Internet of Things Advisory Board (IoTAB) Committee

Established by 9204(b)(5) of the William M. (Mac) Thornberry
National Defense Authorization Act for Fiscal Year 2021 (Pub. L. 116-283)

December 12 & 13, 2023

Virtual Meeting Platform: Webex

MEETING MINUTES

Board Members

- **Michael J. Bergman**, Consumer Technology Association
- **Dr. Ranveer Chandra**, Microsoft
- **Nicholas Emanuel**, CropX
- **Steven E. Griffith**, National Electrical Manufacturers Association
- **Tom Katsioulas**, Global Semiconductor Alliance
- **Ann Mehra**
- **Robby Moss**, Moviynt
- **Nicole Coughlin**, Town of Cary North Carolina
- **Maria Rerecich**, Consumer Reports
- **Debbie A. Reynolds**, Debbie Reynolds Consulting
- **Dr. Arman Shehabi**, Lawrence Berkeley National Laboratory

Board Members Absent:

- **Prof. Kevin T. Kornegay**, Morgan State University
- **Peter Tseronis**, Dots and Bridges LLC
- **Debra Lam**, Georgia Institute of Technology

Board Chairs and NIST Staff

- **Benson M. Chan**, Strategy of Things Inc. (Chair)
- **Daniel W. Caprio Jr**., The Providence Group (Vice Chair)
- **Barbara Cuthill**, NIST (Designated Federal Officer)
- **Jeffrey Brewer**, NIST (Alternate Designated Federal Officer)
- **Katerina Megas**, NIST (Federal Working Group Co-Convener)
- **Alison Kahn**, NIST (Federal Working Group Co-Convener)
- **Greg Witte**, NIST Contractor, (Report Editor)
- **Brad Hoehn**, NIST Contractor (Report Editor)
- **David Lemire**, NIST Contractor (Scribe)
- **Wendy Szwerc,** NIST Contractor (Scribe)

Speaker(s):

- **Kathleen McTigue** (NIST)
- **Renil Paramel** (Strategy of Things)
- **Christopher Reberger** (Strategy of Things)
- **David Duncan** (Strategy of Things)

Action Items Over Both Days

*Note: Names and roles are **bolded** to show ownership.*

Report Recommendations:

- 1.1.1 – Ms. Mehra with the assistance of Mr. Griffith to draft some language for the "iot.gov" concept to be included in the front sections (was discussed within the context of this recommendation at the time).
- 2.3.4 – Mr. Griffith indicated he would provide a separate commentary on this (this was the recommendation related to streamlining permitting which was deleted).
- 2.4.1 – Mr. Griffith would refine to include interoperability text and cite some examples that standardization can address.
- 2.5 - Mr. Witte asked for support in refining material in implementation considerations.
- 2.5 and 2.5.1 - Dr. Chandra will revisit recommendation for update.
- 2.5.2 - Mr. Chan to draft a change to be more associated with IoT in the recommendation based on the discussion.
- 3.2.1 – Mr. Witte would look at revision of language from discussion over privacy vs confidentiality.
- 3.2.5 – Ms. Reynolds to update implementation considerations.
- 3.3.5 – Mr. Witte to examine recommendations 3.3.1, 3.3.5, 3.3.6, and 3.3.7 and grouping together as they are all similarly related.
- 3.3.7 - Mr. Griffith indicated he could give text to update around use of 62443 standards.
- 3.3.8 - Mr. Griffith indicated pulling the last bullet and adding language calling out the 62443 series of standards that are used in the smart manufacturing sector.
- 4.2 and 4.2.1 – Mr. Katsioulas to revise the recommendations.
- 4.2 and 4.3 – Mr. Witte to provide updates back to the board.
- 4.3.5 – Mr. Katsioulas asked the board to review his updates.
- 4.3.6 – Mr. Katsioulas requested Mr. Bergman review.
- 5.1.5 – Mr. Caprio to weigh in with his input.
- 5.2.1 - Mr. Griffith indicated he would augment the recommendation with more IoT text (note on combining federal use and federal advocacy). And to add some specific examples of how IoT tools and technologies can manage energy efficiency.
- 5.10.1 - Ms. Coughlin indicated an action item to get input from a police chief and brief the team.
- 5.12.2 - Mr. Bergman and Mr. Griffith to review the recommendation (ultra-wide band).
- Board members were requested to identify any other items being worked on in an email to the chair and editors.

Other Editor Actions:

- Mr. Witte to follow up on actions and an updated schedule.
- Mr. Witte to provide an IoTAB report back to team with a clear structure and indications of what's needed and a template for a storyboard narrative.

IoTAB Meeting on Tuesday, Dec 12, 2023

Chair Opening Remarks Action Item Review (Oct Meeting)

Ms. Cuthill opened the meeting, welcomed the attendees, and introduced the chair, Mr. Benson Chan.

- Mr. Chan went over the agenda and goals for the ninth meeting of the Internet of Things Advisory Board (IoTAB). Showed a slide of outcomes for the meeting:
  - Gain a baseline understanding of the report state (currently 250 pages).
  - Understand the report structure.
  - Understand Mr. Katsioulas' value chain story.
  - Approval/rejection of recommendations (new/existing).
  - Identification of other information and content gaps.
  - Identify gaps in findings and recommendations.
  - Discuss possible delivery extension.
- Mr. Chan noted that many of the new recommendations in the latest report draft originated from work that the speakers would be presenting.
- Mr. Chan invited the audience to comment by sending comments to Barbara Cuthill.

Outside Expert Speaker(s) from NIST IoT Technology Infrastructure Research Project Overview

Mr. Chan introduced the speakers, stating they would be presenting on a report titled *Economic Research and Analysis of the National Need for Technology Infrastructure to Support IoT*.

- Kathleen McTigue (NIST)
- Renil Paramel (CEO, Strategy of Things)
- Christopher Reberger (Director, Strategy of Things)
- David Duncan (Consultant, Strategy of Things)

Presentation: Strategy of Things Presentation

Document: Strategy of Things Project Description

Project website: https://strategyofthings.io/nist

- Ms. McTigue provided background, saying this study is an example of a widely scoped, competitively awarded economic impact study managed by NIST. She said this study came to fruition prior to the COVID pandemic, which imposed some delays on Strategy Of Things (SoT).
- Ms. McTigue summarized the Office of Management and Budget (OMB) requirements for the study (see the Strategy of Things Project Description).
- Ms. McTigue said the study considered a broad range of elements as part of infrastructure and was to produce a "quantitative empirical ranking of the technology infrastructure gaps". She noted that the study was primarily focused on future investment and examined the broad-based economic impact of Sa $10M investment in public research for a particular technology.
- Ms. McTigue said that prior to COVID there was an expectation that IoT investment "would be taking off by leaps and bounds" but in fact developments have been much slower than predicted.

- Mr. Paramel introduced the SoT team and explained that SoT has been performing this research for several years and is approaching the end of the work.
- Mr. Paramel explained the presentation was in three parts:
  - NIST IoT Infrastructure Gaps Research Study – the study's scope and the research process.
  - Key Findings: Industry Challenges and IoT Infrastructure Gaps – summarized the gaps that were identified and the associated economic modeling.
  - Draft Strategy of Things Recommendations – a set of recommendations aligned with the identified gaps.
- Mr. Paramel discussed the scope of the study as economic analysis for understanding IoT and the infrastructure around it. He said they examined the current state of IoT and in particular to identify technology gaps and then perform an economic analysis to understand the impact of closing those gaps. He said this research provides a basis to recommend federal research investments. The final task was to communicate the results in a variety of fora and media.
- Mr. Paramel discussed the approach to the study. He explained that this began by selecting 9 industries, in consultation with NIST, based on the expected potential for investment impact. They then assessed the characteristics of each industry and looked for challenges particular to that industry, such as rural connectivity in agriculture. He said they identified top use cases for each industry, collecting 20-30 use cases for each. This was followed by hypothesizing infrastructure gaps for the industry, which were then validated through interviews and surveys. He said they both validated hypothesized gaps and identified unexpected ones. Mr. Paramel said the top gaps for each industry were fed into the economic model.
- Mr. Reberger described the economic analysis approach, noting that there was a lot of information to integrate and analyze. He noted the potential to "over interpret" the results of the economic analysis. He explained the analysis started with a taxonomy of possible technology gaps, starting from a NIST taxonomy, and expanding to 25 categories. He said they designed a survey that received about 450 responses. He said part of the survey asked for identification of the five most important technology gap categories for the responder's industry.
- Mr. Reberger said the survey process was paralleled by desk research and interviews, the results of which were fitted into the taxonomy. The quantitative survey data and the qualitative interview and research data were merged to develop a ranking of technology adjusted by the role of the public sector. He explained that if all the responses for an industry indicated there was no role for the public sector, that would "zero out" the importance of that technology for that industry. The result was a ranking of the relative importance of each of the 25 technologies for each of the industries.
- Mr. Reberger said the ranking was then weighted by the value of IoT over the period 2025-2030, based on third party analysis such as a McKinsey study. He explained this accounted for the greater impact of IoT, as an example, in healthcare compared to construction. He said the result is a ranked list of the most important technologies for public sector investment. He explained that the quantitative analysis was an input into a broader narrative about the public sector investment opportunities in different industries based on the interviews and research, and commonalities across industries such as interoperability or privacy standards. He acknowledged there are many assumptions leading up to the assessment of the impact of a $10M investment.
- Mr. Paramel presented a summary of the study's findings of industry challenges and IoT gaps across the 9 industries examined. He noted that they captured both technology and non-technology gaps for each industry, noting right to repair concerns and lack of digital skills in agriculture as an example.
- Mr. Reberger presented charts illustrating economic analysis results and discussed how they feed into the overall analysis. He identified common themes from the desk research and interviews such as

interoperability, privacy enhancing technologies, reliability, and connectivity. He explained these were weighted by their importance to various industries, showing the weights within a technology, as well as the importance of that technology across all industries, and emphasized that the ratios on the chart are the important characteristic.

- Mr. Katsioulas asked if the study made any distinction between personal privacy and corporate data confidentiality, and whether there was any associated data.
    - Mr. Reberger answered that such details would derive from the desk research and interviews and be addressed at the narrative level.
- Ms. Megas stated she didn't understand the answer to Mr. Katsioulas' question regarding privacy. She explained that NIST considers privacy concerns as being associated with concerns around individuals' privacy risk and differentiates them from concerns around protecting an organization's proprietary information. She asked for clarification whether the information on the qualitative slide included both personal privacy and corporate confidentiality concerns.
    - Mr. Reberger suggested this might be a case of over-interpreting the data. The qualitative analysis identifies industries where privacy enhancing technologies are important, which then factors into the narrative.
    - Mr. Katsioulas asked if privacy enhancing technologies include confidentiality, and Mr. Reberger confirmed that is true.
- Mr. Reberger explained that SoT used the McKinsey report, which was global, and then weighted the numbers by the economic value in the U.S.
- Mr. Reberger presented the results of assessing the impact of a $10M investment in the top four technologies. He said the investment was allocated to industries based on the weightings developed in the analysis, and that returns on investment were based on industry ratios, factoring in profit margins and other elements. He said the result is a "defensible argument" for the estimated returns that is traceable back to the surveys, interviews, and research, but also acknowledged that there are a lot of assumptions.
- Mr. Katsioulas asked, assuming a bill to provide funding, if the SoT report was recommending allocation of such funding relative to the potential value that they would get.
    - Mr. Reberger answered in the affirmative, saying the identification of the best three technologies to invest in was the stated objective of the study. He repeated that these numbers need to be placed in the context of the narrative.
- Mr. Paramel moved on to present "actionable recommendations". He said SoT recognized the need to contextualize the gaps and so developed a 5-stage model for IoT evolution. He said that stages 1 and 2 are happening now; stage 3, with a big uptake in AI algorithms is just beginning and it will take time for AI to propagate across industries. Stage 4 is an outcome-based model that focuses less on the particulars of IoT devices and data and more on the outcomes achieved, and stage 5 is where things will be "a little bit on autopilot". He said SoT used this model to contextualize the gaps.
- Mr. Chan discussed the drivers for the model. He explained that the survey answers were solving today's problems, focused on stages 1 and 2 of the SoT model. He said that the innovation at startups is focused maybe 3 years beyond industry and such startups aren't thinking about far future gaps, while more established companies tend to be less innovative but have financial runway for long-term thinking and often buy startups. Mr. Chan stated that very few people have thought further ahead, and that they were hearing drivers for IoT today and emerging trends. He said they did conduct a few visionary interviews.

- Mr. Paramel said they tried to map the recommendation to the 5 stages of the model. He said some gaps are applicable now and others could potentially be addressed in later stages. He shared a framework for their recommendations, with technology-focused and non-technology recommendations against specific industries as well as other recommendations that are cross-industry or focused on the future of IoT.
- Mr. Chan presented some of the specific recommendations, noting that all of recommendations presented on the slides are in the draft IoTAB report. He described the future recommendations as more "hard research" oriented. He said that while the study was focused on technology gaps it had also identified material relevant to the goals of the IoTAB.
- Mr. Chan described some of the agriculture recommendations as examples of both the technology-oriented and non-technology categories. He noted that certain themes recurred across industries, such as the financial challenges for both smaller farms, manufacturers, and retailers to adopt IoT. He described federal research regarding ways to reduce the cost of sensors as an answering recommendation.
- Mr. Chan discussed an example of the challenge of AI explainability when the insurance industry uses data to compute personalized premiums and creates a class of people of uninsurable drivers. He said that right now the explanations are not transparent.
- Mr. Chan explained that an outcome of the research is a method and a model to assess the IoT technology impact on the economy across different industries. The model was applied across 9 industries and can be useful both to the board and to activities such as policy planning. Mr. Chan stated the model could be applied to future industries and future technologies.
- Mr. Chan pointed out that the study analyzed a point in time, and some of the research will become outdated. The model includes a suggested refresh frequency for various aspects, and there is a corresponding recommendation to continue refreshing the existing model to assess the economic impact. The recommendation also includes evaluating other industries and technology gaps the study didn't examine.

Board Discussion

- Mr. Katsioulas asked about the schedule for releasing the report, and whether there is an intent to align the board's work with the report. He stated his belief the board could benefit from the study's results.
    - Ms. McTigue said because the report was conceived before launch of advisory committee it should be published separately. She said SoT are welcome to share information with the board. She explained the reason this has not been shared based on her decision as the federal officer not to share incomplete results.
    - Ms. Cuthill concurred, stating the board comes out of the DIGIT Act, has its own charter, and is free to take info from any source as the board deems it valuable in developing recommendations. She described the board's efforts as "a totally separate exercise", with different experts and different perspectives. She described the SoT report as "one data source" being brought to the table.
    - Mr. Chan said that SoT came across some areas of intersection during the research and shared what finding they could with the board. He noted that some of his recommendations came from the research's insights. He gave the example that interviews with cities found that funding and lack of skills were real issues, hence he had provided the board some early recommendations regarding those gaps.

- Mr. Chan said SoT can make a report draft available but that it is incomplete. He said the publication target was March 2024. He noted the report is nearly 500 pages and contains citations for statistics that back up the findings.
- Mr. Chan explained the study applied a 3-stage criteria to select industries: (1) what is the GDP contribution to the U.S. economy; (2) the strategic importance of the industry, based on economic, strategic, or national security considerations; and (3) how strong is the "fit" of IoT for this industry. Mr. Chan explained that the SoT research was important context for the board when considering the associated new recommendations.

Approach/Expectations for Findings and Recommendations

Mr. Chan and Mr. Witte

Document: Draft IoT Advisory Board Report Dated December 11, 2023

- Mr. Chan invited Mr. Witte to talk about the report structure.
- Mr. Witte thanked the board members for the input and feedback to the November 28th draft. He described the current challenge as "mak[ing] sense of the big picture" from the large volume of material. He stated the report has its introduction, background material, and has incorporated graphics from the SoT report. Mr. Witte described the "chasm" between the stories being developed and the 100s of recommendations that aren't clearly traceable back to their purpose. He noted that SoT was able to demonstrate the threads between findings and their results (recommended prioritization and approach). He said the meeting will discuss general and industry-specific findings and make the connections to explain the prioritizations and recommendations. He said the recommendations are organized into six themes:
  - Establishing a national strategy
  - Modernization, including interoperability and the handling of IoT-produced data
  - Trust, including privacy, cybersecurity, and lack of trust as an obstacle to adoption
  - Connected IoT Value Chains
  - IoT leadership / Government capabilities, consolidating three previous themes that address international leadership, government leadership, and government use; he noted this includes leadership across various industries
  - IoT-Ready Workforce, which applies across many of the subgroups.
- Mr. Katsioulas noted that the introduction currently doesn't address all six themes and Mr. Witte concurred that it should.
- Mr. Witte described a challenge of adjusting the provided information to a consistent level of detail, since the input ranges considerably in level of detail. He suggested 3–5-page stories to accompany the findings, with supplemental, in-depth examples deferred to the appendices. He said the board's input is needed on the right level of granularity to provide Congress.
- Mr. Chan stated the report is starting to come together.
- Ms. Reynolds expressed concerns that recommendation content that had been submitted using Mr. Chan's template seemed to be lost, and that much of the basic privacy material had been "homogenized" and no longer made sense. She recommended the privacy material be consolidated, including explanatory material that's currently in an appendix. Ms. Reynolds suggested that trust be a higher-level section but disagreed that other recommendations should be gathered under trust as a topic. She said she felt that the bigger points related to privacy have been watered down.

- Mr. Caprio concurred with Ms. Reynolds, saying a lot of work is needed to consolidate the proposals and streamline the report. He said that while the recommendations on national strategy are clear he felt seminal privacy proposals have gotten lost, such as a robust recommendation for comprehensive federal privacy bill. He stated that some material needed to be restored and suggested other members might have similar concerns.
- Mr. Witte stated that the privacy material can consolidated and that he can work with Ms. Reynolds to ensure it reflects the board's intent. He suggested that all of the content derived from the templates might not be needed, but that the justification and rationale should be documented. He said that material would be divided, with some accompanying the recommendations, and some of the justification and barrier relief would be with the story. He clarified that he wasn't suggesting that all stories would be in the appendix.

- Ms. Mehra suggested the horizontals should be those presented in the SoT report. She said taking that approach would place privacy and security under standards. She suggested having a similar structure would be less likely to confuse the audience regarding the agenda of IoT. She said the focus is to highlight barriers to adoption and recommendations to address them in order for the U.S. to stay the innovator and leader in technology.
  - Ms. Reynolds agreed, saying the board needs to think about the readers who may not be interested in every category. She suggested having material in "larger buckets" would make readability easier.
  - Mr. Witte, Mr. Bergman, and Mr. Chan disagreed indicating that many of the board's recommendations didn't fit into the taxonomy from the SoT report. Further, the themes were introduced partly as a way to think about why IoT hasn't achieve the hoped-for adoption. Modernizing infrastructure and addressing privacy are big, cross-cutting themes. Themes can help to tell the story and can serve as the "elevator pitch" and the findings were written from that perspective.
  - Mr. Katsioulas proposed developing a matrix of the 6 themes vs. 4-5 horizontals. He concurred with consolidating horizontals but suggested that they need to be accompanied with "a vertical snippet" to show how they are associated with specific applications.
  - Ms. Mehra said the horizontals are defined (the six NIST categories from the SoT presentation), and that having a consistent set of horizontals would strengthen the message to Congress. She said the board's charter includes both horizontals and verticals. She stated it would be less confusing to the audience to stick with known horizontals that are "tried and true". She said the six NIST categories covered the report requirements other than policy and workforce.
  - Mr. Chan said that SoT applied a technology-centric perspective although they did find some non-technical and policy-related items. He said that policy doesn't readily fit into technology or non-technology "boxes" and said that using the NIST technology perspective would miss other important matters. He said that not everything the board is working on fits into that NIST model.
  - Mr. Witte clarified that confidentiality in this report was as part of the confidentiality, integrity, availability (CIA) security triad, not a legal construct, and that a statement can be added to the report to clarify that.
  - Mr. Katsioulas stated that the appropriate horizontal was not confidentiality but digitalization, which is part of modernization and has multiple levels that include simple digitalization and aspects that relate to trust.
  - Mr. Witte reminded the board that they are tasked to fulfill requirements from Congress that includes specific components. He noted that these focused on higher-level constructs.

- Mr. Chan described the findings, both larger and smaller, as a means to connect recommendations to the input that motivated them. He said they were building on things heard across the set of board

meetings and were intended to be supported by data or statements from speakers. He acknowledged he may have missed some findings. He described examples of the inputs that led to findings, which are intended as a home for recommendations, and solicited board member input on both the approach and other findings that should be included.

- Mr. Katsioulas said he liked the approach of findings and suggested focusing on consistency of how the findings are articulated. He suggested that findings should connect quantitative research, qualitative research, and opinion, and that commentaries should then focus on what to do with the finding: identifying problems to solve, corresponding solutions, and expected benefits. He urged the presentation of findings be consistent.
- Ms. Reynolds noted that she had written commentaries to connect recommendations to themes, including how the privacy recommendations address child privacy concerns, and matters related to privacy and AI.

- Mr. Witte reiterated that a decision on structure was needed, saying that reorganizing again would be difficult but should be done now if at all. He added that it seemed clear the report would not be done by January, and that the new delivery target is March. He suggested a timeline of reviewing recommendations in December, reviewing the findings, stories, and commentaries in January, and finalizing the details in February.
  - Mr. Chan concurred with Mr. Witte's timeline.
  - Mr. Katsioulas asserted the need to agree on structure in this meeting in order to fulfill Mr. Witte's timeline. He said he was willing to transform his two major stories into findings and commentaries. He noted Ms. Reynolds comments about consolidating the privacy material and said he would like similar consideration for the value chain material.
  - Ms. Reynolds stated the privacy content simply needed to be consolidated and ensure it is complete. She said it needed to tell a cohesive story but that new content isn't needed.
  - Mr. Bergman pointed out that reorganizing isn't "free", saying the members will need to do a careful review to ensure no material is lost.
  - Mr. Witte stated that not every piece of every subgroup's work will be in the report, and the board needs to agree regarding what is retained.

- Mr. Katsioulas asked Ms. Reynolds for clarity about how she envisions consolidating the privacy recommendations.
  - Ms. Reynolds stated the themes are more overarching commentary and should be separate from the recommendations. She asserted that material the subgroup had supplied (e.g., justifications) was missing from the report. She said that recommendations should have at least a brief description.

- Mr. Chan shifted the discussion to address structure and an example storyboard. Mr. Witte described the value chain story as fairly complex. He showed Mr. Chan's storyboard concept diagram, illustrating how the overall vision will be supported by findings and commentaries that address "the what" and recommendations organized by theme that address "the how". He noted that the themes are banners and recommendations under them are grouped together by topic. He stated he believed the themes still make sense and can address the concerns raised in today's meeting.
- Mr. Witte reported that FWG reviewed have observed the report contains a lot about funding and said the editors can analyze the number of recommendations asking for money vs. leadership vs. research. He discussed the ability to move blocks of recommendations around and demonstrated the use of the spreadsheet to filter recommendations by topic. He explained this will enable ensuring the report has the right recommendations and the right backup.

- Mr. Witte suggested the priority is to agree on what to recommend then on how to recommend it, connecting back to the findings and commentaries. He commended Ms. Reynolds on the privacy commentary she had supplied. Mr. Witte urged moving forward with the current approach of organizing the findings and recommendations under the six themes. He offered the possibilities of tagging every recommendation with which of the 6 NIST taxonomy elements it affects.
- Mr. Chan stated that an organization of a finding and associated recommendations is "never that cut and dried" because one finding may connect to multiple themes and recommendations. He said the findings are to identify the "big areas" that need to be exposed. He suggested there should be 15-20 or fewer big findings, with smaller findings consolidated under those. He said he believed privacy should have its own finding and that he had grouped that under the larger finding of lack of trust, noting that there are three "big findings" under trust.
- Mr. Chan used an example of an agriculture finding to illustrate adoption is slow and uneven, which he said can be supported and which drives to set of recommendations. He noted there are also privacy and interoperability concerns associated with agriculture but those are addressed under the horizontals.
- Mr. Witte noted the ability to bundle similar recommendations that apply across multiple sectors, such as workforce recommendations for agriculture, manufacturing, retail, etc. He said a finite set of recommendations can cover a lot of sectors.
    - Mr. Chan acknowledged this replication across topics like workforce, interoperability, cybersecurity, that can be consolidated into single recommendations that apply to multiple industries using examples. He noted he still needed to supply public safety recommendations.
- Ms. Mehra asked whether cluster analysis done against the complete set of recommendations before the probationary additions, saying it was important to look at the previous set of recommendations before considering the additional probationary recommendations.
    - Mr. Witte explained the editorial team did considerable analysis, which led to some of the key recommendations. He said the analysis wasn't put it into the report but helped with developing it, and that the results would not be simple to present.
    - Ms. Mehra asked about the use of a legend to connect key recommendations to sectors.
- Mr. Caprio endorsed the goal of further consolidation to produce a shorter report and asked Mr. Witte his sense for how much could be cut?
    - Mr. Witte stated he believed the size could be reduced by nearly half, through bundling of recommendations.
    - Ms. Mehra expressed concern that there is a lack of visibility into how recommendations that had received preliminary consensus have been consolidated, and suggested a visual would be very helpful.
    - Mr. Caprio expressed his view that the report would be too long even with a 50% reduction and urged saying things in a very concise way.
    - Mr. Chan noted that one of the problems is that the editors have still been taking in recommendations and there are others that need to be considered, both of which make it difficult to reduce the volume of content.
- Mr. Katsioulas recommended documenting specific action items in order to get the report to completion:
    - Finalize the recommendations in draft form and ensure all members review them before the next meeting. He said it would ideal if member expressed approval or concerns about recommendations before the meeting.

  - Replace "persona" with "stakeholder", saying the former is a fictional character created by marketing to present a certain demographic in their target audience.
  - Align on keywords and use them with a consistent meaning (e.g., supply chain and value chain, persona and stakeholder, confidentiality and privacy, digitalization and digital transformation).
  - Include a sample glossary to document a minimal but meaningful set of terms helpful for non-technical people.
  - Avoid defining IoT.
  - Use embedded links in the report text in place of having links in footnotes.

- Mr. Witte stated that there was feedback from the FWG about the need to agree on terms, especially where there might be confusion, citing the example of "framework". He said a terminology section would help specify the meaning of terms as used in this report.
  - Mr. Tseronis suggested using the official NIST Glossary: https://csrc.nist.gov/glossary
- Mr. Chan stated the intent had been to go through the recommendations at this meeting to get to consensus. He expressed confidence in the editors to take input from the board and put it in a uniform structure. Mr. Witte restated the need to get the recommendations solidified so that updated material for review can be sent to the board. He said he hoped to have review material available December 29.

Recommendations Discussion

Mr. Witte

Document: Draft IoT Advisory Board Report Dated December 11, 2023

Note: Numbered Recommendations cited throughout the remainder of the minutes refer to specific recommendations in the report linked above.

Theme: Establishing A National IoT Strategy

Mr. Witte

Key Recommendation 1

- Mr. Witte explained that the national strategy was a new theme added in the last update. He said there needs to be a strategic approach to presenting the requirements. He said each theme has an objective and invited feedback on those objectives. He said the objectives may eventually be replaced with findings. He explained the objectives are there to provide a context for what the recommendations are intended to produce.

Key Recommendation 1.1

- Mr. Witte presented the new key recommendation (1.1) to have a national strategy and described it as an example of consolidation from enabling recommendations to create an overarching recommendation. He asked for the board's approval to keep this in the report.

Enabling Recommendation 1.1.1

- Mr. Witte presented enabling recommendation 1.1.1, "IoT must be added back to the critical and emerging technology list", noting the strength of the "must" terminology and acknowledging that the board has been clear about the importance of this item.

  - Mr. Chan pointed out there are some other recommendations related to strategy, including ones in agriculture and smart cities, and asked if those will be added here.
  - Mr. Witte replied he is inclined to leave those recommendations where they are and use the matrix to show that they link to the strategy requirement. He explained his thinking considered whether a particular recommendation is more about strategy or more about the sector. He noted similar considerations applied to sector-oriented recommendations that address privacy, as Ms. Reynolds had pointed out. He also provided the rationale of whether the board would be asking the White House to take an action for including under the national strategy recommendation.
  - Mr. Caprio concurred, saying that starting with a national strategy is pithy and direct and that adding recommendations such as the agriculture strategy would water down the key recommendation.

- Mr. Katsioulas asked if the national strategy recommendations would go up front, perhaps in the executive summary. He expressed concerned about it getting lost.
  - Mr. Witte said the need for an IoT strategy could be one of the findings. He also said there should be a table up front listing the key recommendations.
  - Mr. Katsioulas suggested using the executive summary to explain the need for a national strategy and the major themes it should address, combining IoT and adjacent technologies, to place it in front the reader immediately.

- Mr. Chan asked whether there were objections to the section 1 material on national strategy and none were raised.
  - Ms. Mehra recalled the discussion of an "iot.gov" website at a previous meeting and urged that could be included as part of the national IoT strategy to help keep visibility on the IoT agenda.
  - Mr. Witte said the "iot.gov" concept could be included in the front sections and invited Ms. Mehra to draft some language. Ms. Mehra accepted an action to draft that language. Mr. Griffith volunteered to assist.

Theme: Connected IoT-based Supply Chain Logistics

Key Recommendation 4

- Mr. Witte shifted to discussion of section 4, Connected IoT Value Chains, to discuss changes to that material.
- Mr. Katsioulas explained he had shifted terminology from "supply chain" to "value chain", saying the new term is a superset of supply chain. He described value chains as providing greater traceability in complex supply ecosystems with many partners.
- He said the participants in these ecosystems need a business incentive, hence the emphasis on a value chain. He said scaling such ecosystems quickly requires "platform-based ecosystems with network effects".
- He said the network effects is a new aspect of the description. He said this environment includes architecture (the interconnections of the participants), governance (which may involve government regulation at the national level), and network effects (connecting the elements to maximize and accelerate adoption). He identified public-private partnerships and technology hubs as mechanisms to equitably connect large and small participants in value chains. He quoted definitions that identify supply chains as primarily concerned with logistics whereas the value chain encompasses the entire range of activities from the conception of a product or service to its delivery to customers and beyond.

He added that the value chain concept includes the development of business value at each stage of the process.

- Ms. Reynolds raised a concern that using "value chain" may cause readers to misunderstand this material in the report, contending that "supply chain" is the prevalent term where "value chain" is not a current term of art. Mr. Bergman supported Ms. Reynolds view.
- Mr. Katsioulas replied that the intent is to introduce "value chain" as a new term, saying there is a need for a new level of definition for the operation of modern supply chains. He suggested that value chains that incorporate digitalization and traceability to regulate market access and use. He connected this concept to "pay as you go" adjustments to deployed product capabilities.
- Ms. Reynolds said that readers will likely miss a nuanced point and not pay attention due to the use of unfamiliar terminology.
- Mr. Bergman advocated describing the IoT value chain concept in a sidebar to not distract from the policy recommendations the report seeks to convey.
- Mr. Griffith suggested that the value chain discussion could go into a commentary. He agreed the value chain content should be retained but reported that supply chain is the current focus of industry.
- Mr. Witte pointed out that Congress asked the board to look at "augmented logistic and supply chains".
- Mr. Katsioulas concurred with using supply chain in headings but still wants to get the value chain concept into the discussion.

- Ms. Mehra suggested the board revisit the horizontal and vertical items and confirm there is agreement among the board regarding them. She also suggested that there may be a seventh category that would include policy, workforce, and supply chains, saying the list from Congress is "a mish mash of verticals and horizontals".

Enabling Recommendation 4.1

- Mr. Witte presented section 4.1 as a good example of the appropriate level of granularity for report content. He indicated that the recommendations should focus on the "how", with the "why" being discussed in the preceding stories.
  - Mr. Katsioulas stated that each section should have the same consistent structure and that he had found having consistent highlighted labels made it easier to navigate while reading. He said bold headings help readers who primarily want to skim.
  - Mr. Witte asked for other input regarding formatting to make the report more readable.
  - Mr. Chan pointed out that the template was intended to help standardize the information supplied to the editors. He agreed that a consistent format with headings helps with readability.
  - Mr. Witte concluded that the content would be presented primarily as prose, with bullets for lists where appropriate.

- Mr. Witte presented Supply Chain 4.1, describing it as fairly broad, and not much changed.

Enabling Recommendation 4.2

- Mr. Witte presented Supply Chain 4.2, relating to public-private partnerships (PPPs). He noted this currently has a lot of content that will likely be reduced.
  - Mr. Katsioulas noted that 4.2 overlaps with a later recommendation relating to "orchestrated PPPs" and there might be opportunity for consolidation.

- Mr. Witte pointed out an inconsistency in how the inputs addressed barriers, saying some spoke to the barriers to implementing the recommendation and others to the barriers the recommendation was addressing. He said the stories and commentaries will describe the value that will be delivered by accomplishing a recommendation. He asked for guidance on the correct content for barriers.
    - Ms. Megas said she believed the intent was for audiences to understand the barriers a recommendation is addressing, providing the justification for the recommendation. She said that knowing what the recommendation is trying to fix can provide context to someone implementing a recommendation or considering alternatives to address the same barrier.
    - Mr. Witte took the board's guidance that the barrier relief that will occur will appear in the justification and the barriers restrict implementing a recommendation will appear under potential barriers under the recommendation.
    - Mr. Witte stated that the federal considerations under each recommendation will be kept general and high level and avoid targeting specific agencies except in special cases.

Enabling Recommendation 4.2.1

- Mr. Witte stated recommendation 4.2.1 has changed quite a bit, with the intent shifting from encouraging PPPs to subsidizing initiatives.
    - Mr. Bergman suggested this recommendation may no longer belong under the 4.2 recommendation on public-private partnerships.
    - Mr. Katsioulas said the action should be to change 4.2 to discuss PPPs and orchestration. He described the goal of subsidizing a proof-of-concept digital thread implementation potentially through an orchestrated PPP.
    - Mr. Bergman responded that the language of 4.2.1 doesn't support Mr. Katsioulas' intent, saying the text seems to be recommending the government support digital transformation of enterprises whereas the verbal description was recommending a proof-of-concept project.
    - Mr. Katsioulas acknowledged the concerns regarding the language, and said the intent was for government to broadly encourage the concept while subsidizing a small project. He agreed to revise the language, but the revision will encompass both 4.2 (broader encouragement) and 4.2.1 (subsidizing a proof-of-concept).

Enabling Recommendation 4.2.2

- Mr. Katsioulas said he changed data to digital because digital marketplace may include data, assets, and services, and he wanted the scope to encompass asset and data producers and consumers.
- Mr. Bergman raised concerns about the recommendation to "incentivize" this technology, saying that term implies a request for funding to a government audience. He suggested "promote" as a more appropriate term and agreed to provide suggested changes to Mr. Katsioulas.

Enabling Recommendation 4.2.3

- Mr. Witte said that 4.2.3 introduces the concept of AIoT.
    - Mr. Katsioulas explained that AI in general is a broad concept. He said that in the context of supply chains or value chains, IoT is data producing, AI is data consuming; supply chains and networks where data flows are arteries, and data is the blood. He said that in a circular economy AI and IoT are intimately related and he was trying to connect the two concepts. He said the intent was to present AI and IoT not as adjacent technologies but as very connected.

- Mr. Katsioulas explained that an "AIoT platform" combines AI and IoT to enhance the delivery of analytics. He was amenable to using AI-IoT as a replacement term as suggested by Dr. Chandra and Ms. Mehra.
- Mr. Bergman suggested avoiding "across circular value chains" in the recommendation statement. He said the intent of the recommendation is promoting trusted AIoT platforms and that the circular value chain element takes away from the key point of recommendation. He raised no objection to the discussion of circular value chains in the description.

- Mr. Witte continued the discussion of 4.2.3, asking if Mr. Katsioulas is actually recommending regulation?
  - Mr. Katsioulas said he feels strongly that there is a need to regulate AI and AI / IoT combinations, describing concerns regarding data generated by "bad AI actors".
  - Mr. Bergman expressed the opposite opinion, saying that "the regulatory bus is already on its way" and he saw no benefit to further recommending regulation. He said it was possible to promote AIoT without addressing regulation.
  - Ms. Reynolds said the new EO about AI isn't calling for regulation but making orders to agencies what they can do within their purview prior to regulation. She said the EO has called for regulation from a privacy perspective but not for AI.
  - Mr. Bergman warned against calling for blanket regulation, and that the board should be careful addressing this topic without anything specific to say about it.
  - Mr. Katsioulas said his concern was to encourage consideration of the combination of AI and IoT in regulating AI to avoid future trouble. He said that AI moving very rapidly and that he is trying to formulate a sustainable recommendation regarding AI and IoT
  - Ms. Reynolds said this is moving ahead of where the U.S. is with AI regulation, based on the EO's language. She noted the report already calls for comprehensive privacy regulation, which is needed for AI, but expressed the need to moderate the report's language to align with how the government is looking at AI.
  - Mr. Chan suggested the issue regarding regulation of AI is related to not know what outcomes to anticipate, what AI might do with IoT data, and a lack of transparency related to AI training and outcomes. He pointed out other recommendation in insurance, retail, and healthcare that speak to AI explainability without calling for regulation. He that people are afraid of what AI can and can't do because they can't examine the training models. He suggested that developing tools for explaining AI decision could be a part of the recommendation.
  - Mr. Katsioulas summarized his actions related to section 4.2: take out circular value chains, focus on privacy, focus on education & awareness about the components of AI and AIoT, focus on accelerating awareness of how disruptive it could be.

- Ms. Megas asked if the concern is that greater integration of AI and IoT could lead to safety concerns by allowing IoT to take action on physical world without an understanding of the AI decision making.
  - Mr. Katsioulas described the potential for rapidly expanding vulnerabilities if there are bad actors in networked value chains, and the accelerated lowering of barriers to adoption with good actors. He said the combination of AI and IoT can accelerate the effects of both good and bad actors because of how fast the processing loop will become. He said it will be impossible to develop remedies in time unless we "use good AI against bad AI" for balance. He described the challenge as regulating the rate of AI adoption so that it doesn't create havoc.

Key Recommendation 4.3

- Mr. Witte noted the change in language from "research" to "assess" as a potential catch point.
  - Mr. Katsioulas clarified that "assess" meant reviewing the output of a proof-of-concept both for whether it works and the economic value realized by the participants.
  - Mr. Witte sought clarity on what's meant by "support" in the recommendation.
- Mr. Bergman suggested something similar to an NCCoE[1] proof-of-concept project, and Mr. Katsioulas concurred with that interpretation. Mr. Bergman was supportive of a proof-of-concept project.
  - Ms. Mehra inquired if there are other proof-of-concept recommendations in the report.
  - Mr. Witte replied the only specific similar item is the proposed Farm of the Future under agriculture, and that other recommendations only speak to research.
- Ms. Mehra asked about the potential for suggesting an IoT national lab be established as part of a national IoT strategy. She suggested such a lab could execute proof-of-concept efforts.
  - Mr. Tseronis responded that it would be a challenge to get a new national lab. He stated he liked the idea of establishing an NCCoE community of interest or community of practice. He also suggested the NITRD[2] program at OSTP[3] as a location for entrepreneurial R&D.
  - Mr. Bergman stated that while IoT is very horizontal, sector-specific pilots will need sector expertise. He suggested that NCCoE could address supply chain security well, but that other sectors such as smart cities or agriculture should be done with the expertise of people in those areas, and a generalist isn't suitable for these projects.
- Ms. Mehra offered that the lack of a central hub for IoT may help explain the slow pace of IoT adoption. She pointed out that IoT is conceptually more complex than manufacturing chips. She suggested that an IoT lab that provides a centralized place for IoT innovation is a recommendation that the board should consider. She agreed with the need for subject matter experts, saying the government has agencies that can bring that expertise to specific proof-of-concept efforts under an IoT lab (e.g., the USDA or Department of Agriculture could support an agriculture-oriented proof-of-concept).
  - Mr. Bergman indicated he doesn't see a need to allocate funding to a new national lab.
  - Ms. Mehra responded that the board is making recommendations, and there could be investment options (small / large / medium).
  - Mr. Katsioulas suggested recommending localized labs associated with disciplines.
  - Dr. Chandra agreed, noting that the Farm of the Future recommendation had been linked to land grant universities due to the geographic considerations associated with agriculture but that the universities would need funding support.
  - Mr. Katsioulas said he was suggesting adding more application-specific pilots that could drive home the point of operationalizing IoT.
  - Mr. Witte suggested adding an enabling recommendation for the national strategy to consider additional research and laboratory necessities.
- Ms. Mehra stated that removing barriers to IoT is not going to happen in a bottom-up manner, and that a top-down approach is needed applying a concerted effort at the national level.
- Mr. Bergman suggested that prudent use of taxpayer funds would be to use existing capabilities until there's a need for something specific.
- Mr. Witte pointed out that the strategy does speak to research needs, and that how to address them would be part of the national strategy.
- Mr. Bergman suggests tabling this discussion until there's a specific proposal to review.

[1] NIST's National Cybersecurity Center of Excellence: https://www.nccoe.nist.gov/
[2] Networking and Information Technology Research and Development program: https://www.nitrd.gov/
[3] White House Office of Science and Technology Policy: https://www.whitehouse.gov/ostp/

- Mr. Witte took an action to send out sections 4.2 and 4.3 for specific review and feedback.

Enabling Recommendation 4.3.4

- Mr. Katsioulas said regarding recommendation 4.3.4 he had added wording to "promote network effects" because that accelerates things.
  - Mr. Bergman asked whether network effects are defined in the recommendation, saying jargon needs to be defined in the document.
  - Mr. Katsioulas concurred. He suggested a definition that the value of a platform grows with the number of participants and if it is orchestrated it accelerates adoption.

Enabling Recommendation 4.3.5

- Mr. Katsioulas said recommendation 4.3.5 had few changes and he would appreciate feedback on the wording.

Enabling Recommendation 4.3.6

- Mr. Katsioulas said recommendation 4.3.6 is totally new and invited Mr. Bergman's input to address cybersecurity aspects.
  - Mr. Bergman stated there is a related thread about device identity and agreed to review 4.3.6.
- Mr. Chan requested confirmation that the board has reviewed all of Mr. Katsioulas' recommendations.
  - There were no objections.

Closing

Barbara Cuthill adjourned the meeting.

IoTAB Meeting on Wednesday, Dec 13, 2023

Opening Remarks

Ms. Cuthill opened the day's meeting. She thanked people for attending and turned the meeting over to the chair, Mr. Chan.

Mr. Chan

Mr. Chan asked Mr. Witte to discuss the day's agenda.

Mr. Witte

- Mr. Witte noted the value the board could derive from the SoT research presented on Day 1.
- Mr. Witte stated that there is an opportunity for the board to make the justification for its recommendation more compelling and the SoT findings may help in that area.
    - Mr. Bergman pointed out that the board's report should acknowledge the significant amount of information coming from another federal study.
- Mr. Witte reviewed the agenda and emphasized the need to use the meeting time efficiently.
- Mr. Chan emphasized the need for all board members to contribute and to follow through on any actions assigned in order to complete the board's work and incorporate all of the voices on the board.
    - Mr. Witte stated the editors' willingness to accept any remaining input in the form most comfortable for the board members.

Continuation of Discussion on Recommendations

Mr. Witte

Document: Draft IoT Advisory Board Report Dated December 11, 2023

Document: Public Safety Internet of Things (IoT) Use Case Report and Assessment Attribute

Document: Healthcare Recommendations

Mr. Witte pointed out features in the report's formatting to aid board member in navigating the content and identifying where topics are discussed.

Theme: Modernizing IoT Infrastructure

Mr. Witte

- Mr. Witte discussed Objective 2, regarding modernizing infrastructure for IoT to improve data sharing and interoperability.

Key Recommendation 2.1

- Mr. Witte stated that nothing had changed but the recommendation is there to emphasize ways the policies would encourage and protect that data.

Enabling Recommendation 2.1.1

- Mr. Witte noted a proposed minor wording change to remove a qualifier regarding "third parties".
  - Mr. Bergman asked if there is precedent for the government defining how to license something between two parties.
  - Mr. Witte referenced his experience where the government has served as a broker to define usage conditions on the sharing of genomics research data. He suggested that "data sharing [and] usage" are the more important terms in the recommendation, both from a privacy perspective and regarding the responsible use of the data.
  - Mr. Bergman pointed out that the recommendation and implementation considerations portions have a different focus and suggested that wording regarding disclosure of data sharing is needed.
  - Mr. Witte explained this recommendation began as a privacy recommendation but was adjusted to address sharing of data produced by the IoT Ecosystem. He explained that there might need to be controls placed on the sharing of data, given its potential value, and so the template concept includes licensing.
  - Mr. Bergman suggested the goal was best practices for data sharing.
  - Ms. Megas noted there are examples where FTC has put out models, such as a model privacy form. She described these as a resource the government can make available for organizations.
  - Ms. Cuthill added that HHS has some model for protections on for human research data, and that the concept of such models is not new.
  - Ms. Reynolds pointed out there is a privacy recommendation on data use and asked about the relationship between the two recommendations. She observed that this recommendation seemed to be combining privacy and cybersecurity and suggested the two should be separated.
  - Mr. Chan responded that 2.1.1 is not privacy related but focused on data that is meant to be shared.
  - Mr. Bergman concurred with Ms. Reynolds, saying this recommendation isn't needed given other related privacy recommendations. He suggested removing enabling recommendations 2.1.1 and 2.1.2.
  - Mr. Witte stated that many meetings have identified that data produced by IoT could be made available for many different purposes with the potential for significant benefits. He said the recommendation is responding to a call for adequate clarity for how that data could be shared.
  - Ms. Reynolds stated this recommendation, if kept, should focus on business needs, with consumer privacy needs addressed elsewhere.
  - Mr. Bergman pointed to recommendation 4.2.2, saying that addresses trusted data exchange and licensing and that he didn't support 2.1.1.
  - Mr. Chan pointed out the volume of IoT data, such as from air quality monitors, that isn't human-related or privacy sensitive but may be valuable to share. He asked if data of this type has been adequately addressed in the recommendations.
  - Mr. Bergman asked for clarity on the difference between 2.1.1 and 4.2.2.
  - Mr. Witte responded that section 4 is about sharing data about supply chain, especially traceability and provenance within the value chain. He described 2.1.1 as being about IoT-produced data in general, how to share it, and can government provide guidance on how to share it.
  - Mr. Bergman said that 2.1.1 doesn't need to address privacy, and that 4.2.2. is not specific to supply chains. He said right now the two recommendations can be confused regarding what actions the government should take, and the wording needs to be more explicit.

Enabling Recommendation 2.1.2

- Mr. Bergman pointed out the overlap in wording with the term "digital threads" in other material. He advocated for reviewing these recommendations (2.1.1, 2.1.2) to focus clearly on data collected by IoT sensors, clearly distinguished from supply chain arguments.

Enabling Recommendation 2.2

- Mr. Witte noted that Mr. Katsioulas had observed that federal data repositories could provide transparency. Mr. Chan noted that this recommendation had originated in the context of consolidating environmental data from a variety of sources, such as air quality data, for availability to researchers.
- Mr. Chan suggested the recommendation is unclear what kind of data would be stored as well as the rationale for using a government repository.

Enabling Recommendation 2.2.1

- Mr. Witte said that the recommendation had been transportation specific and suggested there may be an opportunity to cover data exchange in a broader sense.
- Mr. Chan described the broader issues of interoperability of transportation-related data between states due to lack of standards. He said that IoT data is only one element of this interoperability problem.
    - Mr. Witte suggested that 2.2.1 might be better placed supporting 2.3.
    - Mr. Bergman noted the wording "consistent data taxonomy that allows for the sharing and exchange of data", noting that experience indicates a taxonomy isn't sufficient. He suggested adding words for a "… and conformity assessment tooling that enables the sharing …" to the recommendation.
    - Mr. Witte asked if the language suggested for 2.2.1 should be applied to 2.3 for IoT related data generally?
- Ms. Megas asked if the interoperability work being described, with a taxonomy and conformity assessment, would be better addressed by a standards development organization (SDO) with industry and customer input?
    - Mr. Bergman concurred, noting that AASHTO[4] is an SDO, but also pointed out that the language could be clearer that the government should be promoting interoperability.
    - Mr. Witte proposed language for the government to "encourage" other organizations to develop a taxonomy. Mr. Bergman and Mr. Griffith concurred with this wording.
- Ms. Megas asked for clarity regarding the role of different levels of government in addressing the traffic data interoperability issue.
    - Mr. Chan explained that each state DOT has their own standards and are "barely interoperable among themselves". He said the states are working through AASHTO but these efforts are voluntary and slow, and suggested that federal government promotion of interoperability could stimulate action, without mandating a particular solution.
    - He suggested the specific language of 2.1.1 could be applied more generically.
    - Mr. Witte asked if that concept should be applied to recommendation 2.3, including carrying the language just agreed to into that recommendation.
    - Mr. Griffith suggested using the transportation interoperability challenge as an example under 2.3 as part of a single recommendation, perhaps with another example.
    - Mr. Chan noted that the SoT report includes a common recommendation for promoting interoperability.

[4] American Association of State Highway and Transportation Officials, https://transportation.org/

- Mr. Witte asked if the board wanted to strengthen this recommendation, perhaps with language about prioritizing agencies that use the taxonomy.
  - Mr. Chan endorsed this concept and suggested there are a number of recommendations about government leadership where that could be applied.

Enabling Recommendation 2.3.1

- Mr. Witt stated that this one hadn't changed.
- Mr. Chan pointed out that the general concept of 2.3.1 that the government should promote interoperability standards is valid, but that as worded the recommendation is very specific to transportation and perhaps should be moved.
- Mr. Chan suggested using the transportation case as an example for a more general recommendation.

Enabling Recommendation 2.3.2

- Mr. Witte noted that a consistency check of this one's language against the previous recommendations is appropriate. He noted that 2.3.2 combines interoperability and cybersecurity, in contrast to the discussion on previous recommendations to separate them.
- Mr. Bergman supported removing cybersecurity, saying it is addressed by the requirements cited in the supporting text.

Enabling Recommendation 2.3.3

- Mr. Witte identified this one as another candidate to be used instead as an example supporting a more general requirement. Mr. Chan concurred.

Enabling Recommendation 2.3.4

- Mr. Witte noted that Mr. Griffith had added language to this recommendation, specifying "within the broader electric grid" and asked if this should also be used as an interoperability example?
  - Mr. Chan explained this recommendation originated from challenges and delays in deploying grid-level renewable energy systems due to slow approval processes. He noted that IoT is integral to these systems, so these renewable energy deployments also promote IoT adoption. He acknowledged the recommendation may not be a good fit.
  - Mr. Griffith added that an associated challenge is transmission line construction to deliver renewable energy output, as the deployment of renewables is a "location constrained" matter.
  - Mr. Chan raised the question for the board of whether this recommendation is out of scope?
  - Mr. Griffith suggested the material could go into a commentary section, and Mr. Chan and Mr. Witte concurred with that approach.

Enabling Recommendation 2.4.1

- Mr. Witte suggested that this recommendation was similar the ones just discussed and may be shifted to the adjacent technologies section.
  - Mr. Chan disagreed, noting the lack of an industry standard for inverters and other renewable energy elements.
  - Mr. Griffith concurred and added that the recommendation should speak more to interoperability than the current language does. He agreed to help with improving the interoperability language.
  - Mr. Witte agreed and added that it just needs to be clarified.

Enabling Recommendation 2.4.2

- Mr. Witte described the recommendation as a similar challenge focused on public safety, and another opportunity to combine under a single recommendation to advocate for interoperability.
    - Ms. Megas pointed to the wording that is focused on the data on the device. She asked for clarification whether the interoperability issue was regarding "stand-alone" IoT devices or another aspect of interoperability (e.g., between IoT ecosystems). She noted the existence of the federal government's catalog of minimum cybersecurity requirements for IoT devices.
    - Mr. Witte stated the recommendation was "largely about data" but that he would ask the board's public safety advocates for clarification.

Enabling Recommendation 2.4.3

- Mr. Witte described the recommendation as another example addressing a healthcare-related topic but focused on data interoperability. He asked whether the correct focus was data exchange standards or interoperability?
    - Mr. Chan reported that many IoMT devices are operating with a larger ecosystem, like a hospital environment and may share data with each other. He said one of the issues is that devices from different manufacturers don't necessarily talk together; interoperability is a theme that appears regularly in the literature as well as expressed by speakers at board meetings. researched. He said that interoperability is broader than just data.
    - Mr. Witte asked whether having the government "promote" interoperability identifies something specific. He asked for confirmation regarding use of the term "incentivize".
    - Mr. Chan noted that whereas the federal government uses IoMT it could require adherence to particular standards for interoperability.
    - Mr. Bergman pointed out that it was unusual for government to develop a protocol, which would normally be addressed by an industry SDO. Mr. Griffith concurred.
    - Mr. Chan stated that the default position should be leadership and development by industry and SDOs.
- Mr. Witte summarized that enabling recommendations 2.4.3 and 2.4.4 are both specific examples of encouraging interoperability of technology and/or data.

Enabling Recommendations 2.4.4 and 2.4.5

- Mr. Witte discussed both recommendations 2.4.4 and 2.4.5, saying they could be aligned with the preceding recommendations in a similar manner. He noted that while both are about interoperability, 2.4.5 emphasized standardized protocols to provide assurance of interoperability. He asked if these two should be combined?
    - Mr. Moss stated that 2.4.5 was developed with supply chain logistics in mind, whereas 2.4.4 is geared towards traceability. He agreed they could be combined ("take the best of both"). Mr. Katsioulas concurred.

Key Recommendation 2.5

- Mr. Witte discussed the key recommendation and noted that connectivity was a frequent topic related to infrastructure. He asked for input on the wording of key recommendation 2.5, noting that spectrum availability is a topic specially called out in the enabling legislation.

- Mr. Chan noted there is a similar recommendation in agriculture that is also connectivity related, and suggested they could be combined here and referenced from the agriculture section. He identified certain aspects, such as "last acre" connectivity and symmetric upload / download speeds, that are specific to agriculture and should remain in that section.

Enabling Recommendation 2.5.1

- Mr. Witte noted that it is specific to spectrum, both licensed and unlicensed.
  - Dr. Chandra discussed the need for more lower frequency spectrum with propagation characteristics appropriate for IoT. He noted that FCC "white space" rules regarding allocated spectrum that is unused in a particular area are restrictive, as are the power limitations put on use of unlicensed spectrum. Dr. Chandra took an action to propose revised working for recommendation 2.5.1.

Enabling Recommendation 2.5.2

- Mr. Witte discussed this recommendation saying it dovetails with 2.5.1 and the associated discussion. He noted this is a broad recommendation and that the IoT FWG had asked for more specifics and a stronger connection to IoT.
  - Mr. Chan took an action to contribute material to strengthen the connection.
  - Mr. Chan reported there is a study by USDA regarding the impact of 5G on precision agriculture, which quantified the economic value. He noted that there is also rural manufacturing that can benefit by access to broadband.
  - Mr. Witte ask for more information on how the lack of connectivity impacts IoT.
  - Mr. Chan explained that the lack of connectivity precludes the installation and operation of towers for wireless or cellular. He said that the lack of broadband in rural areas presents factories from developing smart manufacturing, which lowers their competitiveness. He added that current agricultural IoT applications only require low bandwidth but new applications like drone imagery and remote tractor control are bandwidth intensive.
  - Dr. Chandra added that precision agriculture depends on IoT connectivity.

Enabling Recommendation 2.5.3

- Mr. Chan suggested this recommendation regarding narrowband satellite adoption could be expanded to satellite broadband as well, noting that there are a new generation of lower orbit satellite broadband services coming online.
  - Dr. Chandra stated that broadband receives more investment than narrowband and advocated for keeping a requirement specific to narrowband satellite for IoT, based on the distinct use cases, lower usage costs for narrowband use, and its potential to connect IoT devices in very isolated locations. He said the use cases for narrowband satellite for IoT extend beyond agriculture and supports a distinct category of IoT devices.
  - Mr. Chan agreed with Dr. Chandra, noting that remote areas could include oceanic locations. He suggested rewording the recommendation to include IoT applications in rural, remote, and ocean areas. He pointed out that transmission line monitoring often takes place in very remote areas.
  - Mr. Witte asked for clarification on the language and whether "satellite IoT systems" was appropriate.

- Mr. Chan stated a better phrase would be "satellite for IoT applications" or "satellite-delivered connectivity services for IoT applications". He summarized that satellites could deliver connectivity where there are no terrestrial wireless services.
- Dr. Chandra explained that this connectivity can come from a hybrid of low earth orbit (LEO) and geosynchronous (GEO) satellite systems. He suggested the recommendation include innovated hybrid solutions that can provide connectivity everywhere.
- Mr. Witte noted the recommendation has very specific content and requested board members pay particular attention to the implementation considerations when reviewing this recommendation.

Theme: IoT Trust

- Mr. Witte moved the discussion to focus on trust recommendations, which he described as one of the largest areas. He said some of the trust content might take the place of policy areas discussed earlier.

Key Recommendation 3.1

- Mr. Witte asked for feedback and in particular whether "policy" was supposed to be included in the wording.
  - Ms. Reynolds pointed out that material she had provided with appropriate privacy wording did not appear in the report and offered to resend that content. She pointed to the Day 1 discussion about consolidating privacy-related material in the report.
  - Mr. Katsioulas stated the need to address both privacy and data confidentiality.
  - Mr. Witte stated the confidentiality material would be under cybersecurity.
  - Mr. Katsioulas clarified he was talking about the recommendation that was moved to become 2.1.2, to establish data policies that stimulate economic growth. A component of that is to allow data exchange between enterprises with a level of confidentiality controlled by the data producers. He characterized this as part of data trust.

Enabling Recommendation 3.1.1

- There was discussion on this recommendation which concluded that it was no longer needed based on other recommendations regarding a data taxonomy. Mr. Witte summarized:
  - Recommendation 3.1.1 will be addressed through a previous recommendation.
  - Recommendation 3.1.2 will be relocated to other privacy recommendations.

Enabling Recommendation 3.1.2

- Mr. Witte identified this recommendation for a IoT federal privacy policy framework and acknowledge is should probably be placed with the privacy recommendations.
  - Ms. Reynolds concurred with the wording in the draft, and that the focus is the processing and sharing of consumer data.

Enabling Recommendation 3.1.3

- Mr. Witte suggested recommendation 3.1.3 was no longer relevant.
  - Ms. Reynolds and Mr. Bergman concurred with 3.1.3's removal.

Enabling Recommendation 3.1.4

- Mr. Witte asked if recommendation 3.1.4, regarding automobile data sanitization, should move to the privacy section?
  - Ms. Reynolds confirmed that it should be moved.
  - Mr. Witte suggested the board may need to examine the level of granularity on recommendations. He noted that some recommendations are very detailed whereas other as much more general.
  - Ms. Reynolds stated she had a structure for presenting the privacy recommendations in her proposed recommendations.
  - Mr. Chan stated his expectation that the report will contain both "big picture" recommendations as well others that are more specific. He said it would be important to structure the report to not reduce the impact of "the big important recommendation". He stated that he and Mr. Caprio are working to ensure the visibility of such recommendations.
  - Mr. Witte asked if vehicles are a sanitization example for something that should apply to any IoT technology being resold by the government.
  - Ms. Reynolds stated she didn't want to dilute recommendation 3.1.4, describing it as very specific to automotive.
  - Mr. Katsioulas suggested a separate recommendation for device resetting that would fall under cybersecurity.

Enabling Recommendation 3.2.1

- Mr. Witte began a discussion on the plain language in IoT privacy policies.
  - Mr. Bergman and Ms. Reynolds agreed to remove Mr. Bergman's proposed addition of "advocate for the use of" in the recommendation language.
  - Ms. Reynolds and Mr. Bergman supported the proposal to add "in the private sector" to the recommendation discussion. Mr. Bergman stated that this can help drive change in the private sector.
  - Mr. Bergman clarified that the intent of the recommendation is for the government should require plain language in IoT privacy policies from vendors. Multiple board member concurred.
- Mr. Witte summarized that the recommendation is for the FAR to require providers of products and services to the government to follow the plain language requirements, with the expectation that a side effect will be to encourage general improvement in privacy policies and notices to use plain language more clearly understood by all of their customers.
- Ms. Megas noted that for enterprises their concerns would focus on loss of proprietary information, which is not a privacy concern.
  - Mr. Bergman acknowledged that calling out the FAR might be overkill but saw value in the government encouraging the use of plain language in the private sector.
  - Mr. Witte suggested there is still value in requiring plain language privacy documentation policies for products and services it acquires, which could help begin a change for consumer products.
  - Ms. Megas recalled that there has been consensus that privacy notices are for individuals, not related to the collection and use of enterprise data.
- Mr. Witte noted an action to revise this requirement while maintaining the intent for the government to encourage plain language IoT privacy policies in the public sector.

Enabling Recommendation 3.2.2

- Mr. Witte discussed this recommendation for the government to include IoT in proposed federal privacy regulations.

- Ms. Reynolds clarified that this recommendation complements the recommendation to establish the federal privacy regulation, adding that they should be presented together.

Enabling Recommendation 3.2.5

- Mr. Bergman pointed out wording specifying the U.S. Cyber Trust Mark and Ms. Reynolds responded that the preferred term for the board's report is "E-labeled".

Key Recommendation 3.3

- Mr. Witte discussed the recommendations under cybersecurity improvements and noted this had been generally accepted.

Enabling Recommendation 3.3.1

- Mr. Witte asked if the specific reference to promote the U.S. Cyber Trust Mark was appropriate?
  - Mr. Bergman concurred with the wording in the draft presented.

Enabling Recommendation 3.3.2

- Mr. Witte noted the earlier discussions suggested that "privacy" should be removed from the wording. He also pointed out that there is a significant volume of supporting language with specifics that still needs editing.
  - Ms. Reynolds, Mr. Bergman, and Mr. Katsioulas concurred with that change.
  - Mr. Witte added that the reference to NICE in the implementation considerations will be updated to the National Initiative for Improving Cybersecurity in Supply Chains (NIICS).

Enabling Recommendation 3.3.3

- Mr. Witte noted this recommendation is oriented toward IoT product developers.
  - Mr. Bergman recalled that there are requirements proposed in regulations and best practices for IoT developers to address known vulnerabilities before their products are released to the public but there isn't a good source for that information. He said that the developers at CISA have agreed it would be useful to develop a tool for this purpose.
  - Mr. Bergman added that the U.S. Cyber Trust Mark is considering whether vulnerabilities should be flagged to users, but the obstacle is that very few users register their products.

Enabling Recommendation 3.3.4

- Mr. Witte noted this requirement is specific and technical.
  - Mr. Griffith said the goal is to address places where the grid can't handle these technologies.
  - Mr. Chan described the original intent as to address the obstacles to deploying renewable energy technologies that integrate IoT. He cited an example of excess solar capacity in California that can't be consumed during daylight due to lack of demand, which could be addressed through additional transmission lines to distribute that power elsewhere, but currently discourages additional solar deployment. These barriers discourage the deployment of IoT-enabled systems.

Enabling Recommendation 3.3.5

- Mr. Bergman noted that recommendations 3.3.1, 3.3.5, 3.3.6, and 3.3.7 should be grouped together.

- Mr. Witte took an action to make that adjustment.

Enabling Recommendation 3.3.6

- Mr. Witte noted this recommendation has edits 'labeling' to 'certification'
- Mr. Bergman again noted that 3.3.5, 3.3.6, and 3.3.7 on same topic.

Enabling Recommendation 3.3.7

- Mr. Witte asked if support for smart retail should be an individual recommendation or added into the supporting text for other recommendations?
  - Mr. Witte clarified that drawing on above what do we want to apply for smart retail? Is that a necessary addition or should we have it in the text?
  - Mr. Chan described this recommendation as one of a set of recommendations from the SoT research that address specific industries and advocate eventual e-labeling for associated products offered for sale. He described cybersecurity as one common theme for the set, and cybersecurity-trained workforce as another theme. He noted that the workforce material could be relocated.
  - Mr. Bergman inquired whether applicable threat models have been identified. He pointed out that the payment card industry has a robust cybersecurity for IoT activity. He also noted that the Cyber Trust Mark is a "business to consumer awareness program" and that he'd anticipate a B2B program to be a separate certification program without an actual label. He also asked if the views of retail stakeholders had been sought.
  - Mr. Chan addressed Mr. Bergman's questions:
    - He referred to Steve Kelly's April 2023 presentation to the board[5]. He stated that Mr. Kelly had stated the consumer side of IoT cybersecurity is just the beginning and would be followed by industrial and enterprise needs. Mr. Chan said this recommendation follows on that information.
    - He said that SoT spoke with a retail analyst and heard that cybersecurity is raised as a concern in their annual survey of retailers.
    - He said there wasn't a specific threat model considered but note that the industry considers smart retail as a broad range of capabilities, including shopping apps on mobile devices.
  - Mr. Bergman suggested generalizing the first supporting bullet to advocate exploring ways to improve cybersecurity in smart retail, describing the Cyber Trust Mark program as a model to consider along with mobile app cybersecurity certification programs.
  - Mr. Griffith supported Mr. Bergman, saying the Cyber Trust Mark is an opportunity to educate consumers on the value of procuring more secure products, whereas he believes there are better approaches than a label for B2B situations. He advised caution on broadening the Cyber Trust Mark to other industries. He pointed to the example of the DOE sector, where there are applicable standards in use, saying it was unlikely there would be a labeling program there.
  - Mr. Bergman pointed out that Mr. Kelly is applying a very high-level national security perspective, and that approaches other than labels are better suited to non-consumer environments.

Enabling Recommendation 3.3.8

- Mr. Griffith suggested that the last bullet under recommendation 3.3.8 could be removed, citing uncertainty about the future of the legislation referenced there.

[5] Mr. Steve Kelly, National Security Council; see April 2023 IoTAB Meeting Minutes.

  - Mr. Bergman asked Mr. Griffith why the first bullet, regarding "existing standards" does not reference IEC 62443.
  - Mr. Griffith agreed that 62443 family of standards is widely used and could be added. He took an action to provide language to add it to the description.
- Mr. Witte used this recommendation as an example to ask the board's view on the balance of broad versus specific suggestions. He pointed out that specific examples draw attention to particular topics but also expand the number of recommendations although some of those recommendations may be brief.
  - Mr. Griffith stated specifically for recommendation 3.3.8 it makes sense to call out a widely used standard for the sector.

Key Recommendation 3.4

- Mr. Witte discussed the recommendations under privacy. He began with the key recommendation 3.4, for the government to address privacy-related concerns for IoT technology, which he described as providing an overarching, opening recommendation to connect other recommendations.
- He noted that, per earlier discussion, some of the privacy recommendations already discussed will be moved to this section using the privacy team's recommended order.

Enabling Recommendation 3.4.1

- Ms. Reynolds and Mr. Bergman concurred with the sense of the recommendation, but both emphasized that the phrase "using the "Cyber Trust Mark" as a guide" should not be broken apart and suggested moving that language into the implementation considerations rather than having it as part of the recommendation statement.
- Mr. Witte confirmed with Ms. Reynolds that "a privacy transparency system" was the correct wording.

Enabling Recommendation 3.4.2:

- Mr. Witte asked for clarification on what problem is trying to be solved with the recommendation.
  - Ms. Reynolds identified it as a barrier to adoption and a key cybersecurity issue around breaches.
  - She indicated there is an impact to the data on these devices and believes there are 2-3 things ongoing in the federal government today related.

Enabling Recommendation 3.4.3:

- Mr. Witte asked if Mr. Chan was advocating anything beyond the one above (3.4.2).
  - Mr. Chan clarified facilitate the use vs promote the use. He gave an example that within government facilities, different topologies Privacy Enhancing Technologies (PETs)[6] would need to be included. He clarified that the US Government should lead the way by doing.
  - Ms. Reynolds indicated the Biden Executive Order (EO) from November for the government to facilitate within the government and that it will influence the private sector from there.
- Mr. Witte asked for support for merging these two – Enabling Recommendations 3.4.2 and 3.4.3.
  - Ms. Reynolds and Mr. Chan agreed.

[6] Privacy-enhancing technologies (PET) are technologies that embody fundamental data protection principles by minimizing personal data use, maximizing data security, and empowering individuals. (Wikipedia)

Under both Enabling Recommendations 3.4.2 and 3.4.3 discussion continued on the topic of PETs.

- Mr. Bergman provided the language from the EO and wanted to discuss more about the definition of a PET. He indicated that we either have no definition or a highly specific technical definition. He wanted to know what do the agencies end up doing as a result of the recommendation.
  - Ms. Reynolds indicated that agencies may already be starting to adopt these PETs.
  - Mr. Bergmann asked about the value of synthetic data generation tools we are recommending.
  - Reynolds indicated that was one of many different types and that synthetic data replaces parts of identifiable data so people can do data analysis without creating privacy issues.
  - Mr. Bergman deferred to Ms. Reynolds, who was supportive of the recommendation.
  - There was a discussion on homomorphic encryption.

Enabling Recommendation 3.4.4:

- Mr. Witte asked about the connection of PETs to 3.4.4?
  - Ms. Reynolds clarified that there isn't a connection. She further explained that Privacy by Design (PbD) is not necessarily connected to PETs. PbD is a set of principles that is advocated for companies to use as they are developing or implementing tools. It is a set of principles that has been codified into some standards and is talked about in the privacy and standards arenas.
  - Mr. Witte indicated that the reference to PETs would be dropped.
  - Mr. Chan added in that privacy is sometimes an afterthought and these principles are a way to incorporate it into the design process.
  - Ms. Reynolds further clarified that this is technology agnostic, so take PETs out of this.

Editorial Discussion

- Mr. Witte clarified with the board that all of our recommendations should have a full sentence with a period, and Mr. Bergman agreed.

Enabling Recommendation 3.4.5

- Mr. Witte asked if there was a duplication with above?
  - Ms. Reynolds indicated there is not a duplication - one is private and one is government but they should be together.
  - Editorially, Mr. Bergman indicated to take out car, and replace with 'automobile'.

Enabling Recommendation 3.4.6

- Ms. Reynolds indicated that this recommendation would be updated.

Enabling Recommendation 3.4.7

- Ms. Reynolds indicated that this is the leading recommendation. Discussion was held between Ms. Reynolds and Mr. Bergman on whether the recommendation should stay as is, be removed, or be preceded by an earlier recommendation on the privacy policy framework (from previous meeting discussions).

- Mr. Bergman indicated that the policy framework should come before the regulation. He advocated a stronger recommendation if the two are tied together. And that it should not be in here if it's not consistent with the recommendation 3.1.2.
  - Ms. Reynolds disagreed and was in favor that they are separate.
- Mr. Chan indicated the discussion started with framework and settled on regulation.
  - Mr. Bergman continued that it would be an element of recommendation 3.1.2. Recommendation 3.1.7 should be consistent with the federal privacy framework.
- Mr. Bergman asked the board for their opinion.
  - Ms. Megas pointed out that the board did not have consensus and there will need to be more discussion on this one.
  - Mr. Witte indicated that the report is not final until its approved final. For now it can be noted for disparity and need the board to approve or disapprove the inclusion of the recommendations.
- Mr. Bergman clarified that the question is should they be made consistent with each other and if so, how.

Editorial Discussion

- Ms. Reynolds asked an editorial question: When you format the report are all of these recommendations going to be in these blue boxes?
  - Mr. Witte replied that yes, for each theme there is an objective. So there will be 6 blue boxes.

Theme: IoT Leadership / Government Capabilities

Enabling Recommendation 5.1.1

- Mr. Witte indicated this is speaking to the use of IoT by federal entities. The government should promote the use of IoT and use it in a responsible way. Asked whether should still say 'consider' before 'upgrading'?
  - Mr. Griffith talked about cybersecurity and their connected systems. He said there is available funding, and the recommendation is about leading by example.
  - Mr. Chan indicated there is a whole series of recommendations of the government leading by example. And then asked if they should be separated out or this one broadened to account for the different types for things they could do.
  - This issue was tabled until the next meeting.

Enabling Recommendation 5.1.2 (A/B)

- Mr. Witte asked for clarification on removing 5.1.2A since he thought he recalled a removal of the National Emerging Technologies Office.
  - Mr. Chan indicated that the board had agreed to remove.

Enabling Recommendation 5.1.3

- Mr. Witte asked if this also went away with the removal of the program office.
  - Mr. Chan confirmed the removal of this recommendation.

Update to the first heading under IoT / Government capabilities

- Mr. Chan indicated he thought the heading should be updated from "Establish Government Capabilities" to "Improved Government Adoption of IoT" to better clarify the section.
  - Mr. Witte made the update.

Enabling Recommendation 5.1.4

- Mr. Chan indicated that smart cities stalled because the cities do not have the expertise, especially smaller cities. Extension partnerships provide support and augment city capabilities. Idea is to follow similar model where the government has more established capabilities.

Enabling Recommendation 5.1.5

- Mr. Chan indicated that further discussion would be needed on this recommendation.

Enabling Recommendation 5.2.1

- Mr. Witte asked is there more IoT we can add to this one?
  - Mr. Griffith indicated he can add more IoT text.
  - Mr. Witte agreed on Mr. Chan's comment on combining federal use and fed advocacy.

Enabling Recommendation 5.2.2

- Discussion from Mr. Chan and Mr. Griffith on specifying federal considerations on how to use IoT on other projects.
  - Mr. Chan indicated the big influence in driving adoption and specifying opportunities.
  - Mr. Griffith pointed to the education piece to specify the outcomes you want to achieve and to let the technical community design solutions to meet that.
  - Mr. Witte liked the specification for inclusion and making it outcome based and not just throwing IoT at it.

Enabling Recommendation 5.3

- Mr. Witte indicated that this recommendation helps the government to re-evaluate its approach of thinking about new service models (e.g., regional sharing or extended funding) and asked if that was the goal?
  - Mr. Chan agreed based on conversations heard. He gave two examples one from talking with the Highway Engineering Exchange Program (HEEP) and the other with USDA.
    - In HEEP[7] it became clear that there were plenty of funding sources for project funds, but sustainable program funding is harder to come by. The states don't have the budgets. So, project funds help with the initial expenditure but funds dry up while the people who rely on the benefits of it lose out.
    - In the example of USDA it was asked what happens when the funds run out and the indication was the government just shuts it down. So, if it was broadband service, it just goes away.
  - Mr. Chan pointed out there is not a one size fits all and the government needs to consider the sustainability long term with their collective capabilities to funding.

Enabling Recommendation 5.3.1

[7] Highway Engineering Exchange Program (HEEP) - https://www.heep.org/

- Mr. Witte noted that this is the same as 5.3 and as a duplicate would be removed.

Enabling Recommendation 5.3.2

- Mr. Chan pointed out this was an early recommendation developed from a cybersecurity perspective and shifted to a workforce perspective. This was specific to cities but that it could be upleveled to cover additional areas of the economy since this exists where there is limited expertise and/or limited technical skills.
    - Mr. Witte agreed it could be general but that it was a candidate for removal simply because it's covered below in the report under the workforce theme.

Enabling Recommendation 5.3.4

- Mr. Witte indicated there was no disagreement on this one.
    - Mr. Chan indicated this was specific to transportation technologies and broadly speaking from an equity perspective. For example, one can't get an Uber in rural areas. There's not an economic base for people to build their business. This recommendation is a way to say don't forget about the underserved areas.
    - Mr. Witte asked if it could it be broadened to which Mr. Chan pointed out that it was early on specific to transportation technologies and that it could be expanded.
    - Mr. Griffith added in that could be one recommendation that could develop programs to allow these companies to get IoT technology in smart transportation, manufacturing, healthcare.

Key Recommendation 5.4

- Mr. Witte indicated this is just a heading for the specific ones that board members had proposed.

Enabling Recommendation 5.4.1

- Mr. Witte pointed out we could move this recommendation under the National Strategy recommendation because it is very agricultural specific.
    - Mr. Griffith pointed out that the board suggested changing the 'strategy' to 'approach' for this and keeping it separate.

Enabling Recommendation 5.4.3

- Mr. Witte started by indicating that this one was on generative AI applications but specific to agriculture. The discussion was on whether it should be pulled into its own higher-level recommendation or be kept here as-is.
    - Mr. Katsioulas commented that generative AI that comes from any piece of hardware/software in the supply chain is a huge issue that we should consider. There are both positive indications of accelerating adoption and negative indications of creating vulnerabilities that could be detrimental.
    - Dr. Chandra indicated that the board would need some examples just as they are indicated for this (agriculture) sector. There's a separate indication on regulating on positive/negative that is more about if you don't put in the right resources, the applications will never take off. Here you need to have the right incentives so the right industries adopt the right technology and applications.
    - Mr. Katsioulas agreed with Dr. Chandra and that there should be a general statement about generative AI that contains the different uses for different industries.

- The board decided to pull this recommendation out of agriculture and put into a more general AI recommendation with the addition of positive/negative indications.
    - Mr. Witte indicated that some of this could also go in the AI commentary section and Mr. Chan concluded with the opportunity to be bold in our recommendation here.

Enabling Recommendation 5.4.4

- Mr. Witte asked if there was a direct connection to drones?
    - Dr. Chandra indicated that there is. Drones are going to play a particular role in terms of scouting farms as well as with the application of chemicals. He pointed out that when talking about sustainable agriculture, drones have many benefits and provided examples.
        - Older way of site-specific application with tractors is more expensive.
        - You can send multiple drones in an organized fashion to different places on the farm for data collection or site-specific chemical spraying.
        - There are line-of-sight and non-line-of-sight drone scenarios. There are specific constraints associated with line-of-sight in terms of differences in geographical locations and a need to be able to see the drone and navigate it from afar. Also, there are constraints such as live feeds from the drone being stored and the protection of the data.
    - Mr. Chan also pointed out that drones have great utility beyond agriculture for public safety as well (including major benefits and labor savings). However, he pointed out that there is a bigger issue in that technology capabilities have far exceeded existing policies and regulations. Regulations are for steady state but the technology has matured beyond existing barriers and now we have existing regulations holding back the full capabilities of what can be done with drones.
        - Mr. Chan gave an example for beyond-line-of-sight from a discussion with Texas A&M where they have to go onto a military site where the regulations do not apply.
    - Mr. Chan indicated that in urban areas, line-of-sight is important. But in rural areas with thousands of acres, maybe it could be opened up a bit.
    - Mr. Katsioulas pointed out that cheap consumer drones are being used for warfare. So there is a national security issue. There is also a supply chain issue where the chips that you sell are used in foreign drones and this is well documented. So perhaps more here needs to be addressed.

Enabling Recommendation 5.4.5

- Mr. Chan pointed out that he added this recommendation as an equity issue.
    - Mr. Chan pointed out there are three bullet points but that the first two can be combined.
    - Dr. Chandra pointed out that we specify providing 100/100 Mbps in the middle of a farm and it's a much easier problem than to provide 25/3 Mbps to the house. If you can do 100/100 Mbps to the farm, then can definitely do 25/3 to the house.
    - Mr. Witte added that some additional justification could be incorporated from above on meeting the barriers in this recommendation as well.

Enabling Recommendation 5.4.6

- Mr. Chan pointed out the justification is a little different in this one from the one above.
    - Mr. Witte pointed out this would be a sector specific use case for the agriculture industry and asked a larger question – is this perceived duplication with just more specific use cases? Would it make sense to put it with the interoperability? Mr. Chan agreed.

- Mr. Witte emphasized that in this way we can say we had a dozen findings on agriculture and they combine under the umbrella of interoperability. We can then bundle up and include cross-references.

Enabling Recommendation 5.4.7

- Mr. Chan indicated that this is a general set. There are a number of recommendations for helping small businesses in adopting IoT because they have unique constraints. Maybe strategically for the report, we can consolidate these recommendations for small factory, small manufacturers, small retailers, etc.
  - Mr. Witte agreed and called attention to similar ones like 5.6.3, 5.5.3, 5.5.4 as all parallel. These would all support one broader one.

Enabling Recommendation 5.4.8

- Mr. Witte identified that all of the workforce ones should be the same. The use case examples would support the broader one.
  - Ms. Reynolds asked if there is a privacy recommendation in workforce?
  - Mr. Witte indicated in 6.1.3. Ms. Reynolds agreed that it should stay in workforce.

Enabling Recommendation 5.4.9

- Mr. Witte pointed out that 'right to repair' is an important one.
  - Mr. Chan added that states are doing their own right to repair laws and Apple recently announced parts for its equipment. So maybe it is spreading to other industries.
- Mr. Witte asked the board if there are parallels in other areas?
  - Mr. Griffith indicated that at NEMA it had been discussed but Mr. Griffith didn't have a good position on it outside of agriculture.
  - Ms. Reynolds pointed out that right to repair is a big issue in privacy around automobiles, data sanitization, and universal right to opt out - maybe these could be written in there.
  - Mr. Bergman pointed out that this has been debated for many years on the consumer side. And that there are pros/cons to both sides, but people only tend to see the consumer side. He gave an example of right to repair drafts that would have broken encryption of paid TV services. He pointed out that it is extremely contentious and would prefer the board does not step in this area generally but acknowledged that agriculture was a specific case.

Enabling Recommendation 5.4.10

- Discussion was on whether this recommendation might be conflating confidentiality and privacy and adjusting the language.
  - Mr. Chan indicated that we could link the two or make it a subset. The issue is that as these agriculture systems include IoT, the data they collect could be sold by the device manufacturers.
  - Mr. Witte followed up that this then is not about privacy but about proprietary information and could be revised.

Enabling Recommendation 5.4.11

- Mr. Witte asked if we may be able to link this to the extension partnership?

  - Mr. Chan agreed and added that Dr. Chandra had one on land grant universities hosting testbeds "Farms of the Future."

- Mr. Witte clarified so we should say in the land grant recommendation that we include these topics to increase awareness and education?
  - Mr. Chan indicated that we do need to include awareness of these IoT technologies. There are programs and ways the federal government can increase awareness of IoT. Where extension offices and "Farms of the Future" can be forms of dissemination providing education, awareness, and demos. He asked if there was a way to put them together such that the government could play a larger role in driving awareness through existing programs.

Key Recommendation 5.5 and Enabling Recommendations 5.5.1, 5.5.2, 5.5.3, 5.5.4

- Mr. Witte called attention to 5.5 as similar from a manufacturing perspective. As long as these are enabling bullets under the key recommendation this won't take up much space. They are the same, just sector by sector.
  - Mr. Chan noted he had added industry-specific content to the Manufacturing Extension Partnership (MEP) recommendation to the extent he was able.
  - Mr. Witte pointed out that the research is helpful.
  - Mr. Chan indicated could put the statistics in the findings there as well.

Enabling Recommendation 5.6.1

- Mr. Chan discussed the concept of 'Building Information Management' (BIM), explaining that the construction industry is still paper-based and IoT will not really be in use until the industry more digitized.
  - Mr. Witte described BIM potentially improving efficiency, reducing cost and perhaps improving safety.
  - Mr. Chan pointed out that the number one issue is quality control and clash detection.
  - Mr. Witte asked will it help the federal government to do monitoring over the federally funded projects? Mr. Chan said yes.

Enabling Recommendations 5.6.2 to 5.8

- In the interest of time, Mr. Witte skipped over 5.6.2, 5.6.3, 5.6.4 as they are similar considerations for the construction sector, 5.7 recommendations as they are for the insurance sector and 5.8 recommendations as they are for the retail sector.
  - Mr. Chan pointed out one that might be slightly different 5.8.1.

Enabling Recommendation 5.8.1

- Mr. Chan indicated this one is more of a research recommendation and doesn't have to just be for the retail sector. He noted that in retail, RFID is expensive. For a large store, could the cost of sensing be brought down lower, so that IoT may be better adopted?

Enabling Recommendation 5.8.2

- Mr. Chan indicated SoT spoke with a company that does retail consultancy and they believe that AI is completely transformational for the retail industry. Understanding usage of consumer buying patterns,

inventory/demand management where industry has suffered from low margins. The industry would need to use trustworthy AI.

- Mr. Witte pointed out that it also seems specifically focused on small business.

Enabling Recommendation 5.9.1

- Mr. Witte indicated these have been well received and speak to smart cities.
  - Mr. Witte asked about infrastructure reference models - is that still the term we are using?
  - Mr. Chan indicated it was.

Enabling Recommendation 5.9.2

- Mr. Chan indicated this is a general recommendation to find ways to facilitate adoption of IoT and equity of its benefits. For example, cities have received broadband grants and may have a way to leverage the infrastructure to build smart city applications on top of that to maximize the use of the broadband access.
  - Mr. Witte clarified that we are encouraging agencies to do this and examine opportunities?
  - Mr. Chan agreed here are some areas the federal agencies can facilitate.

Enabling Recommendation 5.9.3

- Mr. Witte made a brief comment that this was parallel for rural communities and Mr. Chan added that rural communities tend to get overlooked.

Enabling Recommendation 5.9.6

- Mr. Chan made a brief comment that small and medium cities tend to get shut out and have less abilities and needs than big cities that have larger funds.

Enabling Recommendation 5.9.7

- Mr. Witte made a brief comment about updating the recommendation.

Enabling Recommendation 5.9.8

- Mr. Witte made a comment for Ms. Reynolds to weigh in, asking if there are specific privacy concerns focused on smart cities?
  - Ms. Reynolds agreed there were.
  - Mr. Witte indicated that for this one we can leave this one here with a link saying, 'for more specific privacy recommendations see X part of the report.'

Enabling Recommendation 5.9.10

- Mr. Chan pointed out he thinks the federal government through global cities team challenge (GCTC) have been trying to foster collaboration between cities and industries and academia. GCTC has dropped off the map in the last two years and the board is indicating the program should be expanded.

Enabling Recommendation 5.10.1 (note: stockpile for public safety, report had a duplicate 5.10.1)

- Mr. Witte indicated there is a gap here. He mentioned a paper, '*Public Safety Internet of Things (IoT) Use Case Report and Assessment Attributes*' that Ms. Kahn forwarded that would be shared with the board. He asked for thoughts from the board on what's missing for public safety.
    - Mr. Bergman asked for clarification on what goes into a stockpile?
        - Mr. Chan stated that he would not like to advance this recommendation, saying the definition is lacking in substance and is not a sustainable or viable one.
        - Ms. Coughlin agreed with the comments from all.
    - The board agreed to consider the removal of this recommendation at the next meeting.
- Mr. Witte pointed out that everything we have talked about over the last two days deals with public safety.
    - Ms. Coughlin pointed out that the board could tell a story of how but specific recommendations are unclear.
    - Mr. Witte commented that while there may not be something specific, it helps us be safer every day.
    - Mr. Chan thought there were some recommendations that could be made such as spectrum for public safety and implementation of next generation 911 systems that could also adopt IoT. He indicated he is not a public safety expert, but there are pockets of opportunities. He mentioned that when Mr. Moore was here as a speaker he mentioned to Mr. Chan that he is working to secure $17 billion to facilitate an upgrade of 911 systems across the country.
    - Mr. Witte indicated this is a gap to fill but we need to finalize recommendations soon. If the gap can't be filled, then maybe we can just say a study needs to go into more specifics.
    - Ms. Coughlin indicated she will take an action item to collect more information and bring back to the board.

Enabling Recommendation 5.10.1 (IoMT enterprise priority, report had a duplicate 5.10.1)

- Mr. Bergman commented that the framing may not be right. He noted that it needed to be rephrased and suggested 'the government should use its influence to promote IoMT as an enterprise priority to healthcare facility executive teams'.
    - Mr. Witte asked if it should be healthcare executive leadership teams or healthcare stakeholders in general?
    - Mr. Bergmann pointed out that about the intent was leadership teams.
    - Mr. Chan agreed it starts from the leadership top down. He indicated he likes the word 'promote' but how do you promote it? It should be an enterprise priority.
- Mr. Witte asked if priority is the right word? Or are we just saying the government is not telling them what to do, just telling them it should be a priority?
    - Mr. Chan started by saying that the intent of IoMT is revolutionary and can give better patient care, so it should be a priority. But in the day to day running of a medical office it may not come up as a priority. The road to governance is very limited unless you pay them through Medicare and can drive those priorities.
    - Mr. Witte seems like something that can be added to the conversation. This is not talking about a policy but just that the government should take advantage of those conversations and promote it.

Enabling Recommendation 5.10-2

- Mr. Witte asked what the board thinks about this HIPAA recommendation? Is it already covered by HIPAA?
  - Ms. Reynolds added that she believes the intent was saying that data that is not part of a patient provider relationship even though it is of medical/health nature and is not covered by HIPAA. She stated that the intent is some type of protection of that data even if it's not part of patient provider situation, and pointed out that there is a law currently that could possibly cover this situation and is about breach of security. Companies that have consumer data that is outside of a patient provider relationship have certain penalties that would happen to them if that data was breached, but that only applies to a data breach situation. The gap is that the data need protection even if without a data breach.
  - Mr. Witte gave an updated example with a watch that is tracking a heartbeat which could resemble healthcare data on a consumer device. The issue Ms. Reynolds described then is the gap in the protection of the data that still exists even with the law illustrated because the law only provides coverage when there is a breach.
  - Mr. Bergmann wanted to know how to turn this into an action on the government side and thought it would be to add entities that collect medical data through IoT devices to the 'covered entities' list in HIPAA. He suggested HIPAA "covered entities" are "generally, health care clearinghouses, employer-sponsored health plans, health insurers, and medical service providers that engage in certain transactions" Mr. Bergman continued that you would make sure that for example, Fitbit, is covered.
  - Ms. Reynolds added that the word 'medical' is problematic. It may need to be 'health' because that's a broader category. Medical is covered by HIPAA.
  - Mr. Bergmann asked if 'protected health information' is a key phrase in HIPAA?
  - Ms. Reynolds it is, but it straddles HIPAA and this other law that covers breaches in security. She added that heartbeat data on the watch is considered health data but is not covered by HIPAA. It is only covered by consumer laws and there are gaps based on laws in local jurisdictions.
  - Mr. Bergman suggested to extend HIPAA to include entities that collect what would amount to protected health information if it were in the context of HIPAA already. Organizations that collect HIPAA protected information from devices prior to transmitting it to the current covered entities.
  - Ms. Reynolds indicated that the problem here is HIPAA because this data not covered. From the example, Fitbit is health data and that data is not covered by HIPAA.

- Mr. Witte suggested that the report could ask the government to research ways in which private health-related information is being gathered, collected, stored, and used, and is not under the same protection levels HIPAA data would be. If data was provided to a doctor, it becomes protected health information (PHI) protected by HIPAA, but if a user is using data to improve health, it is not. The board could recommend that the government research this disparity and address any needs that are found.
  - Ms. Reynolds and Mr. Bergmann both agreed.
  - Ms. Reynolds suggested changing the term it from 'medical' to 'health' information.

Mr. Witte paused the current report to bring up new healthcare recommendations provided in a separate document titled '*IOTAB SoT healthcare recommendations*'. Healthcare (HC) recommendations refer to recommendations in that document.

Recommendation HC1

- Mr. Witte indicated this would go into interoperability. This one is more specific but facilitate cybersecurity in IoT and smart medical devices. Should the report say medical or health related?
  - Mr. Chan commented that the report should say health related.

Recommendation HC2

- Mr. Griffith would strike the first bullet. They are heavily regulated by the FDA.
  - Mr. Bergman added that last year's appropriations gave the FDA new power to regulate anything in consumer wearables.
  - Mr. Witte indicated that bullet will be removed.

Recommendation HC3

- Mr. Chan indicated that here the government through programs (e.g., Veteran's Administration, Medicare) could specify the use of IoT devices that is in their control. This could help drive adoption.
  - Mr. Chan indicated the benefit is to reduce overall healthcare expenditures, improve patient outcomes, provide better access to healthcare in rural areas.

Recommendation HC4

- Mr. Chan indicated this recommendation ties into privacy and it doesn't need to be a recommendation as long as it is covered earlier.
  - Mr. Witte asked if there is a way to phrase it better? And offered 'facilitate privacy protections in medical and healthcare IoT' which was accepted.

Enabling Recommendation HC8

- Mr. Chan identified three components: research, data privacy, and workforce.
  - Ms. Reynolds advocated for a high-level recommendation about facilitating the adoption of AI that could be an umbrella for other AI ones.

Enabling Recommendation 5.11 (returning to the draft board report under discussion)

- Mr. Chan recalled that air quality is collected from devices and should be integrated.
  - Dr. Shehabi agreed and said the idea was to have a repository for data to be collected and shared around environmental monitoring.
  - Mr. Witte clarified that we say promote open sharing and availability and that is different from establishing – so is it both?
  - Dr. Shehabi indicated that open availability with the repository would be one way to promote availability of data.

Enabling Recommendation 5.11.2

- Mr. Witte identified the focus on sensors and asked do we want to call for more types of monitoring or other types of sensors?
  - Dr. Shehabi indicated that EPA air quality sensors are very sophisticated vs IoT ones that are cheap but not as accurate. He identified an opportunity for those complex EPA devices to help calibrate the lower cost IoT sensors. The board was not aware of other types of complex equipment that is widely dispersed by a federal agency. Air quality could be an example.

Enabling Recommendation 5.11.3

- Mr. Witte asked if this one could be included as an example in the connectivity recommendation.
  - Mr. Chan agreed

Enabling Recommendation 5.11

- Mr. Witte pointed out this is another stockpile recommendation, and asked if it should be kept?
  - Dr. Shehabi indicated that this was a result of brainstorming. He asked if the concept is something that we could use somewhere else, for example, being able to use IoT during catastrophic events?
  - Mr. Witte added that we could add prose in recommendation 5.11.2 to suggest researching ways to quickly deploy equipment such as using a stockpile.
  - The board agreed to the idea.

Enabling Recommendation 5.11.7

- Mr. Chan explained the addition by reading the prose of the recommendation. There were no changes.

Enabling Recommendation 5.12.2

- Mr. Griffith pointed out that there is a new recommendation on ultra-wide band.
  - The recommendation here is to have the FCC revisit this regulation.
- Mr. Bergman asked if this is DRC?
  - Mr. Griffith indicated that he is familiar with the 5.9 GHz band.
  - Mr. Bergman pointed out we should revisit this after doing some research on this and making sure this information is consistent. He added there is an ultra-wide band regulation and would have to look into it more.
  - Mr. Chan pointed out an action item for Mr. Bergmann and Mr. Griffith to clarify this recommendation.

Discussion on Remaining Recommendations

- Mr. Witte noted the new recommendations in 5.16 on future state and recommendations in 6.1 on workforce need further board discussion.
- Mr. Witte asked the board to review Supply Chain, international, and Small Business sections of the report.
- Mr. Witte asked the board to formalize decisions indicated during the discussion.
- The board decided on the removal of the following recommendations:
  - Removal of the Emerging Technology recommendation, 5.1.2A? Yes.
  - No longer recommending a Nat Emerging Tech office? Agreed
  - Recommendation 5.2.2B? Yes.
  - Recommendation 5.1.3? Yes.
  - Recommendation 5.1.4? No, this will remain.

Open Action Item Review

Mr. Chan

- Mr. Chan pointed out the need to discuss the timeline. He pointed to the meeting in January and asked what our delivery time looks like now.
  - Ms. Cuthill pointed out that there will be substantial revisions in January to discuss. She pointed out the work that the board has accomplished and looking at where we are, there are a number of recommendations in flux.
  - Mr. Witte clarified to Ms. Cuthill's questions on timeline that there will be a draft by the end of December and comment is needed back by Jan 12 (for the IoTAB Jan 23 meeting).
- Ms. Cuthill identified that the board will still have some final work to do and a February meeting is needed to get to the final edits and formal approval of the final text. This would be looking at a March delivery.
  - Mr. Bergman asked for an updated schedule with assumptions.
  - He also pointed out there could be a potential government shutdown on January 19 and so all work needs to be teed up prior to any potential shutdown.
  - Mr. Witte noted there are specific people asked to review material in the report; if those reviews can be returned by December 22, then an update can be published by December 29.
- Mr. Chan indicated that action items would be finalized with Mr. Witte and followed up after the meeting.

Closing

Barbara Cuthill adjourned the meeting at 5:02 pm.