SEMARAK ILMU PUBLISHING

Journal of Advanced Research in Applied Sciences and Engineering Technology

Journal homepage: https://jaraset.com/
ISSN: 2462-1943


# EDGE INTELLIGENCE BLOCKCHAIN AND DEEP LEARNING FRAMEWORK FOR INTRUSION DETECTION IN INDUSTRIAL INTERNET OF THINGS ENHANCING SECURITY IN MANET NETWORKS

**DR. ABDUL RAZZAK KHAN QURESHI [1*], DR. SATYENDRA KUMAR BUNKAR [2], DR. HEMANT PAL [3], DR. RAJDEEP SINGH SOLANKI [4], DINESH SALITRA [5], PROF. MANISH JOSHI [6]**

[1] Assistant Professor, Department of Computer Science, Medi-Caps University, Indore, India; dr.arqureshi786@gmail.com
[2] Associate Professor, Department of Computer Science, Chameli Devi Group of Institutions, Indore, India; satyendra.bunkar@gmail.com
[3] Assistant Professor, Department of Computer Science, Medi-Caps University, Indore, India; hemantpal.scs@gmail.com
[4] Assistant Professor, Department of Computer Science, Medi-Caps University, Indore, India; rajdeepslnk@yahoo.co.in
[5] Assistant Professor, Department of Computer Science, SICA College, Indore, India; dinesh.salitra@gmail.com
[6] Assistant Professor, Department of Computer Science, Medi-Caps University, Indore, India; manish_riya@Yahoo.co.in

**ARTICLE INFO**

***Article history:***
Received: 15-04-2024
Received in revised form: 25-05-2024
Accepted: 10-06-2024
Available online: 13-09-2024

***Keywords:***

Internet of things, edge-cloud, data management framework, cloud computing.

**ABSTRACT**

This tendency is now being accompanied by the growth of the Internet of Things and more intelligent connected gadgets. Thanks to cloud computing, which has also established itself as the industry standard for offering clients highly scalable, reasonably cost computing services, the utilization of apps has increased dramatically. IoT applications are expanding swiftly and becoming more and more integrated into our everyday lives, which have led to an abundance of IoT devices and the data they produce. Strict computational delay constraints are used to achieve acceptable performance since the majority of these applications are known to be time-sensitive. A new cloud paradigm called edge computing seeks to bring cloud-based services and utilities closer to end users. This next cloud platform, also known as edge clouds, seeks to lessen network stress on the cloud by using computing resources close to users and Internet of Things sensors. In an attempt to replicate cloud-like performance, the resultant architecture blends a variety of heterogeneous, resource-constrained, and unstable compute-capable devices.

## INTRODUCTION

The Internet of Things (IoT) was born out of the current tendency in the Internet world to link everything devices, products, and things to the Internet in an attempt to improve our everyday quality of life [1], [2]. Application owners may be put on a generic platform provided by centralized cloud infrastructure, which shields them from the specifics of the hardware below. Standardized protocols and technologies that attempt to streamline the deployment procedures for application owners are what enable the advancements in cloud computing [13]. Several essential elements make up the new Internet of things (IoT) paradigm [SBH16, AIM10].

One potential remedy for this problem is edge computing (EC) [Rap16, SCZ+16]. EC delegated data processing tasks to gateways and edge devices throughout the period of data collection on the edge of the Internet of Things [SEKC15, Rap16]. More than 40% of the data generated by the Internet of Things is expected to be processed, preserved, and utilised next to the network edge, according to IDC Future Sight [12]. This method lowers the burden on the Internet of Things network, lowers application latency, and increases application reliability by spreading out the processing. But it also brings with it new difficulties and issues that must be resolved, such as resource management and allocation.

The gateway uses low-power, low-bandwidth wireless protocols like LoRa, BLE, or ZigBee to connect to IoT edge nodes even if it is connected to the Internet via a high-bandwidth WiFi or cellular connection. New compression methods [BMB+16, SBH15] or service quality adaption [STX+16b] might potentially lower the bandwidth consumption of IoT edge nodes. However, the best course of action would be to assign some of the data handling to the IoT devices and leave the remaining computation to the gateway or another more potent device [3].

Table 01: IoT wireless technology throughput [Mulb, Smi11]

| **Wireless** | **BLE** | **ANT+** | **ZigBee** | **HaLow** | **LoRa** | **SigFox** |
|---|---|---|---|---|---|---|
| **Throughput [Kbps]** | 262 | 22 | 122 | 154 | 55 | 10 |

## RISE OF EDGE COMPUTING

The resource management strategies discussed in the next technical paper [7] need an understanding of edge computing and the related difficulties in reconsidering typical datacenter-based cloud architecture. This background provides such information. We begin with a quick overview of the parts and layout of typical datacenters, as well as the extreme care the provider takes to guarantee reliable, peak performance. We also talk about the difficulties brought about by new applications that need a major overhaul of the architecture of cloud computing [6]. The article reviews many edge cloud architectures that other academics have suggested and discusses the design decisions that have made them appropriate for certain application tasks.

The anticipated difficulties in IoT, such as effective resource allocation, service quality monitoring, and compute offloading, have been the subject of several recent and continuing research projects [CRMS09]. A server is the main physical element of a datacenter. Its duties include processing, evaluating, and liaising with other servers both within and outside of DC facilities. The cloud providers placed network-attached storage within the same building in addition to the built-in storage that each server has to allow local calculations [8]. This gives all DC servers a fibre link to high-speed storage.

Although conventional clouds advertise themselves as a storehouse of very powerful computers, new online applications have different needs than what traditional clouds can provide. One example of this is the Internet of Things (IoT). IoT devices and sensors are already widely dispersed across the network, and demand for them is rising quickly.

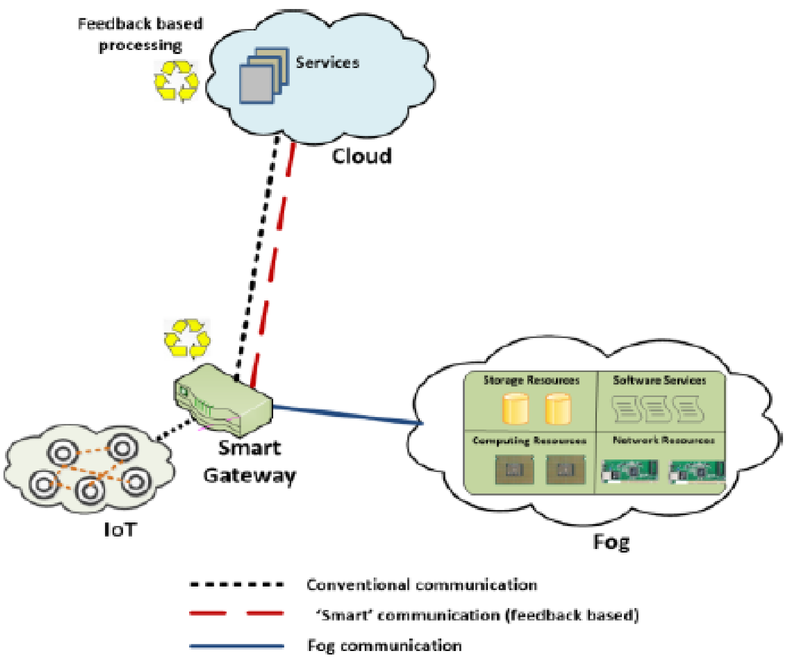


Figure 01: Smart Network/Fog Computing Smart Gateway

### Internet of Things (IoT)

An Internet of Things (IoT) network is a system of linked and heterogeneous items, such cars and household appliances, that can communicate and transmit data via a network. These interconnected gadgets bridge the gap between the digital and physical realms to improve social interactions, industries, and overall quality of life [1]. Across the globe, billions of devices are linked to the Internet, producing, gathering, and sending data [2]. Everything has the potential to be connected to the Internet [3]. Everyday items may be given networking, sensing, and identification capabilities. In order to facilitate IoT-based services and goods, the following technologies are widely used [5]:

- **Radio-frequency identification (RFID):** When an item is linked to an RFID-enabled tag, the technology known as RFID uses wireless communication to automatically identify and track it [6]. The amount of storage that RFID tags can hold depends on the needs of the application. Compared to alternative tracking technologies like barcode technology, RFID tags offer more storage capacity [5].
- **Wireless-sensor networks (WSNs):** a wireless sensor network (WSN) is an infrastructure-free network made up of dispersed sensors that can track environmental and physical factors [3].
- **Middleware:** is a piece of software that acts as a bridge between Internet of Things devices and apps [7]. It serves as a link between Internet of Things apps and devices. It connects heterogeneous IoT devices and a range of IoT applications to facilitate development, integration, management, and communication across several network interfaces [8].
- **Cloud computing:** a system that moves different functions to distant computers, including data processing, administration, and storage [9]. IoT networks are improved by cloud computing because it offers effective online administration, storage, and data processing. In this study, cloud computing is covered in more detail.

**Not with standing its potential benefits, the Internet of Things confronts a number of obstacles related to:**

- **Scalability:** the capacity of a system, process, or network to handle an increasing volume of work well. Because so many different apps access raw data, this is a severe problem for the Internet of Things [4]. Furthermore, a lot of IoT applications like IoT-enabled smart city environments involve a big number of IoT devices that constantly evolve and expand in response to needs.
- **Self organizabiliy:** The network need to have the ability to bootstrap communication between devices in the event of a node, connection, or communication failure [3].

**Network availability is increased via self-organization.**

- **Data size:** Because of the volume and diversity of data produced by IoT devices, IoT networks need efficient data-transmission methods as well as a suitable storage system [3].

- **Timely data analysis:** Immediate data analysis is necessary for real-time applications. As a result, IoT networks and emerging technologies like edge computing should be combined [4].
- **Interoperability:** One obvious difficulty is the heterogeneity and abundance of IoT devices with various functionality and applications, made by many manufacturers with their own proprietary standards. IoT networks must thus be capable of handling diversity and heterogeneity.
- **Bandwidth scarcity:** The need for bandwidth rises as more IoT devices are added, and bandwidth is needed to meet the needs of IoT applications [5]. IoT devices use bandwidth to gather and send data.

## HARDWARE SOLUTION FOR EDGE

Recent and continuing technology breakthroughs in fields such as RFID, mobile phones, ultra-low power CPUs, embedded sensors and actuators, wireless communication, and cloud/fog computing have made possible the emergence of the Internet of Things (IoT). Recently, a range of edge computing models have also been put out to address specific task needs for certain applications [11]. The majority of research initiatives have a similar trend, which is the utilisation of locally available community-sourced computing resources (smart phones, tablets, smart speakers, etc.) [10].

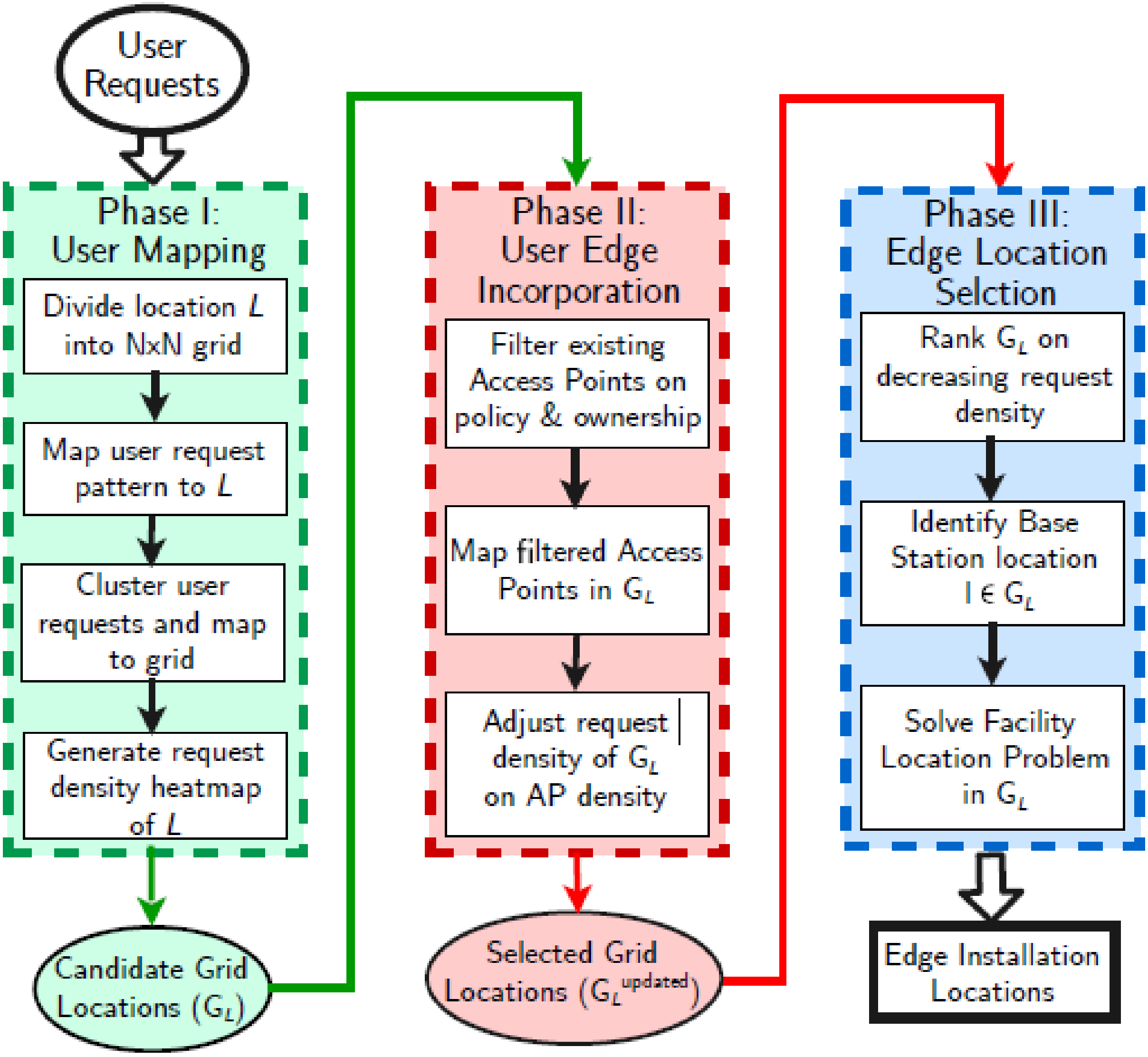


Figure 02: Workflow of Design

## INFRASTRUCTURE SERVICES FOR EDGE

It offers a thorough framework for managing input signal data for Internet of Things (IoT) applications in the healthcare industry [17]. After that, it shows the IoT applications' operation modes as a control parameter to adapt to various IoT environment conditions. The various compute offloading levels and/or service quality levels that may be selected at runtime dictate the operational modes [13]. Although Edge-Fog Cloud aims to complement traditional cloud computing, its core designs are quite different from those of the former. The following table lists the many approaches that data-placement systems now use to address data placement and reduce access latency [14]. Many strategies, including divide and concur and graph partitioning, were used. Furthermore, some systems perform poorly or don't scale effectively in an LSD-IoT setting [16].

### SDN-Based Architectures

In IoT networks, as the architecture in [9] consists of the following elements: Permanent and cloud-based, CSDNC is the component that controls the whole system and symbolises global intelligence. While representing local intelligence, LSDNC centralises intelligence. It manages the local fog cell and is under the jurisdiction of the CSDNC. The LSDNC regulates the fog nodes, which make up the fog cell. Fog nodes provide their customers this service since they are unable to calculate their jobs. They could be cars, people, or institutions. Base stations keep cloud and fog node communication intact. The LSDNC multicasts its Fog-SDN capabilities in VISAGE. Every car might use the fog cell's services or take part as a fog node. The LSDNC might be used to link the fog cells to the Internet. The CSDNC then coordinates the resources once the LSDNC has communicated with it.

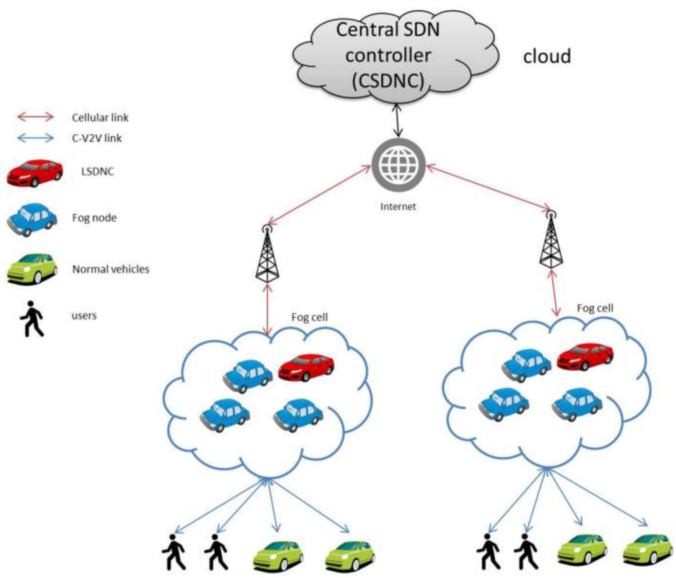


Figure 03: VISAGE architecture.

### SDN-Based VANET Architecture (FSDN)

The design described in [13] improves VANET resource management. The SDN controller is a cloud-based device that manages intelligence globally. Although resource management and network orchestration are absent from this design, no performance measurement is done for it.

Table 02: A comparison of the designs for data location

| Architecture | Deployed Techniques | Improvement | Weakness |
| --- | --- | --- | --- |
| **IFogStor** | precise resolution | Latency | Not suitable for LSD-IoT |

| | | | |
|---|---|---|---|
| **IFogStorZ** | Split and agree | Latency | Loss of optimally occurs |
| **IFogStorG** | Graph partitioning and Floyd's algorithm strategy | Latency | Not easily put into practice |
| **IFogStorM** | Greedy algorithms | Latency | Network overhead in LSD-IoT |

## Transferring Trained Models (TTM)

The insufficiency of training data in in-home applications hinders the ability of models to be trained for the implementation of new services. The transfer of trained models across different smart homes has emerged as a significant area of study. An architecture for transferring activity recognition models from a source house to a target home was presented by the authors in [7]. Three levels were specified in their suggested design, as shown in Figure 8. Initially, a collection of smart houses categorised according to their respective cities. The second layer is the fog-node layer, in which every fog node is in charge of a certain city.

Third, the cloud-system layer, which gives the fog nodes the capacity to interact with one another and control common settings, environmental variables, information, and data. Two requirements must be met for the trained model to be transferred from a source house to a target home: homogeneity between the source and target environments and model correctness. Feature analysis, the first stage of their suggested architecture, is in charge of expanding source datasets to address variability in feature spaces across diverse data sources. However, since there are a lot of features created, dimensionality reduction is used to cut down on the amount of features. After that, by mapping features from the source and target, the diversity issue between the source and destination is resolved, creating a new feature space that is appropriate in the target environment. To get a consistent form that accurately depicts the target dwelling, target-environment attributes are applied to the mapped features.

## DISCUSSION

This research investigates the feasibility of utilising Multipath TCP (MPTCP) to leverage several edge server network interfaces concurrently, with the goal of improving reliability and bandwidth over wireless networks. Our research, however, indicates that MPTCP performance is worsened by mobility more than by standard TCP, mostly as a result of increased packet buffering on one of the pathways. To mitigate the anticipated link delays caused by on-path packet buffering, we devise a cross-layer MPTCP scheduler that switches to the connection that performs better. When compared to the state of the art, our examination in practical circumstances demonstrates that offers more than a 55% boost in data rates.

## CONCLUSION

The operating modes of the IoT devices were considered as a control parameter to manage the few resources on the network edge. For a cloud provider to replicate datacenter-like performance, its edge servers must be continuously serviced and observed. We found that the existing base station locations are a good fit for future edge deployments since cellular operators already have a strong regulatory presence in the area. It is not worth it for cloud providers to install edge servers on every cellphone tower. Locating edge servers close to customers is made feasible by ExEC; nevertheless, containerised services must be moved to these servers with the assistance of the application owner. Current container protocols are not designed to manage the wide variations in user requests that may occur locally. The conviction that having separate edge servers in place is necessary to guarantee the efficient functioning of edge computing. In this paper, we describe technical approaches that let independent edge providers live in harmony with the existing cloud.

## FUTURE SCOPE

This paper concentrated on modeling Internet of Things applications for the healthcare industry, defining modes of operation that enable adaptable control of restricted resources on the devices and shared resources on the gateway. Even though our solutions were designed to serve an essential purpose, several of our techniques may benefit from further granularity. Based on the specific requirements of the edge cloud provider, the infrastructure protocols outlined in this work must be modified (e.g., facilitating data flow for particular kinds of traffic, assigning jobs based on bandwidth rather than processing).

## REFERENCES

[1] Ehsan Ahvar, Shohreh Ahvar, Noel Crespi, Joaquin Garcia-Alfaro, and Zolt´an Ad´am Mann. Nacer: a network-aware cost-efficient resource allocation method for processing-intensive tasks in distributed clouds. In 2015 IEEE 14th International Symposium on Network Computing and Applications, pages 90–97. IEEE, 2015.

[2] Mohammad Al-Fares, Alexander Loukissas, and Amin Vahdat. A scalable, commodity data center network architecture. In Proceedings of the ACM SIGCOMM 2008 Conference on Data Communication, SIGCOMM ’08, pages 63–74, New York, NY, USA, 2008. ACM.

[3] Apple Inc. Use Multipath TCP to create backup connections for iOS.

“https://support.apple.com/en-us/HT201373,2017", 2017.

[4] Rihards Balodis and Inara Opmane. History of data centre development. In Reflections on the History of Computing, pages 180–203. Springer, 2012.

[5] Olivier Bonaventure, Mark Handley, and Costin Raiciu. An overview of Multipath TCP. ; login:, 2012.

[6] Flavio Bonomi, Rodolfo Milito, Jiang Zhu, and Sateesh Addepalli. Fog computing and its role in the internet of things. In Proceedings of the first edition of the MCC workshop on Mobile cloud computing, pages 13–16. ACM, 2012.

[7] Vitalik Buterin et al. A next-generation smart contract and decentralized application platform. white paper, 2014.

[8] Yu Cao, Songqing Chen, Peng Hou, and Donald Brown. Fast: A fog computing assisted distributed analytics system to monitor fall for stroke mitigation. In 2015 IEEE International Conference on Networking, Architecture and Storage (NAS), pages 2–11. IEEE, 2015.

[9] Jason Carolan, Steve Gaede, James Baty, Glenn Brunette, Art Licht, Jim Remmell, Lew Tucker, and Joel Weise. Introduction to cloud computing architecture. White Paper, 1st edn. Sun Micro Systems Inc, 2009.

[10] Alberto Ceselli, Marco Premoli, and Stefano Secci. Mobile edge cloud network design optimization. IEEE/ACM Transactions on Networking (TON), 25(3):1818–1831, 2017.

[11] Lucas Chaufournier, Prateek Sharma, Franck Le, Erich Nahum, Prashant Shenoy, and Don Towsley. Fast transparent virtual machine migration in distributed edge clouds. In Proceedings of the Second ACM/IEEE Symposium on Edge Computing, page 10. ACM, 2017.

[12] Yang Chen. Checkpoint and restore of micro-service in docker containers. In 2015 3rd International Conference on Mechatronics and Industrial Informatics (ICMII 2015). Atlantis Press, 2015.

[13] Mung Chiang and Tao Zhang. Fog and iot: An overview of research opportunities. IEEE Internet of Things Journal, 3(6):854–864, 2016.

[14] N. Kuhn, E. Lochin, A. Mifdaoui, G. Sarwar, O. Mehani, and R. Boreli. Daps: Intelligent delay-

aware packet scheduling for multipath transport. In IEEE International Conference on Communications (ICC), 2014.

[15] Utsav Drolia, Rolando Martins, Jiaqi Tan, Ankit Chheda, Monil Sanghavi, Rajeev Gandhi, and Priya Narasimhan. The case for mobile edge-clouds. In 2013 IEEE 10th International Conference on Ubiquitous Intelligence and Computing.

[16] Dave Evans. The Internet of Things: how the next evolution of the internet is changing everything (april 2011). White Paper by Cisco Internet Business Solutions Group (IBSG), 2012.

[17] S. Ferlin, . Alay, O. Mehani, and R. Boreli. BLEST: Blocking estimation-based MPTCP scheduler for heterogeneous networks. In 2016 IFIP Networking Conference (IFIP Networking) and Workshops, 2016.