

SPECIAL ISSUE

## ADAPTIVE AND SCALABLE COMMUNICATION NETWORKS

*Edited by R. Steinmetz, I. Stavrakakis, C. E. Rothenberg, and B. Koldehofe*

### 639 Scalable 360° Video Stream Delivery: Challenges, Solutions, and Opportunities

*By M. Zink, R. Sitaraman, and K. Nahrstedt*

| INVITED PAPER | This article introduces a novel networking scenario, namely 360° video streaming, discussing its challenges, existing approaches, and the research opportunities which it enabled.

### 651 Web AR: A Promising Future for Mobile Augmented Reality—State of the Art, Challenges, and Insights

*By X. Qiao, P. Ren, S. Dustdar, L. Liu, H. Ma, and J. Chen*

| INVITED PAPER | In the context of mobile augmented reality, this article addresses a challenging network scenario that requires adaptation in the usage of computing, storage, and communication resources.

### 667 Will Serverless Computing Revolutionize NFV?

*By P. Aditya, I. E. Akkus, A. Beck, R. Chen, V. Hilt, I. Rimac, K. Satzke, and M. Stein*

| INVITED PAPER | This article explores a network scenario that is emerging as a different type of a novel cloud computing paradigm in which applications are decomposed into smaller and modular functions.

### 679 Modeling of Aggregated IoT Traffic and Its Application to an IoT Cloud

*By F. Metzger, T. Hofßfeld, A. Bauer, S. Kounev, and P. E. Heegaard*

| INVITED PAPER | This article provides a survey on traffic models for the Internet of Things (IoT), a challenging network scenario comprising highly varying load characteristics and interconnections of devices.

### 695 Scalable Personalized IoT Networks

*By A. El-Mougy, I. Al-Shiab, and M. Ibnkahla*

| INVITED PAPER | In the context of the Internet of Things, this article surveys the readiness and interplay of various distinct technologies, including scalable sensing, information-centric networks, and AI, that are likely to be necessary in order to enable personalized IoT networks.

### 711 Adaptable and Data-Driven Softwarized Networks: Review, Opportunities, and Challenges

*By W. Kellerer, P. Kalmbach, A. Blenk, A. Basta, M. Reisslein, and S. Schmid*

| INVITED PAPER | This article reviews and analyzes adaptation opportunities and the potential for building scalable communication systems by means of software-defined networking (SDN) and network function virtualization (NFV).

### 732 Scaling Millimeter-Wave Networks to Dense Deployments and Dynamic Environments

*By C. Fiandrino, H. Assasa, P. Casari, and J. Widmer*

| INVITED PAPER | This article surveys adaptive communication techniques that relate to the coordination of antennas and beams that allow millimeter-wave networks to operate at scale.

DEPARTMENTS

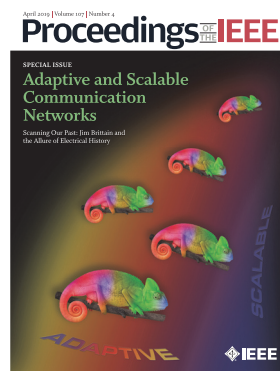
### 635 SCANNING THE ISSUE

Adaptive and Scalable Communication Networks  
*By R. Steinmetz, I. Stavrakakis, C. E. Rothenberg, and B. Koldehofe*

### 847 SCANNING OUR PAST

Jim Brittain and the Allure of Electrical History  
*By A. B. Magoun*

### 856 FUTURE SPECIAL ISSUE/SPECIAL SECTIONS



**On the Cover:**  
This month's cover cleverly captures the essence of the adaptability and scalability of communication networks through the image of a chameleon.

[Continued on page 634 ►]

# CONTENTS

CONTINUED FROM PAGE 633

SPECIAL ISSUE: Adaptive and Scalable Communication Networks

## 746 Survey of Performance Acceleration Techniques for Network Function Virtualization

By L. Linguaglossa, S. Lange, S. Pontarelli, G. Rétvári, D. Rossi, T. Zinner, R. Bifulco, M. Jarschel, and G. Bianchi

| INVITED PAPER | In the network function virtualization, this article surveys ways of realizing network functions in a scalable way. It introduces techniques for hardware and software acceleration that allow for removing inherent bottlenecks in the deployment of network functions.

## 765 Energy-Adaptive Error Correcting for Dynamic and Heterogeneous Networks

By H. Jeong and P. Grover

| INVITED PAPER | This article reviews adaptive coding techniques for achieving energy efficiency in wireless communications. It analyzes and presents fundamental limits of adaptive coding techniques.

## 778 Learning and Management for Internet of Things: Accounting for Adaptivity and Scalability

By T. Chen, S. Barbarossa, X. Wang, G. B. Giannakis, and Z.-L. Zhang

| INVITED PAPER | In the context of online learning and management policies, this article illustrates ways of dealing with extreme heterogeneity, massive number of devices, and unpredictable dynamics in the context of the Internet of Things.

## 797 Elements of Application-Layer Internetworking for Adaptive Self-Organizing Networks

By J. Liebeherr, M. Valipour, and T. Y. Zhao

| INVITED PAPER | This article presents an internetworking approach based on self-organizing application-layer networks, surveying findings related to scalability, the ability to adapt after disruptions, heterogeneous substrate networks, distributed security, and the dynamic creation of network services.

## 819 Self-Organization and Resilience for Networked Systems: Design Principles and Open Research Issues

By S. Dobson, D. Hutchison, A. Mauthe, A. Schaeffer-Filho, P. Smith, and J. P. G. Sterbenz

| INVITED PAPER | This article reviews and proposes research on the twin fields of self-organization and resilience for networked systems.

## 835 Transitions: A Protocol-Independent View of the Future Internet

By B. Alt, M. Weckesser, C. Becker, M. Hollick, S. Kar, A. Klein, R. Klose, R. Kluge, H. Koeppel, B. Koldehofe, W. R. KhudaBukhsh, M. Luthra, M. Mousavi, M. Mühlhäuser, M. Pfannemüller, A. Rizk, A. Schürr, and R. Steinmetz

| INVITED PAPER | This article provides a taxonomy of an adaptation principle, named transition, which aims at increasing the flexibility and scale at which communication networks can be adapted.

Proceedings OF THE IEEE

On the Web

[proceedingsoftheieee.ieee.org](http://proceedingsoftheieee.ieee.org)

Find the following information on our website.

About the Proceedings  
Recent and Upcoming Issues  
Featured and Popular Articles  
Instructions for Guest Editors and Authors  
Editorial Leadership  
Webinar Series  
Subscription Information



On the Web

[www.ieee.org](http://www.ieee.org)

### MEMBERSHIP

Check out the many features available through the IEEE Membership Portal.

### PUBLICATIONS

Find IEEE articles by using the search features of IEEE Xplore

### SERVICES

The IEEE offers many services to Members, as well as other groups.

### STANDARDS

The IEEE is the leader in the development of many industry standards.

### CONFERENCES

Search for the ideal IEEE Conference, on the subject of your choice

### CAREERS/JOBS

Find your next job through this IEEE service.