

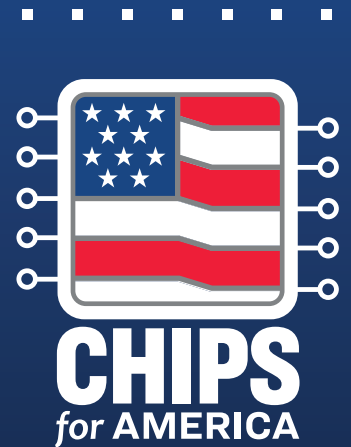


# CHIPS *for* AMERICA



## Response to Public Comments: Building a Metrology Exchange to Innovate in Semiconductors (METIS)

August 2024



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**NIST Creating Helpful Incentives to Produce  
Semiconductors for America  
NIST CHIPS 1100-1**

**Response to Public Comments: Building  
a Metrology Exchange to Innovate in  
Semiconductors (METIS)**

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## **Abstract**

In December 2023, NIST released a publication outlining a proposed data-sharing platform, titled “Building a Metrology Exchange to Innovate in Semiconductors (METIS).” The publication was open to public comment from December 2023 to February 2024 to allow for a diversity of people to contribute their viewpoints and to ensure that stakeholders could provide critical feedback to shape the final paper outlining the vision for this data exchange. NIST received numerous comments and identified trends that fell broadly into four specific categories. In this publication, NIST discusses the trends and themes that emerged and provides thematic responses.

## **Keywords**

RFI; public comment; semiconductors; microelectronics; metrology; data security; database utility and value; data provenance and traceability; database functionality.

# RESPONSE TO PUBLIC COMMENTS: BUILDING A METROLOGY EXCHANGE TO INNOVATE IN SEMICONDUCTORS (METIS)



## WHAT IS METIS?

In December 2023, NIST released a publication outlining a proposed data-sharing platform, titled “Building a Metrology Exchange to Innovate in Semiconductors (METIS).” METIS – named after the Greek goddess of innovative ideas, good counsel, skill, and craft – is a data exchange ecosystem developed by NIST that will give stakeholders access to research results from the CHIPS Metrology Program and serve to catalyze innovative breakthroughs in U.S. semiconductor manufacturing.

To successfully serve the microelectronics community, METIS will aim to make research and data available in a manner that guards intellectual property, protects U.S. security interests, is aligned with the approach used by NIST for access to research results, and is self-sustaining to meet future needs.

METIS is intended to provide benefits to a broad group of primary stakeholders, including microelectronics suppliers, manufacturers, product developers, and systems engineers in academia and industry who design, fabricate, and test semiconductors, associated components parts, and their supply chains.

## PUBLIC COMMENT AND NEXT STEPS

The publication was open from December 2023 to February 2024 for public comments, which will inform the final paper outlining the vision for this data exchange. NIST provided a set of questions to solicit feedback on specific topics (reference Appendix A) but all submitted comments have been considered.

During the public comment period, NIST received numerous comments that fell broadly into four categories. NIST is reviewing and considering the trends and themes that emerged in the lists below and has prepared individual responses in the boxes that follow. NIST will use this valuable public feedback to inform revisions to the publication.

# DATA SECURITY

Data security was a prominent theme from commenters, and NIST was encouraged to consider and incorporate the following components within the exchange:

- Methods to manage sensitive / proprietary data, such as a classification system through semantic modeling
- NIST and customer-side processes to assess and approve data to ensure sensitive information has been stripped prior to public sharing
- Access rights to sensitive data based on user profiles and on types of data products
- Stakeholder ability to determine types of data to share through automated controls
- Confidential computing through use of secure chips to strengthen cryptographic identity and security capabilities
- Broadened requirements for FIPS 199 classification beyond low, medium, and high levels to align with future uses of data



In addition, public comments also encouraged NIST to incorporate cybersecurity audits of the METIS system to identify and remediate cybersecurity risks. Stakeholders also recommended NIST establish a METIS steering committee and change management authority, leading to the development of a data sharing charter to define the governance and control system.

***In response:*** NIST recognizes the importance of managing the confidentiality, integrity, and availability of sensitive data, and careful attention will be paid to safeguard access to data while simultaneously providing capabilities that optimize interoperability and performance. In addition to FIPS 199 requirements, METIS will incorporate a classification scheme for data sensitivity based on National Archives and Records Administration (NARA) limited dissemination controls for Controlled Unclassified Information (CUI). The CUI designation will be integrated into METIS metadata. NIST will be evaluating the application of NIST Next Generation Access Control (NGAC) as well. A governance model for data sharing and access rights will be developed and provided for transparency, and NIST will evaluate the feasibility of establishing and authorizing a steering committee per public feedback. As part of NIST requirements, METIS will be implemented only after cybersecurity controls and audits are executed, a process that will be required as part of any release of the system. Finally, while secure chip technology may be currently out of scope for METIS, industry partnering is under consideration for ongoing exchange models.






## DATABASE UTILITY AND VALUE

The utility and value of the data exchange featured in stakeholder feedback, suggesting potential use cases for METIS could include:



- Virtual metrology
- Selective metrology
- Protective maintenance
- General research and development data
- Metrology-related projects executed through the National Semiconductor Technology Center (NSTC)
- New CHIPS Metrology funded projects

Stakeholders recognized the value that METIS would provide broadly, and highlighted the specific benefits this would provide to a range of stakeholders, noting that:



- **Academia** would find value in low-stakes research data and NIST’s analysis of system-wide holdings
- **Industry** would benefit from standard reference products
- **Suppliers** would benefit from restricted data / code ecosystems
- **All stakeholders** would benefit from the opportunity to provide feedback to both NIST and the data originator

**In response:** The primary value of METIS is through providing stakeholders with access to CHIPS Metrology research results and serving to catalyze innovative breakthroughs in U.S. semiconductor manufacturing. At the outset of the project, the scope of METIS will include data solely from the CHIPS Metrology program, and NIST is currently reviewing the data management platforms and development of product definitions, types, and characteristics to be documented and integrated into METIS. This also may include contributed data products by industry and collaborative partners working with CHIPS Metrology program efforts. All data products will be typed and categorized with a transparent taxonomy and will be associated with the originator and their contact information. As part of the development of METIS, NIST will also be reviewing the feasibility of METIS users providing feedback to NIST and data originators directly through METIS.



# DATA PROVENANCE AND TRACEABILITY

In focusing on the importance of data provenance and traceability within the METIS system, stakeholders emphasized the value of:



- **A transparent and well-articulated data provenance and management system** developed with input from industry partners
- **Providing access to supply chain verification certificates** to support supply chain traceability
- **Utilizing persistent identifier (PID) categories** adopted and trusted by other government agencies
- **Creating a standardized structure** to evaluate and analyze provenance into summary metrics

***In response:** Comprehensive data provenance within METIS will ensure that the origin and lineage of the data are established. Within METIS, data will be associated with persistent identifiers (PIDs) and provenance can be generated through versioning. At this time, working data repositories are limited at NIST, however, NIST will be reviewing the feasibility of traceability in research workflows and implementing best practices where applicable. The provenance of digital products generated and delivered with METIS will be a key goal for metrology outcome, including access or reference to methods of evaluation. To provide transparency, the METIS digital framework will be fully documented and shared via GitHub.*


*METIS is also applying for [CoreTrustSeal Certification](#) to establish itself as a trusted data repository, which includes provenance and authenticity as one of the [requirements](#) (R07). As part of its structure, METIS will provide concepts for data source identification, change, accuracy in descriptions, and access to all previous versions of the data.*

*NIST recognizes the importance of providing access to supply chain verification certificates and, if such certificates are developed, NIST will review compliance and include traceability components to support this. NIST will consider the adoption of including organizational identifiers within METIS, for example, Global Business Identifiers (GBIs), as allowable affiliate attributes within the database.*



# DATABASE FUNCTIONALITY

Stakeholders identified key attributes to include within the METIS platform to enhance functionality for its future users, focusing on:



- **Scripted access**, which would allow manufacturers and labs to easily import the latest data and prevent human errors
- **Inclusion of a structured data taxonomy** within the database with detailed search parameters

Stakeholders also showed interest in **integrating generative AI and machine learning within METIS**, allowing users to automate queries through the database. In addition, public feedback suggested AI and machine learning interaction would support automation as the database grows beyond the range of human consumption.

**In response:** Overall, stakeholder use cases will inform the requirements and development of METIS search functionality, and engagement with the various discipline communities operating internally and externally to NIST Microelectronics Research (MER) will be reoccurring, as discoveries through new research areas emerge. As part of METIS, NIST will be dynamically integrating natural language processing (NLP) and implementing an underlying semantic model in a machine-readable format that allows for the integration of analytical processes through application programming interfaces (APIs). Within the semantic model, METIS will include multiple taxonomies, which will be versioned, documented and shared. NIST also intends to collect meta models that may contribute to large language model (LLM) development, although the execution of this will depend on the richness of the datasets.



## APPENDIX A - COMMENT TEMPLATE QUESTIONS

In seeking public comment, NIST provided a set of template questions for stakeholders to consider in commenting on the initial METIS publication, although all submitted comments have been considered. The full set of questions is listed below for reference:

1. METIS is proposing to make 4 types of products/services available to members. Which of these would be of highest value to you and your organization? (pick all that apply)
  - a. Access to low-stake research data from NIST, CHIPS, and/or consortium
  - b. Access to standard reference products (such as SRM, SRD, calibrations)
  - c. Access to restricted data/code ecosystem (consortium members only)
  - d. Access to NIST's analysis of its system-wide holding of low-stake code and research data
  - e. Access to NIST's analysis of its system-wide holding of code and research data, including restricted consortium data/code ecosystem.
  - f. Others (please specify)
2. Do you believe computerized and scripted access to the METIS platform would be useful? (Yes/No)
  - a. If yes, what type of data are you hoping to retrieve with computerized tools?
  - b. If yes, what type of data would you be willing to contribute to the METIS platform that would be accessible with automated retrieval tools?
  - c. Would you be more likely to contribute data if you can specify who can view your data?
3. Could you be convinced to contribute data to METIS if this would allow NIST programs including CHIPS Metrology to analyze and share with you analysis and insights from the METIS data holding?
  - a. If yes, what data would those be?
4. Are there factors that influence your decision to contribute data to METIS if the benefit is the access to consortium partners' contributions to METIS, including related analysis and insights from the METIS data holding?
  - a. If yes, what are those factors?
  - b. If yes, what data contributions would those be?
5. Do you see a need for standardized processes to generate critically evaluated data? Critical evaluation is a process of analyzing all available experimental data for a given property to arrive at recommended values together with estimates of uncertainty, providing a highly useful form for users. The analysis is based on intercomparisons, interpolation, extrapolation, and correlation of the original experimental data collected at NIST, including by CHIPS R&D programs.

- a. If yes, are there specific data sets of interest?
6. Data in METIS will be shared with intellectual property rights in mind and will ensure that all data is reviewed and approved for sharing with authorized parties. Does your organization have a review process for proprietary data?
  - a. If yes, what are the important factors in that process that must be included in the METIS review process?
7. Do you see value in establishing a relationship between METIS and the National Semiconductor Technology Center (NSTC) so that NSTC members can access METIS resources in a transparent manner?
8. Does your organization have an enterprise solution for research data that includes sensitive or proprietary information, including FIPS 199 High-impact data?
  - a. If yes, are their key attributes for your enterprise system that you would recommend incorporating into METIS?
9. Partnering organizations will also contribute data, process models, and code to the metrology programs at NIST, requiring a secure means for the transfer and exchange of digital assets. When appropriate, partners will also be able to participate in co-development of specific platform systems or components. This will require the ability to accommodate hybrid solutions that mix multiple open-source and commercial solutions while securely integrating with government network infrastructure. (Section 4 Operations Concept.)
  - a. Please list up to three specific open-source solutions that you would like to see incorporated.
  - b. Please list up to three specific commercial solutions that you would like to see incorporated.
10. Services for mapping, extraction, and translation of working data outputs into a NIST Microelectronics Research (MER) data model will be a key part of product development. These techniques are widely accepted as best practice in data science and will become part of the METIS data model and semantic toolkits. Are their specific techniques or toolkits that you would like to see incorporated into METIS?
11. Comprehensive data provenance ensures that the origin and lineage of the data are established. Appropriate provenance can be achieved by including the original authoritative copy, version identification, and the provenance of data derived from other sources. Are there specific best practices and/or community standards for storing digital assets you would like to see incorporated into METIS?
12. Partner organizations, members, and the general public wishing to interface with METIS by building custom apps may require expert NIST staff engagement and user support processes to facilitate those initial efforts. What specific support processes would facilitate collaboration with you?
13. Do you have recommendations for specific use cases for data that you would like to see available in METIS? A specific use case is a definition of a specific data set or product or capability that METIS needs to accomplish for it to be useful to the stakeholder community.
  - a. If yes, please list up to three specific use cases.
  - b. If yes, for each specific use case please list external partners that should be consulted to ensure successful outcomes for the specific use case.
  - c. If yes, for each specific use case please describe how that use case supports your needs.