility and optimality of network traffic prediction within the dynamic landscape of cloud technologies. The Deep Metric Algorithm is designed to operate as a physically interpretable probabilistic model that captures network-wide traffic patterns. Unlike traditional methods that rely solely on current traffic states observed at specific intervals, this algorithm leverages an initially expensive set of measurements to construct a network-specific traffic model.The algorithm's innovation lies in its ability to utilize this network-specific model alongside readily available, less expensive measurements, thereby significantly improving the accuracy of traffic predictions. By employing the Deep Metric Algorithm, the system can predict traffic fluctuations not only over observed links but also extend its predictions to unobserved links. This is a crucial advancement as it enables the system to offer more comprehensive insights into network behavior, even where direct measurements might be limited.One notable strength of the proposed Deep Metric Algorithm is its demonstrated applicability across various traffic periods within the same network. This adaptability ensures that the learned model remains effective over time, showcasing its potential utility in optimizing network performance as it evolves. The algorithm's predictive capabilities, coupled with its ability to adapt to changing network conditions, position it as a valuable tool for load-aware resource management and predictive control, thereby contributing to the efficient management of multi-provider networks in the evolving cloud landscape.

KEYWORDS: Quality of Service (QoS), network traffic, accurate predictions, network-specific traffic model, Deep Metric Algorithm.

1.INTRODUCTION

1.1 Wireless Traffic Prediction:

Currently, most of wireless traffic prediction approaches are focusing on centralized learning strategy and involves transferring huge amount of raw data to a datacenter to learn a generalized prediction model. However, frequently transmission of training data and signaling overhead could easily exhaust the network capacity and yield negative impacts on payload transmissions. Thus new wireless traffic prediction approaches that can cope with the above challenges are needed.Recently, wireless traffic prediction has received a lot of attention as many tasks in wireless communications require accurate traffic modeling and prediction capabilities. Wireless traffic prediction is essentially a time series prediction problem. The methods to solve it can be roughly classified into three categories, i.e., simple methods, parametric methods, and non-parametric methods.Computer networks consist of nodes (routers and switches) connected by physical links (optical or copper wires). Data from one node (called a source) to another (destination) is sent over the network on predetermined paths, or routes. We will call the stream of data between a particular source/destination pair a flow. The socalled flowlevel traffic may traverse only a single link, if the source and destination nodes are directly connected, or several links, if they are not. Also of interest is the aggregate data traversing each link. The traffic on a given link is the sum of the traffic of the various flows using the link.

Both the flowlevel and linklevel traffic have been studied in the literature. Flow level data is expensive to obtain and process, but provides information directly about the flows. Data, especially that involving packet delays from source to destination, has been used to do something. See some references. On the other hand, the link level data is less expensive to obtain, but provides less information about the underlying flows. These data have been studied extensively by the field of network tomography.Current TCP/IP network infrastructures and management systems are facing a tough time in handling the unusual increase in network traffic due to the surge of typical real-time applications. To solve this problem, management system predicts the changes in network traffic and handle them proactively.Expeditious growth in computing power and wireless technologies have triggered the massive adoption of mobile devices, an increase in mobile content and services, and new technologies like Internet of Things (IoT.

2.LITERATURE SURVEY

Chuanting Zhang implemented a real-time application for intelligent cellular traffic prediction in Spatial Technology. Their proposed work revolutionizes traffic modeling and prediction by transitioning from traditional methods to an automated process. By comprehensively understanding users and their roles within the cellular network, they've devised a system that provides controlled access to resources. Recognizing the significance of randomization in traffic prediction, they've integrated an efficient algorithm that ensures complete randomness and eliminates question repetition in subsequent traffic predictions. Their system distinguishes between different user roles, ensuring efficient task allocation and management.

Qingtian Zeng have implemented a system aimed at improving traffic prediction in wireless cellular networks. Their innovative work shifts away from traditional prediction methods towards an automated approach. By incorporating cross-domain data and leveraging deep transfer learning techniques, they've enhanced the accuracy of traffic prediction models. Their system ensures controlled access to resources and generates question papers with diverse and non-repetitive content. The proposed Fusion-transfer strategy optimizes prediction performance by integrating multiple cross-domain datasets and dynamically adjusting predictor selection.

Lina Wu have developed an artificial neural network-based model for predicting path loss in wireless communication networks. Their system provides accurate predictions by extracting environmental features and employing principal component analysis for feature reduction. By combining different datasets and constructing multiple prediction models, they've achieved robust path loss predictions. The proposed system ensures efficient utilization of resources and enhances prediction accuracy by considering various environmental factors.

Qing He have proposed a meta-learning scheme for adaptive short-term network traffic prediction. Their system dynamically selects predictors based on recent prediction performance, allowing for efficient adaptation to changing traffic patterns. By leveraging deep reinforcement learning techniques, they've outperformed standalone predictors and achieved superior prediction accuracy. The proposed system ensures optimized resource allocation and adapts to evolving network conditions, making it a promising solution for short-term traffic prediction

Harbil Arregui have developed a system for short-term vehicle traffic prediction to optimize terahertz line-of-sight estimation in small cells. Their system utilizes data-driven prediction algorithms to estimate future vehicle traffic demand accurately. By integrating random forests regression over spatiotemporal aggregated data, they've achieved efficient management of radio resources in small cell networks. The proposed system ensures robust coverage and improves the quality of service for connected vehicles, making it a valuable tool for optimizing wireless communication networks.

S.NO	TITLE	AUTHOR	PROS	CONS
1	Deep Transfer Learning for Intelligent Cellular Traffic	Chuanting Zhang, Haixia Zhang, Jingping Qiao, Dongfeng Yuan, and Minggao Zhang (2019)	Captures complex patterns	Requires diverse cross-domain data
2	Traffic Prediction of Wireless Cellular Networks	Qingtian Zeng, Qiang Sun, Geng Chen, Hua Duan, Chao Li, and Ge Song (2020)	Improves prediction accuracy	Complexity in integrating datasets
3	Artificial Neural Network Based Path Loss Prediction	Lina Wu, Danping He, Bo Ai, Jian Wang, Hang Qi, Ke Guan, and Zhangdui Zhong (2020)	Accurate path loss prediction	Limited to defined environmental features
4	A Meta-Learning Scheme for Adaptive Short-Term Traffic	Qing He, Arash Moayyedi, György Dán, Georgios P. Koudouridis, and Per Tengkvist (2020)	Adapts to changing traffic	Complexity in predictor selection
5	Short-Term Vehicle Traffic Prediction for Terahertz	Harbil Arregui, Andoni Mujika, Estíbaliz Loyo, Gorka Velez, Michael T. Barros, and Oihana Otaegui (2019)	Provides dynamic resource management	Limited to specific traffic conditions
6	Modeling and Predictability Analysis on Channel Spectrum	Yafei Hou, Julian Webber, Kazuto Yano, Shun Kawasaki, Satoshi Denno, and Yoshinori Suzuki (2021)	Predicts spectrum occupancy status	Relies on data categorization method
7	A Novel Spatio-Temporal Model for City-Scale Traffic Speed	Kun Niu, Huiyang Zhang, Tong Zhou, Cheng Cheng, and Chao Wang (2019)	Accurate urban traffic prediction	Limited discussion on scalability
8	A Hybrid Deep Learning Framework for Long-Term Traffic Flow	Yiqun Li, Songjian Chai, Zhengwei Ma, and Guibin Wang (2021)	Improved long-term flow prediction	Complexity in wavelet decomposition
9	Comparison of Machine Learning Techniques Applied to Traffic	Daria Alekseeva, Nikolai Stepanov, Albert Veprev, Alexandra Sharapova, Elena Simona Lohan, and Aleksandr Ometov (2021)	Provides comparison of ML techniques	Dependent on the quality of data
10	Prediction of Traffic Congestion Based on LSTM	Dong-Hoon Shin, Kyungyong Chung, and Roy C. Park (2020)	Corrects missing temporal/spatial data	Relies on data preprocessing

3.EXISTING SYSTEM

Wireless mesh networks are getting adopted in the domain of network communication. Their main benefits include adaptability, configuration, and flexibility, with added efficiency in cost and transmission time. Traffic prediction refers to forecasting the traffic volumes in a network. The traffic volume includes incoming requests and outgoing data transmitted by the network nodes. The previous logs of traffic in the network are used for extracting patterns that help for accurate predictions. In this paper, an analysis of various existing traffic prediction methods is done. Specifically, the analysis of a case study where the performance of the High-Speed Diesel (HSD) pump is predicted by observing its output. A network of sensors form a less mesh network; sensors act as nodes while reading the parameters, namely, three-phase Current, Voltage, Temperature, and Vibration. In this existing case study, a High-Speed Diesel pumps performance is predicted by predicting the vibration parameter as the output parameter. Other parameters affecting the performance of the High-Speed Diesel pump which are causing the change in vibration value are identified. Various algorithms, including Statistical Auto-Regressive Integration and Moving Average, Poissons regression, and a few Machine Learning and Deep Learning algorithms like Decision Tree Regressor, Multi-Layer Perceptron, Linear Regression, and Long Short-Term Memory are implemented and evaluated for this purpose. Along with the comparison, a novel architecture using Convolution Neural Network and Long Short-Term Memory is described in the existing paper. networks.

3.1 DRAWBACKS OF EXISTING SYSTEM:

- Computation burden may limit its further application for real scenarios.
- May raise delay and privacy concerns for certain scenarios.
- Fail to capture the hidden patterns of network traffic, their prediction performance is relatively poor.
- The prediction of random components is impossible.
- Difficulty of training, and their learned features packed in a black-box are usually hard to interpret ate.

4.PROPOSED SYSTEM

In building upon the foundation laid by existing studies, this paper introduces a novel approach to network traffic prediction by proposing the utilization of the Deep Metric Algorithm. The key innovation lies in employing traffic flow differences as input parameters for the model. Unlike traditional methods, this approach capitalizes on the dynamic nature of traffic patterns by applying the concept of dynamic rolling prediction, taking into account not just the current traffic state but also the variations in traffic flow over time.

At the heart of this proposed method is the adoption of the Deep Metric Algorithm, a physically interpretable probabilistic model designed to capture network-wide traffic patterns. The Deep Metric Algorithm offers a unique advantage in providing a comprehensive understanding of the network's behavior. Its adaptability and effectiveness in modeling temporal dependencies within the context of network traffic make it a robust choice for enhancing short-term prediction accuracy.

By incorporating the Deep Metric Algorithm, the paper aims to improve the precision of short-term network traffic predictions, surpassing traditional methods by better capturing the temporal dynamics inherent in traffic patterns. The utilization of traffic flow differences as input parameters and the application of dynamic rolling prediction collectively contribute to a more sophisticated and adaptive model. Overall, this paper presents a promising avenue for advancing the field of network traffic prediction, leveraging the capabilities of the Deep Metric Algorithm in the context of traffic flow analysis.

5.CONCLUSION

In the realm of computer network management, predicting internet traffic is a crucial task aimed at avoiding congestion and ensuring the efficient allocation of network resources. Given the intricate nature of internet traffic characterized by high complexity, randomness, non-linear patterns, and uncertainties, this paper builds upon existing studies by introducing a neural network model for traffic prediction. The innovative approach involves utilizing the volume difference between observed data and statistical values as input parameters for the neural network model. Incorporating the concept of dynamic rolling prediction, the model takes into account not only the current traffic state but also its evolving patterns over time.

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