

# Contents

## Preface

<b>Nine Years of Building Up Various Cooperations</b> .....	1
Seigo Kuzumaki (SIP-adus Program Director)	
<b>Toward Solving Social Issues Through Automated Driving, and Achieving a Mobility Society for the Future</b> .....	2
Takafumi Kakudo (Deputy Director General for Science, Technology and Innovation, Cabinet Office)	
<b>Role as Management Agency and Results</b> .....	3
Tomoyasu Nishimura (Executive Director, New Energy and Industrial Technology Development Organization (NEDO))	
<b>For Publication of Final Results Report</b> .....	4
SIP-adus Final Results Report Editorial Committee	

## The Second Phase of SIP–Automated Driving for Universal Services Final Results Report: Introduction ... 6

### Section 1 The Second Phase of SIP-Automated Driving for Universal Services 11

<b>The Second Phase of SIP-Automated Driving for Universal Services (Overview)</b> .....	11
Kotaro Sugiyama, Hiroaki Kimura (Cabinet Office)	
<b>Overview of Activities of the National Police Agency</b> .....	16
Hisaaki Ikeuchi (National Police Agency)	
<b>Overview of Activities of the Digital Agency</b> .....	19
Jun Usami (Digital Agency)	
<b>Overview of Activities of the Ministry of Internal Affairs and Communications</b> .....	22
Takanori Mashiko (Ministry of Internal Affairs and Communications)	
<b>Overview of Activities of the Ministry of Economy, Trade and Industry</b> .....	25
Shigekazu Fukunaga (Ministry of Economy, Trade and Industry)	
<b>Overview of Activities of the Road Bureau, Ministry of Land, Infrastructure, Transport and Tourism</b> .....	28
Masamitsu Waga (Road Bureau, Ministry of Land, Infrastructure, Transport and Tourism)	
<b>Overview of Activities of the Road Transport Bureau, Ministry of Land, Infrastructure, Transport and Tourism</b> .....	31
Yoshitaka Tada (Road Transport Bureau, Ministry of Land, Infrastructure, Transport and Tourism)	

### Section 2 Establishment and Utilization of Traffic Environment Data 34

#### (1) Technological Development Concerning the Generation of Traffic Environment Data 34

<b>Establishment and Utilization of Traffic Environment Data and the Tokyo Waterfront Area Field Operational Tests (Overview)</b> .....	34
Satoshi Hiyama (Honda Motor Co., Ltd.), Masato Minakata (TOYOTA MOTOR CORPORATION)	
<b>1) The Tokyo Waterfront City Area Field Operational Tests</b> .....	41
Yoshiaki Tsuda, Takahiro Yoshino (MITSUBISHI ELECTRIC CORPORATION), Shinya Muroyama, Kentaro Isobe (AISAN TECHNOLOGY CO., LTD), Kosuke Watabe, Katsuya Akimoto (Nippon Koei Co., Ltd.)	
<b>2) Technological Development to Provide Traffic Signal Information to Automated Vehicles Connected to Infrastructures (V2N)</b> ...	47
Yukiko Hatazaki (NIPPON SIGNAL CO., LTD.), Yuichi Takayanagi (Panasonic Connect Co., Ltd.), Toru Mabuchi (OMRON Social Solutions Co., Ltd.), Shunichi Kawabe (UTMS Society of Japan)	
<b>3) Technological Development for Lane-level Road Traffic Information Using Probes Vehicle Data</b> .....	54
Hirokazu Ichikawa, Atsushi Takenouchi, Naoki Funakawa, Naohiro Uchiyama, Akio Mori (PACIFIC CONSULTANTS CO., LTD.), Yukimasa Morisaki, Ryuki Oshima (Mitsubishi Research Institute, Inc.)	
<b>4) Technological Development and Establishment of Simulation Environment for Lane Merging Assistance</b> .....	61
Nobuhiro Araki, Kenta Shintoku (KOZO KEIKAKU ENGINEERING Inc.), Koichi Miyashita, Satomi Aiko (Mitsubishi Research Institute, Inc.)	
<b>5) Improvement of Data Accuracy of Traffic Regulation Information</b> .....	67
Moto Baba (JARTIC), Makoto Maeda (TOSCO CORPORATION), Ryo Sakaguchi (Dawn Corporation)	
<b>6) Technological Development for Traffic Signal Control and Emergency Vehicles Information Using GNSS (Location Information) and Other Technologies</b> .....	73
Kenji Sumi (KOITO ELECTRIC INDUSTRIES, LTD.)	

#### (2) Technological Development Concerning the Transmission of Traffic Environment Data 80

<b>Research for V2X Communication for Cooperative Driving Automation (Overview)</b> .....	80
Hideaki Suganuma (TOYOTA MOTOR CORPORATION)	
<b>1) Research on Communication Methods to Realize Cooperative Automated Driving Use Cases</b> .....	85
Satoshi Kimura, Takeshi Nunomoto (NEC Corporation), Masato Ogawa, Tomoaki Konishi (KYOCERA Corporation)	
<b>2) Development of New Technologies, V2X and Others, for Communication</b> .....	94
Kinya Asano, Shoichi Nakabayashi (Oki Electric Industry Co., Ltd.), Satoshi Kimura, Masahiro Ohtsuka (NEC Corporation)	
<b>3) Research and Development Concerning the Collection and Transmission of Mid-Scale Network Information</b> .....	99
Tomohiko Saito, Shota Taki (NTT Communications Corporation)	

## Section 3 Ensuring the Safety of Automated Driving 104

<b>Technological Development and Education for Enhanced Safety (Overview)</b> .....	104
Osamu Hosaka, Hiroaki Kimura (Cabinet Office)	
<b>1) Development of Driving Intelligence Validation Platform (DIVP®) for Automated Driving Safety Assurance</b> .....	108
Hideo Inoue (Kanagawa Institute of Technology)	
<b>2) Research on the Recognition Technology Required for Automated Driving Technology (Levels 3 and 4)</b> .....	121
Naoki Suganuma, Keisuke Yoneda, Ryo Yanase, Akisue Kuramoto (Kanazawa University), Takayoshi Yamashita, Hironobu Fujiyoshi (Chubu University), Junichi Meguro (Meijo University)	
<b>3) Research of New Cyberattack Techniques and Countermeasure Technologies</b> .....	130
Ken Okuyama, Naohide Waguri, Shinichi Kan, Yuki Imagawa (PwC Consulting LLC)	
<b>4) Research of Education Methods for Advanced Automated Driving Systems</b> .....	135
Makoto Itoh, Huiping Zhou (University of Tsukuba), Yoshiko Goda, Masashi Toda (Kumamoto University), Maki Arame, Junko Handa (Polytechnic University of Japan)	
<b>5) Research on Communication between Low-Speed Automated Transportation and Logistics Services Vehicles and Surrounding Traffic Participants</b> .....	139
Tatsuru Daimon, Masahiro Taima, Jieun Lee, Tomoyuki Furutani (Keio University)	
<b>6) Research of HMI for Advanced Automated Driving Systems</b> .....	145
Toshihisa Sato, Kunihiko Hasegawa, Yanbin Wu, Ken Kihara (National Institute of Advanced Industrial Science and Technology (AIST)), Kimihiro Nakano, Yang Yo (The University of Tokyo)	

## Section 4 A Society with Automated Driving 150

<b>(1) Automated Driving Mobility Services in Regional Communities</b> .....	150
<b>Automated Driving Transportation Services in Rural Areas (Overview)</b> .....	150
Yoshiyuki Kato (Highway Industry Development Organization)	
<b>1) Establishing the Environment for the Deployment of Transportation Services Relying on Automated Driving</b> ...	154
Yoshiyuki Kato (Highway Industry Development Organization)	
<b>(2) Public Acceptance of Automated Driving</b> .....	162
<b>Initiatives for Fostering Public Acceptance (Overview)</b> .....	162
Yuichi Araki, Hiroaki Kimura (Cabinet Office)	
<b>1) Research and Evaluations for Fostering Public Acceptance</b> .....	166
Yukiko Miyaki (DAI-ICHI LIFE RESEARCH INSTITUTE INC.)	
<b>2) Development of Assessment Methodology for Socioeconomic Impacts of Automated Driving Including Traffic Accident Reduction</b> .....	173
Yoshihiro Suda (The University of Tokyo), Hiroaki Miyoshi (Doshisha University)	
<b>3) Projects to Foster Public Acceptance</b> .....	180
Tadashi Hirota (DENTSU MEITETSU COMMUNICATIONS INC.), Hiroshi Kimura (SC-ABEAM AUTOMOTIVE CONSULTING)	
<b>4) Research for Automated Driving Bus Friendly to Persons with Disabilities or Reduced Mobility and Orientation</b> .....	189
Keiji Adachi, Soichiro Shibata, Ai Ikenaga, Ryo Tachikawa (NTT DATA INSTITUTE OF MANAGEMENT CONSULTING, Inc.)	

## Section 5 Data Connection and Use to Achieve Society 5.0 195

<b>Building and Designing a Geographic Architecture (Overview)</b> .....	195
Raita Hiraoka, Hiroaki Kimura (Cabinet Office)	
<b>1) Design of Geographical Data Architecture — Building and Promoting a Traffic Environment Data Portal Site</b> ...	199
Naoki Iso (NTT DATA Corporation)	
<b>2) Resolving Social Issues in Cities Popular with Tourists</b> .....	207
Noriyuki Hayashi, Naohisa Komiyama, Yurie Toyama, Takahiro Kashiwa, Hiroki Ozu, Wataru Uchida (Mitsubishi Research Institute, Inc.), Kazuhiro Noguchi, Taro Morita, Natsuha Makino, Taigo Mitsuhashi (MRI Research Associates, Inc.)	
<b>3) Research to Realize More Effective Logistics System with Probe Vehicle Data</b> .....	211
Yukihiko Akao, Masaaki Kanazawa, Daijiro Sato (NX Logistics Research Institute and Consulting, Inc.)	
<b>4) Utilization and Application of Probe Data to Road Maintenance and Management</b> .....	218
Hirokazu Ichikawa, Atsushi Takenouchi, Naohiro Uchiyama, Shinichi Nedu, Kazuki Tokunaga (Pacific Consultants Co., Ltd.)	

## Section 6 Promoting International Cooperation 222

<b>Overview</b> .....	222
Manabu Umeda (The University of Tokyo, Collaborative Research Coordinator for SIP-adus)	
<b>1) SIP-adus Workshop</b> .....	227
Megumi Funahashi (New Energy and Industrial Technology Development Organization (NEDO))	

<b>2) Japanese-German and Japanese-European Cooperation</b> .....	230
Manabu Umeda (The University of Tokyo, Collaborative Research Coordinator for SIP-adus)	
<b>3) Dynamic Maps</b> .....	234
Satoru Nakajo (The University of Tokyo)	
<b>4) Human Factors</b> .....	238
Satoshi Kitazaki (National Institute of Advanced Industrial Science and Technology (AIST))	
<b>5) Safety Assurance</b> .....	242
Hideaki Sato (TOYOTA MOTOR CORPORATION)	
<b>6) Connected Vehicles</b> .....	247
Masanori Misumi (Mazda Motor Corporation)	
<b>7) Cybersecurity</b> .....	251
Yasumasa Hirai (TOYOTA MOTOR CORPORATION)	
<b>8) Socioeconomic Impacts</b> .....	254
Takashi Oguchi (The University of Tokyo)	
<b>9) Service and Business Implementation</b> .....	257
Yurie Toyama (Mitsubishi Research Institute, Inc.)	

## **Section 7 Other Achievements and Activities** 260

<b>Other Achievements and Activities</b> .....	260
Takahiro Tanaka (New Energy and Industrial Technology Development Organization (NEDO))	

## **Section 8 Conclusion and Outcomes through SIP-adus to be Inherited** 264

<b>1) Looking Back upon SIP-adus History</b> .....	264
Seigo Kuzumaki (SIP-adus Program Director, TOYOTA MOTOR CORPORATION)	
<b>2) SIP-adus and Mission Oriented STI Policy</b> .....	268
Tateo Arimoto (National Graduate Institute for Policy Studies)	
<b>3) SIP-adus Achievement as Heritage and Next Step</b>	
<b>RoAD to the L4</b> .....	271
Toshio Yokoyama (National Institute of Advanced Industrial Science and Technology (AIST))	
<b>Next Phase of SIP</b> .....	274
Kenji Ueki (Cabinet Office)	
<b>4) Final Summary of SIP-adus Program –For the Next Generation of Engineers–</b> .....	277
Seigo Kuzumaki (SIP-adus Program Director, TOYOTA MOTOR CORPORATION)	

## **References** 285

<b>About Japanese National Laws Related to Automated Driving</b>	
<b>The Act for Partial Amendment of the Road Traffic Act</b> .....	285
Hisaaki Ikeuchi (National Police Agency)	
<b>The Act for Partial Amendment of the Road Act</b> .....	288
Road Bureau, Ministry of Land, Infrastructure, Transport and Tourism	
<b>The Act for Partial Amendment of the Road Transport Vehicle Act</b> .....	290
Yoshitaka Tada (Road Transport Bureau, Ministry of Land, Infrastructure, Transport and Tourism)	
<b>Projects List and Publication Status of the Second Phase of SIP Automated Driving for Universal Services</b> .....	292