

**SECURITY AND PRIVACY ISSUES IN SMART  
CITIES OF INDIA: A PROPOSED IT  
GOVERNANCE FRAMEWORK**

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**SECURITY AND PRIVACY ISSUES IN SMART CITIES OF  
INDIA: A PROPOSED IT GOVERNANCE FRAMEWORK**

by

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## **CERTIFICATE**

This is to certify that the thesis entitled “**Security and Privacy Issues in Smart Cities of India: A Proposed IT Governance Framework**” being submitted by **Sheshadri Chatterjee** to the Department of Management Studies, Indian Institute of Technology Delhi for the award of the degree of **Doctor of Philosophy (Ph.D.)**, is a record of *bona fide* research work carried out by him. He has worked under my guidance and supervision and fulfilled the requirements for the submission of the thesis, which has attained the standard required for a Ph.D. degree of the institute. The results presented in this thesis have not been submitted elsewhere for the award of any degree or diploma.

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## **Abstract**

Cities have become modern mostly using the application of Information and Communication Technology (ICT). These cities may be called smart cities. Smart cities in this century have become blessings of innovation of ICT. However, with increase of these opportunities, there has been increase of challenges too. This study would focus attention to the affairs of smart cities of India (SCI) especially on security and privacy issues. These two entangled challenges in SCI would pose serious threats. Cyber regulations are there in India to address these threats. However, full-proof immunization is still wanting. Attempts are being taken to develop smart cities to provide these digital services. Challenges of security and privacy issues in digital activities are required to be addressed. These all have been discussed in Chapter 1. For this, a pragmatic Information Technology Governance Framework (ITGF) is needed. There is no standard ITGF available for smart cities, especially focusing on security and privacy issues. With taking inputs from literature review as discussed in chapter 2, this thesis paper has taken a sincere attempt to understand the factors affecting successful adoption of IT enabled services in proposed SCI and to provide a comprehensive ITGF.

Better adoption of IT enabled services by the potential users can be ensured if the users are protected from security and privacy threats. Then, it will enhance the users' experience also. Enhancement of users' experience in using IT enabled services is perceived to improve the quality of life of the residents. Thus, users' experience in using IT enabled services is expected to improve the quality of life. All these have been discussed in this thesis paper in chapter 4. Thus, to achieve success, focusing on security and privacy issues, alignment between the users and the IT authorities is essential.

Security and privacy issues pose a considerable barrier towards use of IT enabled services expected to be provided to the citizens of SCI. These security and privacy challenges should be mitigated to bring trust in the users' mind. In this respect, part played by IT authorities plays a curtail role. Good alignment between the potential users and the concerned IT authorities would bring overall success. This alignment issue has been discussed in chapter 5. However, it is natural that the potential users of proposed SCI would use the services based on high speed networks like 5G. This is also a crucial factor for achieving success in shaping SCI. Use of seamless high-speed network like 5G is necessary when the SCI will be operational. It is essential to identify the critical success factors for successful adoption of 5G networks addressing the security and privacy issues. For this, process of brainstorming as well as of Delphi methodology has been used as has been discussed in chapter 3. To find out the driving powers as well as to understand interrelation among these other critical success factors, Interpretative Structural Modeling (ISM) methodology has been applied in chapter 6. By IT authority, it is meant officials of department of electronics and information technology, along with officials of information technology sections of other departments of Government of India (GOI).

Finally, the study proposes an IT governance framework (ITGF) in chapter 7. It focuses on security and privacy issues along with other components from citizens' perspective and from IT authority perspective. This provides an opportunity to ensure proper alignment between them. This is achieved through a single data platform to ensure safe usage of digital services using 5G network. This proposed framework would provide citizens a world class secured user experience using digital services in proposed SCI addressing the security and privacy challenges. The SCI has not been operational yet. So, the proposed ITGF could not be properly validated as observed in chapter 8 as a limitation.

## सार

शहर ज्यादातर सूचना और संचार प्रौद्योगिकी (आईसीटी) के आवेदन का उपयोग कर आधुनिक बन गए हैं। इन शहरों को स्मार्ट शहरों कहा जा सकता है। इस शताब्दी में स्मार्ट शहरों आईसीटी के नवाचार के आशीर्वाद बन गए हैं। हालांकि, इन अवसरों में वृद्धि के साथ, चुनौतियों में भी वृद्धि हुई है। यह अध्ययन विशेष रूप से सुरक्षा और गोपनीयता मुद्दों पर भारत के स्मार्ट शहरों (एससीआई) के मामलों पर ध्यान केंद्रित करेगा। एससीआई में इन दो उलझन में चुनौतियों से गंभीर खतरे पैदा होंगे। इन खतरों को दूर करने के लिए भारत में साइबर नियम हैं। हालांकि, पूर्ण-प्रमाणित टीकाकरण अभी भी चाहता है। इन डिजिटल सेवाओं को प्रदान करने के लिए स्मार्ट शहरों को विकसित करने के लिए प्रयास किए जा रहे हैं। डिजिटल गतिविधियों में सुरक्षा और गोपनीयता मुद्दों की चुनौतियों को संबोधित करने की आवश्यकता है। इन सभी पर अध्याय 1 में चर्चा की गई है। इसके लिए, एक व्यावहारिक सूचना प्रौद्योगिकी प्रशासन फ्रेमवर्क (आईटीजीएफ) की आवश्यकता है। स्मार्ट शहरों के लिए कोई मानक आईटीजीएफ उपलब्ध नहीं है, विशेष रूप से सुरक्षा और गोपनीयता मुद्दों पर ध्यान केंद्रित करना। अध्याय 2 में चर्चा के अनुसार साहित्य समीक्षा से इनपुट लेने के साथ, इस थीसिस पेपर ने प्रस्तावित एससीआई में आईटी सक्षम सेवाओं के सफल गोद लेने को प्रभावित करने वाले कारकों को समझने और व्यापक आईटीजीएफ प्रदान करने के लिए एक गंभीर प्रयास किया है।

संभावित उपयोगकर्ताओं द्वारा आईटी सक्षम सेवाओं के बेहतर गोद लेने को सुनिश्चित किया जा सकता है यदि उपयोगकर्ता सुरक्षा और गोपनीयता खतरों से सुरक्षित हैं। फिर, यह उपयोगकर्ताओं के अनुभव को भी बढ़ाएगा। आईटी सक्षम सेवाओं का उपयोग करने में उपयोगकर्ताओं के अनुभव में वृद्धि निवासियों के जीवन की गुणवत्ता में सुधार के लिए माना जाता है। इस प्रकार, आईटी सक्षम सेवाओं का उपयोग करने में उपयोगकर्ताओं के अनुभव से जीवन की गुणवत्ता में सुधार होने की उम्मीद है। इन सभी पर इस अध्याय 4 में अध्याय 4 में चर्चा की गई है। इस प्रकार, सफलता प्राप्त करने के लिए, सुरक्षा और गोपनीयता मुद्दों पर ध्यान केंद्रित करने, उपयोगकर्ताओं और आईटी अधिकारियों के बीच संरेखण आवश्यक है।

एससीआई के नागरिकों को आईटी सक्षम सेवाओं के उपयोग की अपेक्षा सुरक्षा और गोपनीयता के मुद्दों में काफी बाधा उत्पन्न होती है। उपयोगकर्ताओं के दिमाग में विश्वास लाने के लिए इन सुरक्षा और गोपनीयता चुनौतियों को कम किया जाना चाहिए। इस संबंध में, आईटी अधिकारियों द्वारा निभाई गई भूमिका एक कमजोर भूमिका निभाती है। संभावित उपयोगकर्ताओं और संबंधित आईटी अधिकारियों के बीच अच्छा संरेखण समग्र सफलता लाएगा। इस संरेखण मुद्दे पर अध्याय 5 में चर्चा की गई है। हालांकि, यह स्वाभाविक है कि प्रस्तावित एससीआई के संभावित उपयोगकर्ता 5 जी जैसे उच्च गति नेटवर्क के आधार पर सेवाओं का

उपयोग करेंगे। यह एससीआई को आकार देने में सफलता प्राप्त करने के लिए भी एक महत्वपूर्ण कारक है। एससीआई परिचालित होने पर 5 जी जैसे निर्बाध हाई-स्पीड नेटवर्क का उपयोग आवश्यक है। सुरक्षा और गोपनीयता मुद्दों को संबोधित करते हुए 5 जी नेटवर्क के सफल गोद लेने के लिए महत्वपूर्ण सफलता कारकों की पहचान करना आवश्यक है। इसके लिए, अध्याय 3 में चर्चा की गई है, जैसे मस्तिष्क के साथ-साथ डेल्टा पद्धति की प्रक्रिया का भी उपयोग किया गया है। ड्राइविंग शक्तियों को जानने के साथ-साथ इन अन्य महत्वपूर्ण सफलता कारकों के बीच अंतःक्रिया को समझने के लिए, अध्याय 6 में व्याख्यात्मक संरचनात्मक मॉडलिंग (आईएसएम) पद्धति लागू की गई है। आईटी प्राधिकरण द्वारा, यह भारत सरकार के अन्य विभागों (जीओआई) के सूचना प्रौद्योगिकी खंड के अधिकारियों के साथ इलेक्ट्रॉनिक्स और सूचना प्रौद्योगिकी विभाग के अधिकारियों का है।

अंत में, अध्ययन अध्याय 7 में एक आईटी प्रशासन ढांचे (आईटीजीएफ) का प्रस्ताव है। यह नागरिकों के परिप्रेक्ष्य और आईटी प्राधिकरण परिप्रेक्ष्य से अन्य घटकों के साथ सुरक्षा और गोपनीयता मुद्दों पर केंद्रित है। यह उनके बीच उचित संरेखण सुनिश्चित करने का अवसर प्रदान करता है। यह 5 जी नेटवर्क का उपयोग कर डिजिटल सेवाओं के सुरक्षित उपयोग को सुनिश्चित करने के लिए एक डेटा प्लेटफार्म के माध्यम से हासिल किया जाता है। यह प्रस्तावित ढांचा नागरिकों को सुरक्षा और गोपनीयता चुनौतियों को संबोधित प्रस्तावित एससीआई में डिजिटल सेवाओं का उपयोग करके एक विश्व स्तरीय सुरक्षित उपयोगकर्ता अनुभव प्रदान करेगा। एससीआई अभी तक परिचालन नहीं कर रहा है। इसलिए, प्रस्तावित आईटीजीएफ को अध्याय 8 में एक सीमा के रूप में उचित रूप से मान्य नहीं किया जा सका।

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## List of Abbreviations

<b>3GPP</b>	Third Generation Partnership Project
<b>3PP</b>	Third Party Product
<b>AMOS</b>	Analysis of a Moment Structures
<b>AMRUT</b>	Atal Mission for Rejuvenation and Urban Transformation
<b>AVE</b>	Average Variance Extracted
<b>BIS</b>	Business Innovation and Skills
<b>BSI</b>	British Standard Institute
<b>CCTV</b>	Close Circuit Television
<b>CEA</b>	Confirmatory Factor Analysis
<b>CECSRDI</b>	Excellence for Cyber Security Research and Development of India
<b>CERT</b>	Computer Emergency Response Team
<b>CF</b>	Critical Factor
<b>CIA</b>	Confidentiality, Integrity and Authenticity
<b>CISCO</b>	Computer Information System Company
<b>COBIT</b>	Control Objective for Information and Related Technologies
<b>Cr.P.C.</b>	Criminal Procedure Code
<b>CSC</b>	Community Service Centre
<b>CSF</b>	Critical Success Factor
<b>CSTEP</b>	Center for Study of Science, Technology and Policy
<b>DOI</b>	Diffusion of Innovation
<b>DTPB</b>	Decomposed Theory of Planned Behaviour
<b>EAS</b>	Emergency Alert System
<b>EFA</b>	Exploratory Factor Analysis
<b>GDP</b>	Gross Domestic Product
<b>GIFT</b>	Gujrat International Finance Tech City
<b>GOI</b>	Government of India
<b>ICT</b>	Information and Communication Technology
<b>IEEE</b>	Institute of Electrical and Electronics Engineers
<b>IOT</b>	Internet of Things

<b>IPC</b>	Indian Penal Code
<b>ISACA</b>	Information Systems Audit and Control Association
<b>ISM</b>	Interpretive Structural Modeling
<b>ITGF</b>	Information Technology Governance Framework
<b>ITIL</b>	Information Technology Infrastructure Library
<b>ITSM</b>	Information Technology Service Management
<b>ITTF</b>	Information Technology Task Force
<b>JNNURM</b>	Jawaharlal Nehru National Urban Rejuvenation Mission
<b>MICMAC</b>	Matrice d'Impacts Croises Multiplication Appliquee a un Classment
<b>MOUD</b>	Ministry of Urban Development
<b>MRS</b>	Multiple Linear Regression
<b>NAS</b>	Network-Attached Storage
<b>NBA</b>	Nirmal Bharat Aviyan
<b>NFV</b>	Network Function Virtualization
<b>OPEX</b>	Operational Expenditure
<b>PCA</b>	Principal Component Analysis
<b>PII</b>	Personal Identification Information
<b>PLS</b>	Partial Least Square
<b>PPP</b>	Public Private Participation
<b>PROSCI</b>	Professional Science
<b>PTLB</b>	Pepry & Law's Techno Legal Bone
<b>PUF</b>	Physical Unclonable Function
<b>RTI</b>	Right to Information
<b>RM</b>	Reachability Matrix
<b>RQ</b>	Research Question
<b>RRT</b>	Rapid Response Team
<b>RTE</b>	Right to Education
<b>SAP-LAP</b>	Situation Actor Process Learning Action Performance
<b>SCM</b>	Smart City Mission
<b>SCT</b>	Social Cognitive Theory
<b>SDN</b>	Software-Defined Networking

<b>SECaaS</b>	Security as a Service
<b>SEM</b>	Structure Equation Modeling
<b>SLA</b>	Service Level Agreement
<b>SOC</b>	Security Operation Center
<b>SPSS</b>	Statistical Process for Social Science
<b>SPUHS</b>	Sardar Patel Urban Housing Scheme
<b>SSIM</b>	Structural Self Iteration Matrix
<b>TAM</b>	Technology Acceptance Model
<b>TOE</b>	Technology, Organization and Environment
<b>TPB</b>	Theory of Planned Behavior
<b>TRA</b>	Theory of Reasoned Action
<b>UICC</b>	Universal Integrated Circuit Card
<b>UTAUT</b>	Unified Theory of Acceptance and Use of Technology