



Applying 5G Cybersecurity and Privacy Capabilities

Introduction to the White Paper Series

NIST Cybersecurity White Paper

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Abstract

This document introduces the white paper series titled Applying 5G Cybersecurity and Privacy Capabilities. This series is being published by the National Cybersecurity Center of Excellence (NCCoE) [5G Cybersecurity project](#). 5G introduced new security capabilities in the standards focusing on securing interoperable interfaces rather than the underlying IT infrastructure, leaving gaps and options in specified cybersecurity and privacy protections that complicate how organizations assess, deploy, and supplement security for 5G systems. The 5G Cybersecurity project implemented security capabilities within the 5G standards and for the underlying IT infrastructure not specified in 5G standards and demonstrated their effectiveness. Each paper in the series includes implementation guidelines and testbed-derived implementation findings for an individual technical cybersecurity- or privacy-supporting capability available in 5G systems or their supporting infrastructures. Each of the capabilities has been implemented in the NCCoE 5G Cybersecurity testbed as part of the NCCoE project, and each white paper reflects the results of that implementation and its testing.

Audience

This series is intended for technology, security, and privacy program managers who are concerned with how to identify, understand, assess, and mitigate cybersecurity and privacy risk for 5G networks. The information is targeting three types of organizations:

Potential private 5G network operators. Private 5G networks are expected to become a reality, such as at universities and large companies. Any organization considering deploying and operating its own 5G network will need to manage its security using a risk-based approach. This series will explain a range of security capabilities and the risks each capability helps mitigate, which will provide valuable information for organizations' risk management purposes.

Commercial mobile network operators. This series will provide commercial mobile network operators a better understanding of cloud security capabilities that are already available in the systems their vendors provide. These security capabilities are beyond what 5G standards currently specify and can provide complementary protection at this time. This is increasingly important as operations move to commodity platforms and software, and as mobile network technology merges with IT.

Organizations using and managing 5G-enabled technology. Before organizations adopt 5G-enabled technologies, they should make cybersecurity risk management decisions regarding their use, management, and maintenance.

The information in this series should help to inform those decisions.

This series may be helpful to participants in 5G-related standards efforts (e.g., from standards developing organizations) who want to identify gaps in standards to inform their future work. Cybersecurity researchers who want to build 5G cybersecurity research testbeds may also find this series useful as a reference.

All readers should already know the basic concepts of 5G; there are many resources available on 5G basics, including those from the GSM Association (GSMA)¹. Readers should also be familiar with fundamental cybersecurity concepts. No previous knowledge of 5G-specific security or hardware roots of trust is necessary.

¹ GSMA review of 5G systems and security aspects can be found here: <https://www.gsma.com/security/securing-the-5g-era/>

Keywords

5G, cybersecurity, privacy

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5G Cybersecurity and Privacy Challenges

5G technology for broadband cellular networks will significantly improve how humans and machines communicate, operate, and interact in the physical and virtual world. 5G provides increased bandwidth and capacity and low latency. However, professionals in the fields of technology, cybersecurity, and privacy are faced with safeguarding this technology while its development, deployment, and usage are still evolving. As 5G evolves, its capabilities are simultaneously being specified in standards bodies, implemented by equipment vendors, deployed by network operators, and adopted by consumers.

Current standards development primarily focuses on the security of the standards-based, interoperable interfaces between 5G components. The 5G standards do not specify cybersecurity or privacy protections to deploy on the underlying IT components that support and operate the 5G system, and the security controls that the standards do define are left to implementation and deployment decisions. This lack of specifications increases the complexity for organizations planning to leverage 5G. They are challenged to determine what cybersecurity and privacy capabilities 5G can provide, how they can deploy these features, and what supplementary capabilities they may need to implement to safeguard data and communications.

Addressing the Challenges

To address these challenges, the NCCoE is collaborating with 5G operators and technology providers to develop and implement example solution approaches for safeguarding 5G standalone (SA) networks through a combination of the following measures:

- strengthening the system's architectural components;
- providing a trusted and secure cloud-native hosting infrastructure to support the 5G Core Network functions, and associated workloads;
- leveraging 5G standards-based security capabilities for radio access network (RAN) components; and
- enabling the cybersecurity and privacy features introduced in the 5G standards, including demonstrating how to continuously monitor 5G traffic on both signaling and data layers to detect and prevent cybersecurity attacks and threats.

White Paper Series

Each white paper in the series presents information, guideline, and implementation findings for an individual technical cybersecurity- or privacy-supporting capability available in 5G systems or their supporting infrastructures. The capabilities have been implemented in a testbed² as part of the NCCoE project, and each white paper's contents, especially guideline and implementation findings, directly stem from these implementations and their testing. The white paper series provides detailed information on selected cybersecurity and privacy capabilities from the broad range of capabilities available for 5G systems and infrastructures. The series is intended to support risk-based decisions for organizations deploying, operating, or relying on 5G networks.


Each paper has an **Overview** covering the following topics for its cybersecurity or privacy capability:

- The **cybersecurity or privacy problem** that the capability is being used to address. This forms the rationale for why the specific capability exists and provides the reader enough technical context, including pointers to additional resources with more technical details about the problem, to inform risk-based determinations around using a specific capability.
- **How the capability addresses the problem**, including contextual information around when the capability was introduced, where is it expected to be available, and what is necessary to enable it.
- **Which 5G architecture components are involved** in the functionality of this capability.
- **Tips on enabling, configuring, and using the capability**, as informed by our testbed implementation.

Each paper has a **Technical Details** section. It is intended for readers seeking more in-depth knowledge of the cybersecurity or privacy capability. Much technical effort was invested in the deployment, configuration, and validation of each capability in the NCCoE 5G Cybersecurity project testbed. This section of the white papers provides an opportunity to share some of the insight that was garnered while working with these capabilities. Expect this section to provide insights like what particular 5G messages contain, how to measure platform integrity, or how to verify that the capability is working as expected.

The white paper series can be found on <https://www.nccoe.nist.gov/5g-cybersecurity>

² More information about the NCCoE's 5G Cybersecurity testbed can be found on www.nccoe.nist.gov/5g-cybersecurity.



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Additional Information

Additional information about this publication is available at

<https://www.nccoe.nist.gov/5g-cybersecurity>,

including related content, potential updates, and document history.

All comments are subject to release under the Freedom of Information Act (FOIA).