

Cybersecurity Profile for the Hybrid Satellite Networks (HSN) Cybersecurity

DRAFT Annotated Outline

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Abstract

29 The objective of this Cybersecurity Profile is to identify an approach to assess the cybersecurity
30 posture of Hybrid Satellite Networks (HSN) systems that provide services such as satellite-based
31 systems for communications, position, navigation, and timing (PNT), remote sensing, weather
32 monitoring, and imaging. The HSN systems may interact with other government systems and the
33 Critical Infrastructure as defined by the Department of Homeland Security to provide increased
34 resiliency. This Profile will consider the cybersecurity of all the interacting systems that form the
35 HSN rather than the traditional approach of the government acquiring the entire satellite system
36 that includes the satellite bus, payloads, and ground system.

37 NIST is developing a consistent approach to better understand the attack surface, incorporate
38 security, and achieve greater resilience for space systems that may be leveraged by critical
39 infrastructure owners and operators, the DoD, or other government missions.

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Keywords

41 cybersecurity; ground system; hosted payload; space; spacecraft

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Disclaimer

43 Any mention of commercial products or reference to commercial organizations is for information
44 only; it does not imply recommendation or endorsement by NIST, nor does it imply that the
45 products mentioned are necessarily the best available for the purpose.

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Additional Information

48 For additional information on NIST’s Cybersecurity programs, projects, and publications, visit the
49 [Computer Security Resource Center](#). Information on other efforts at [NIST](#) and in the [Information](#)
50 [Technology Laboratory](#) (ITL) is also available.

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

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71 **1 HSN Cybersecurity Profile – Introduction**

72 A significant level of sensing, communications, and PNT capabilities are being provided by the
73 space sector and there is a growing trend toward multi-national/ multi-organizational consortia
74 providing these services. Hybrid Satellite Networks (HSN) present opportunities for
75 organizations to leverage existing space-based capabilities through means such as hosted
76 payloads, however there is a need to ensure that these systems are secure, and the integration of
77 the components are done in a manner that is acceptable to the participating organizations.

78 The HSN cybersecurity profile (hereafter, the Profile) is intended to provide a means to assess
79 and communicate an organization’s cybersecurity posture in a consistent and standardized
80 manner. The Profile applies to;

- 81 • Organizations that have already adopted the NIST Cybersecurity Framework (CSF) to
82 help identify, assess, and manage cybersecurity risks [NIST CSF];
- 83 • Organizations that are familiar with the CSF and want to improve their cybersecurity
84 postures; and
- 85 • Organizations that are unfamiliar with the CSF but need to implement HSN services in a
86 risk informed manner through the use of a cybersecurity risk management frameworks.

87 **1.1 Background**

88 The Space Systems Command (SSC) is charged with acquisition of space-based programs for
89 the U.S. Space Force. This includes acquisition of satellite-based systems for communications,
90 PNT; remote sensing, weather monitoring, and imagery. SSC’s programs are increasing the use
91 of commercial space through means such as hosting payloads on commercial satellites and
92 services to meet mission objectives.

93 In an effort to partner with industry and leverage cybersecurity lessons learned, SSC in
94 collaboration with NIST and the public and private sectors will create the HSN profile.

95 Throughout the Profile development process, NIST will engage the public and private sectors on
96 multiple occasions to include a request for information, participation in workshops, and comment
97 and review of the draft Profile. The Profile development process is iterative and, in the end state,
98 promotes the risk informed use of Hybrid Satellite Networks.

99 **1.2 Purpose and Objectives**

100 The purpose of the Profile is to provide practical guidance for organizations and stakeholders
101 engaged in the design, acquisition, and operation of satellite buses or payloads that involve
102 HSN.

103 A completed Profile for commercial satellite companies operating in a hybrid environment that
104 includes government and commercial entities will provide for future cybersecurity resilience.
105 The Profile is suitable for applications that involve multiple stakeholders contributing to
106 communications architecture and for other use cases such as hosted payloads. Use of the HSN

107 Profile will help organizations ;

- 108 • Identify systems that provide HSN services;
- 109 • Identify data that originated from HSN sources;
- 110 • Protect HSN services by adhering to basic principles of resiliency;
- 111 • Detect cybersecurity-related disturbances or corruption of HSN services and data;
- 112 • Address cybersecurity risk in their management and use of HSN services and data;
- 113 • Identify common threats to systems that leverage HSN services and data;
- 114 • Respond to HSN service or data anomalies in a timely, effective, and resilient manner;
- 115 and
- 116 • Recover the HSN to proper working order at the conclusion of a cybersecurity incident.

117 1.3 Scope

118 The Profile will document an example
119 architecture for data transport through
120 hybrid satellite networks. The architecture
121 will describe the salient cybersecurity
122 functions that are part of the HSN and may
123 include operational views (OVs) to
124 highlight cybersecurity dependencies.

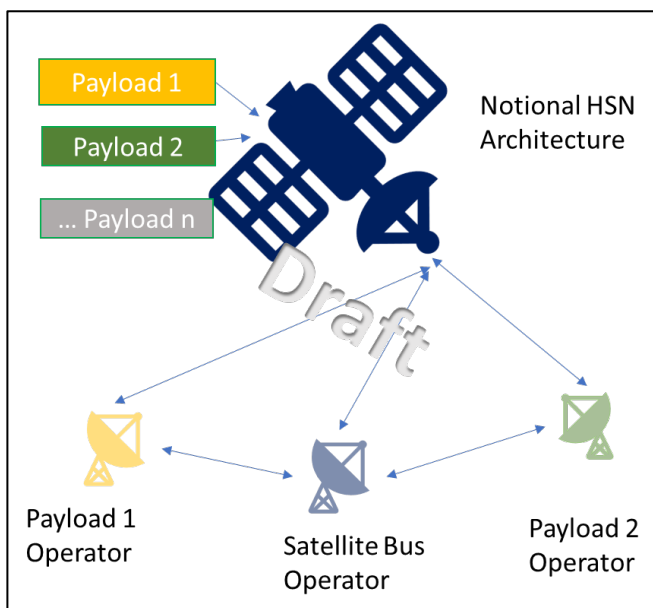
125 The Profile will focus on the complex
126 variety of interfaces, data flows, and
127 institutions/actors involved in modern
128 satellite communications networks. The
129 CSF profile is intended to:

- 130 • Facilitate integration of HSN
131 components thorough
132 consideration of cybersecurity
133 functions, categories, and
134 subcategories
- 135 • Assess and communicate cybersecurity posture in a consistent manner
- 136 • Provide a comprehensive framework to facilitate risk management decisions.
- 137 • Facilitate consistent analysis of cyber-risk
- 138 • Communicate cybersecurity posture and priorities in a consistent manner

139 The Profile identifies a subset of CSF subcategories that are directly applicable to HSN while
140 giving organizations the flexibility to mitigate cyber risk for their unique environment.

141 1.4 Audience

142 This document is intended to be used by those involved in overseeing, developing,
143 implementing, and managing the HSN cybersecurity of systems such as:



- 144 • Public and private organizations that provide HSN services;
- 145 • Managers responsible for the use of HSN services;
- 146 • Risk managers, cybersecurity professionals, and others with a role in cybersecurity risk
147 management for systems that use HSN services;
- 148 • Procurement officials responsible for the acquisition of HSN services;
- 149 • Mission and business process owners responsible for achieving operational outcomes
150 dependent on HSN services; and
- 151 • Researchers and analysts who study the unique cybersecurity needs of HSN services.

2 How to Use the HSN Cybersecurity Profile

153 The Profile will help organizations develop cybersecurity HSN profiles that are appropriate for
154 their respective organization and goals. The Profile will help organizations determine
155 cybersecurity risks based on their assessments of the potential impacts of the manipulation,
156 disruption, or loss of HSN services to business and operational objectives. The Profile is
157 intended to help users of HSN prioritize necessary cybersecurity activities based on their
158 objectives. The Profile may be a tool to help organizations identify areas where standards,
159 practices, and other guidance could help manage the risk of cybersecurity threats to systems that
160 use or provide components to HSN.

161 The Profile is intended to assist an organization's risk management effort. The Profile does not
162 prescribe regulations or mandatory practices, nor does it carry any statutory authority.

163 The development of a Profile by an organization is a multi-step process, including a risk
164 assessment in which organizations may wish to consider the following:

- 165 • What data, processes, and assets do HSN's require?
- 166 • What processes and assets are dependent recipients of HSN data (i.e., identify secondary
167 effects)?
- 168 • What is the impact to the organization should a process or asset be lost or degraded?
- 169 • What processes and assets are vulnerable?
- 170 • What safeguards are available?
- 171 • What techniques can be used to identify threats of concern?
- 172 • What techniques can be used to respond to threats of concern?
- 173 • What techniques can be used to return an HSN to proper working order?

3 HSN Cybersecurity Profile – Overview

175 This section contains an overview of envisioned Profile content and a short description of the
176 kinds of HSN services that are covered by the Profile. The Profile provides information on risk

177 management, cybersecurity capabilities, and mapping to the NIST Cybersecurity Framework to
178 assist with specific implementation of PNT cybersecurity. The Profile will include informative
179 references (including existing standards, guidelines, and practices) and a glossary of terms.

180 **3.1 Risk Management Overview**

181 Risk management is the ongoing process of identifying, assessing, and responding to risk as
182 related to an organization’s mission objectives. To manage risk, organizations should understand
183 the likelihood that an event will occur as well as its potential impacts. With this information, the
184 government can determine the acceptable level of risk to the HSN data and services they use to
185 achieve their mission objectives.

186 As an organization analyzes its mission objectives as they relate to reliance on or use of HSN
187 data, there are a series of guiding questions that inform the process. They include:

- 188 • What are the threats to achieving mission objectives?
- 189 • What damages can result when those mission objectives are disrupted?
- 190 • What are the most important assets for a given mission objective?
- 191 • Where does physical infrastructure affect cybersecurity infrastructure and vice versa?

192 An organization should also be aware of statutory and policy requirements that may have a security
193 or safety dimension. These can be affected by cybersecurity risk or create risks downstream.

194 The Profile supports and is informed by cybersecurity risk management processes. Using the
195 Profile, organizations can make more informed decisions to select and prioritize cybersecurity
196 activities and expenditures that help identify systems dependent on HSN, identify appropriate
197 HSN sources, detect disturbances and manipulation of HSN services, manage the risk to these
198 systems, and ensure resiliency through diversity. For critical infrastructures, HSN sources and
199 distribution networks should be architected with multiple, independent sources; communication
200 paths; and communication mediums. The Profile provides a starting point from which
201 organizations can customize—based on business need and risk assessment—to develop the most
202 appropriate processes to manage cybersecurity risk to their HSN services and data essential for
203 the correct behavior of critical infrastructure applications.

204 Organizations can use the HSN Profile in conjunction with existing cybersecurity risk
205 management processes. Examples of cybersecurity risk management processes include
206 International Organization for Standardization (ISO) 31000:2018, ISO/International
207 Electrotechnical Commission (IEC) 27005:2018, and NIST Special Publication 800-39. A full
208 list of helpful resources will be listed in an Annex of the Cybersecurity HSN Profile.

209 **3.2 Capabilities Overview**

210 The section describes some of the capabilities and controls that impact the organization’s ability
211 to manage residual risk (in the context of HSN degradation or outage).

212 **3.2.1 Policies and Procedures**

213 Cybersecurity policies and procedures will vary in accordance with each organization's tolerance
214 of a HSN loss or degradation. Though it does not add value to burden an organization with
215 excessive requirements, there should be a level of consistency within a sector to enable
216 collaborative efforts, such as the sharing of cybersecurity events that impact or otherwise involve
217 HSN. Consistency also facilitates the acceptance or rejection of inherited risk and compatible
218 tools; techniques and processes enable coordinated responses.

219 HSN policies and procedures should be reflected in an organization's continuity of operations
220 plan (COOP).

221 **3.2.2 Security Technical Capabilities Overview**

222 HSN resiliency requires organizational planning that includes an adequate understanding of the
223 technical capabilities needed to ensure appropriate levels of HSN data confidentiality,
224 availability, and integrity.

225 When considering the technical capabilities as they pertain to HSN resilience, users must
226 consider certain technical challenges that a HSN service may encounter such as propagation
227 delay for geosync, interference events, radiation, and other space environment related concerns.

228 It is beneficial to consider that the analysis of potential integration of multiple and independent
229 technologies can facilitate the detection of anomalies, and ultimately contribute to a more
230 resilient system in the event of a disruption.

231 **3.3 The HSN Cybersecurity Profile**

232 This section will contain the HSN Cybersecurity Profile, which maps the functions, categories,
233 and sub-categories of the CSF with informative references. This section contains information on
234 how users of the profile can mitigate risks that they have deemed necessary to address based on
235 their assessment of the HSN services they are using. This is not an exhaustive list, and the actual
236 selection of controls (if any) must be based on a cost-benefit analysis that is consistent with the
237 risk.

238 **3.3.1 Detection of Disruptions to HSN Services**

239 System verification and validation policy and procedures. Organizations should identify steady
240 state and transient test cases, test plans, and test schedules as an end user, applicable to the
241 industry supply chain, to serve as a basis for verifying and validating HSN data users in order to
242 manage assessed risks associated with HSN disruptions.

243 **3.3.2 Resilience of HSN Services**

244 The ability to provide useable HSN data despite a compromise can be accomplished with
245 technologies such as HSN component diversity and segmentation.

246

References

- [NIST CSF] Framework for Improving Critical Infrastructure Cybersecurity. April 16, 2018.
<https://nvlpubs.nist.gov/nistpubs/CSWP/NIST.CSWP.04162018.pdf>

247 **Appendix A—Acronyms**

248 Selected acronyms and abbreviations used in this paper are defined below.

249	CSF	Cybersecurity Framework
250	DoD	Department of Defense
251	HSN	Hybrid Satellite Networks
252	PNT	Position, Navigation, and Timing
253	RF	Radio Frequency
254	SSC	Space Systems Command