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Heterogeneous Vehicular Networks

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Heterogeneous Vehicular Networks

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Preface

With the advent of the intelligent transport system (ITS), vehicular communications networks have been widely studied in recent years. Dedicated short-range communications (DSRC) can provide efficient real-time information exchange between vehicles even with the lack of pervasive roadside communications infrastructure. Although mobile cellular networks are capable of providing great coverage for vehicular users, the requirement of stringent real-time safety services cannot always be guaranteed in mobile networks. Therefore, the Heterogeneous Vehicular NETWORK (HetVNET), which integrates cellular networks with DSRC, emerges as a promising solution to meet the communications requirements of the ITS. Although there exist extensive reported studies on either DSRC or cellular networks, the combination of these two popular techniques remains a relatively nascent field of research. Building such HetVNETs requires thorough investigations into heterogeneity and its associated challenges.

The objective of this monograph is to present architectures of the HetVNET and to examine recent advances in Medium access control (MAC) layer designs for such systems. In Chap. 1, we present the motivation to the development of HetVNETs after a brief introduction to existing vehicular networks as well as the user cases and requirements of ITS services. Chapter 2 proposes an HetVNET architecture that utilizes a variety of wireless networking techniques, followed by the descriptions of various applications in some typical scenarios. Chapter 3 focuses on the MAC mechanisms of vehicular communications including a novel location-based channel congestion control mechanism. In order to well exploit the radio resources in HetVNETs, efficient resource allocation schemes are desired. Thus, not only the content-based scheme but also the cooperative one are presented in Chap. 4, following a short brief to the state-of-the-art. Finally, Chap. 5 suggests some open issues that help point out new research directions in HetVNETs.

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Acronyms

3D	Three-dimensional
ABF	Adaptive broadcast frame
AC	Access category
ACK	Acknowledgement
AF	Amplify-and-forward
AIFS	Arbitration interframe space
AMC	Adaptive modulation and coding
AWGN	Additive white Gaussian noise
BS	Base station
BSSID	Basic service set identification
CAM	Cooperative awareness message
CAP	Contention access period
CCH	Control channel
CCHI	CCH interval
CDF	Cumulative distribution function
CELL-DCH	CELL dedicated channel
CELL-FACH	CELL forward access channel
CELL-PCH	CELL paging channel
CH	Cluster head
CN	Core network
CQI	Channel quality indicator
CRP	Contention-based reservation period
CSMA	Carrier sense multiple access
CTS	Clear-to-send
CW	Contention window
D2D	Device-to-device
DEN	Decentralized environmental notification
DF	Decode-and-forward
DOT	Department of Transportation
DS-CDMA	Direct sequence code division multiple access
DSRC	Dedicated short-range communications

eMBMS	Evolved multimedia broadcast and multicast service
eNB	Evolved nodeB
EAP	Exclusive access period
EAW	Exclusive access window
ECA	Exclusive channel access
EDCA	Enhanced distributed channel access
EDCAF	Enhanced distributed channel access function
ETSI	European Telecommunications Standards Institute
FCFS	First come first serve
GI	Guard interval
GPS	Global Positioning System
GW	Gateway
HetVNET	Heterogeneous Vehicular NETWORK
HLL	Heterogeneous link layer
I2V	Infrastructure-to-vehicle
ICI	Inter-carrier interference
IEEE	Institute of Electrical and Electronics Engineers
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISO	International Standards Organization
ITS	Intelligent transportation system
LBT	Listen-before-talk
LOS	Line-of-sight
LTE	Long-term evolution
MAC	Medium access control
MBMS	Multimedia Broadcast and Multicast Services
MBSFN	MBMS single frequency network
MCS	Modulation and coding scheme
MIMO	Multiple input multiple output
MSR	Maximum sum rate
NP	Nondeterministic polynomial
OBU	On-board unit
OFDM	Orthogonal frequency division multiplexing
OVSF	Orthogonal variable spreading factor
PCF	Point coordination function
PECA	Prioritized exclusive channel access
PHY	Physical
PS	Processor sharing
QCI	QoS class identifier
QoS	Quality of service
QPSK	Quadrature phase shift keying
RAN	Radio access network
RB	Resource block
RR	Round robin
RRC	Radio resource control

RSSI	Received signal strength indicator
RSU	Roadside unit
RTS	Request-to-send
SC	Service center
SCH	Service channel
SCHI	SCH interval
SF	Spreading factor
SNR	Signal-to-noise ratio
TCP	Transmission Control Protocol
TDMA	Time-division multiple-access
UDP	User Datagram Protocol
UE	User equipment
URA-PCH	URA paging channel
UTC	Universal Coordinated Time
V2I	Vehicle-to-infrastructure
V2V	Vehicle-to-vehicle
VANET	Vehicular Ad hoc NETWORK
VC	Vehicular cloud
VCC	Vehicular cloud computing
VE	Vehicle equipment
VoIP	Voice over Internet Protocol
VRRA	Virtual radio resource allocation
WAVE	Wireless access in vehicular environments
WBSS	WAVE basic service set
WCDMA	Wideband code division multiple access
WHO	World Health Organization
WLAN	Wireless local area network
WSA	WAVE service advertisement
WSMP	WAVE Short Message Protocol