CYBERSECURITY AND PRIVACY OF GENOMIC DATA

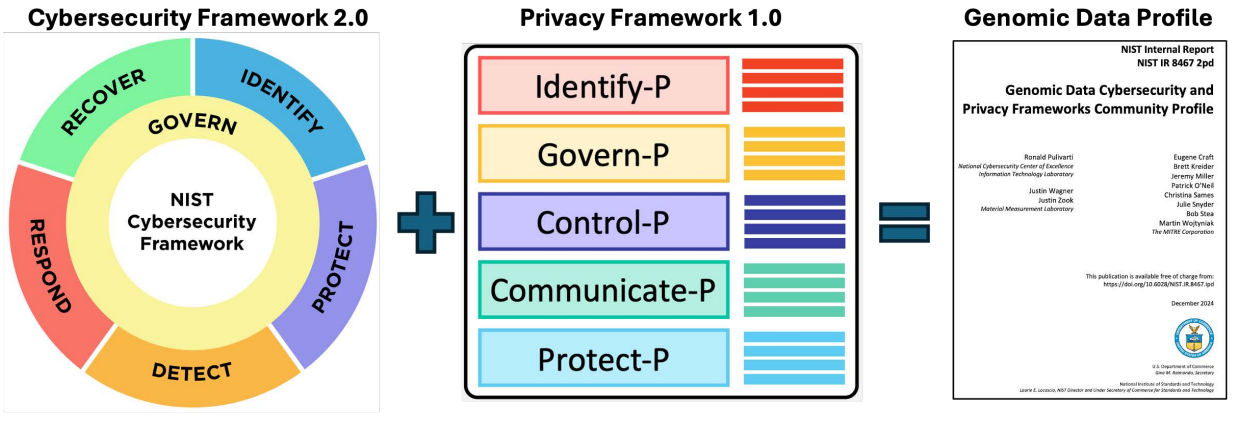
The NIST National Cybersecurity Center of Excellence (NCCoE) is investigating genomic data processing cybersecurity and privacy challenges, along with mitigation strategies. This fact sheet provides an overview of the NCCoE Genomic Data Project, including background & challenge, Cybersecurity Framework (CSF) & Privacy Framework (PF) Profile development, threat modeling & privacy enhancing technologies projects, and a project roadmap.

BACKGROUND & CHALLENGE

Innovations in genomic data processing advance scientific and medical research, improve health outcomes, and help organizations compete within the bioeconomy. Genomic data underpin precision medicine through understanding disease risk, facilitating diagnoses of complex conditions, and developing targeted interventions like Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) therapies. At the same time, these developments heighten cybersecurity risks that may impact the confidentiality, integrity, and availability of this valuable genomic data, introducing economic, privacy, discrimination, and national security risks. Processing human genomic data introduces privacy risks that may impact individuals when systems fail to meet predictability, disassociability, and manageability objectives.

CYBERSECURITY & PRIVACY FRAMEWORKS PROFILE DEVELOPMENT

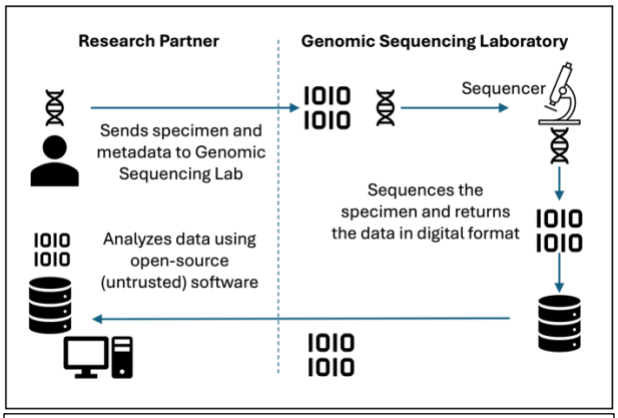
The NCCoE engaged with government, academia, and industry stakeholders to develop risk-based cybersecurity and privacy guidance for the genomic data community. The NCCoE first published ***NIST Internal Report (IR) 8432,*** *Cybersecurity of Genomic Data,* which outlines the genomic data cybersecurity and privacy issues and possible solutions identified from NCCoE public workshops and early stakeholder discussions. As a follow-on effort, the NCCoE collaborated with a subset of the stakeholders to identify Mission Objectives and prioritize NIST CSF Categories and Subcategories for genomic data processing. This led to the release of ***Draft NIST IR 8467****, the CSF Profile for Genomic Data,* which provides a structured approach for organizations looking to manage and mitigate genomic data cybersecurity risks. To help organizations prioritize both cybersecurity and privacy outcomes, the NCCoE engaged additional privacy stakeholders to revise ***Draft NIST IR 8467*** to CSF 2.0 and incorporate the PF 1.0. This effort produced the ***Genomic Data Cybersecurity and Privacy Frameworks Community Profile*** (Genomic Data Profile)***.***



The Genomic Data Profile integrates CSF 2.0 and PF 1.0 into a consolidated Community Profile.

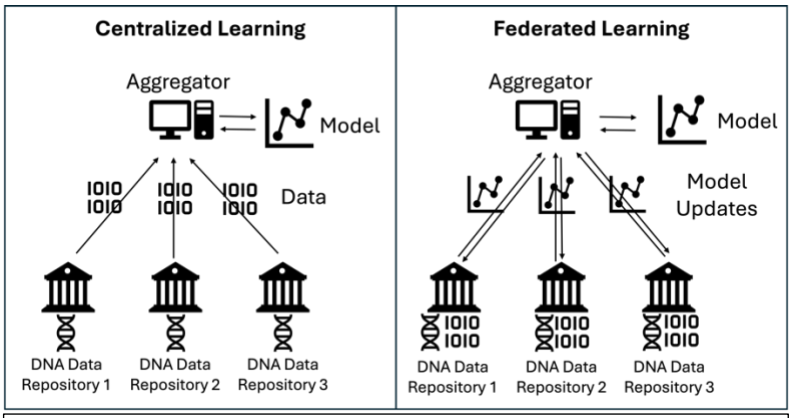
THREAT MODELING & PRIVACY ENHANCING TECHNOLOGIES PROJECTS

The NCCoE conducted cybersecurity threat modeling against a genomic sequencing workflow and documented the results in **NIST Cybersecurity White Paper (CSWP) 35**, *Cybersecurity Threat Modeling the Genomic Data Sequencing Workflow* [see left figure below]. The NCCoE is currently performing privacy threat modeling to produce a CSWP that includes both cybersecurity and privacy mitigation implementation examples. Additionally, the NCCoE is developing a **Privacy Enhancing Technologies (PETs) Testbed** initially focused on privacy-preserving federated learning (PPFL) [illustrated in the right figure below].



The Genomic Data Sequencing Workflow

*The **Research Partner** sends a DNA sample to a **Genomic Sequencing Laboratory** that returns the digital results for further analysis.*



Centralized versus Federated Learning

***Federated learning** trains machine learning models across multiple nodes. **PPFL** is a set of techniques to limit sharing private information across nodes.*

GENOMIC DATA PROJECT ROADMAP

The NCCoE Genomic Data Project will continue collaborating with the genomics stakeholder community to produce the following publications, host workshops and webinars, and adjudicate public comments.

FY25 Q1	FY25 Q2	FY25 Q3	FY25 Q4
Cybersecurity Threat Modeling CSWP Comment Period		***Privacy Threat Modeling CSWP*** Comment Period	***Cybersecurity and Privacy Implementation Examples*** Comment Period
Genomic Data Profile Comment Period		**NCCoE Workshop** on Genomic Data	**PETs Testbed** Operational

The National Cybersecurity Center of Excellence (NCCoE), a part of the National Institute of Standards and Technology (NIST), is a collaborative hub where industry organizations, government agencies, and academic institutions work together to address businesses' most pressing cybersecurity challenges. Through this collaboration, the NCCoE develops modular, easily adaptable example cybersecurity solutions demonstrating how to apply standards and best practices using commercially available technology.

LEARN MORE

For more information about this project, visit: https://www.nccoe.nist.gov/projects/cybersecurity-and-privacy-genomic-data

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