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FY16 ANALYSIS REPORT: FINANCIAL SYSTEMS' DEPENDENCY ON COMMUNICATIONS

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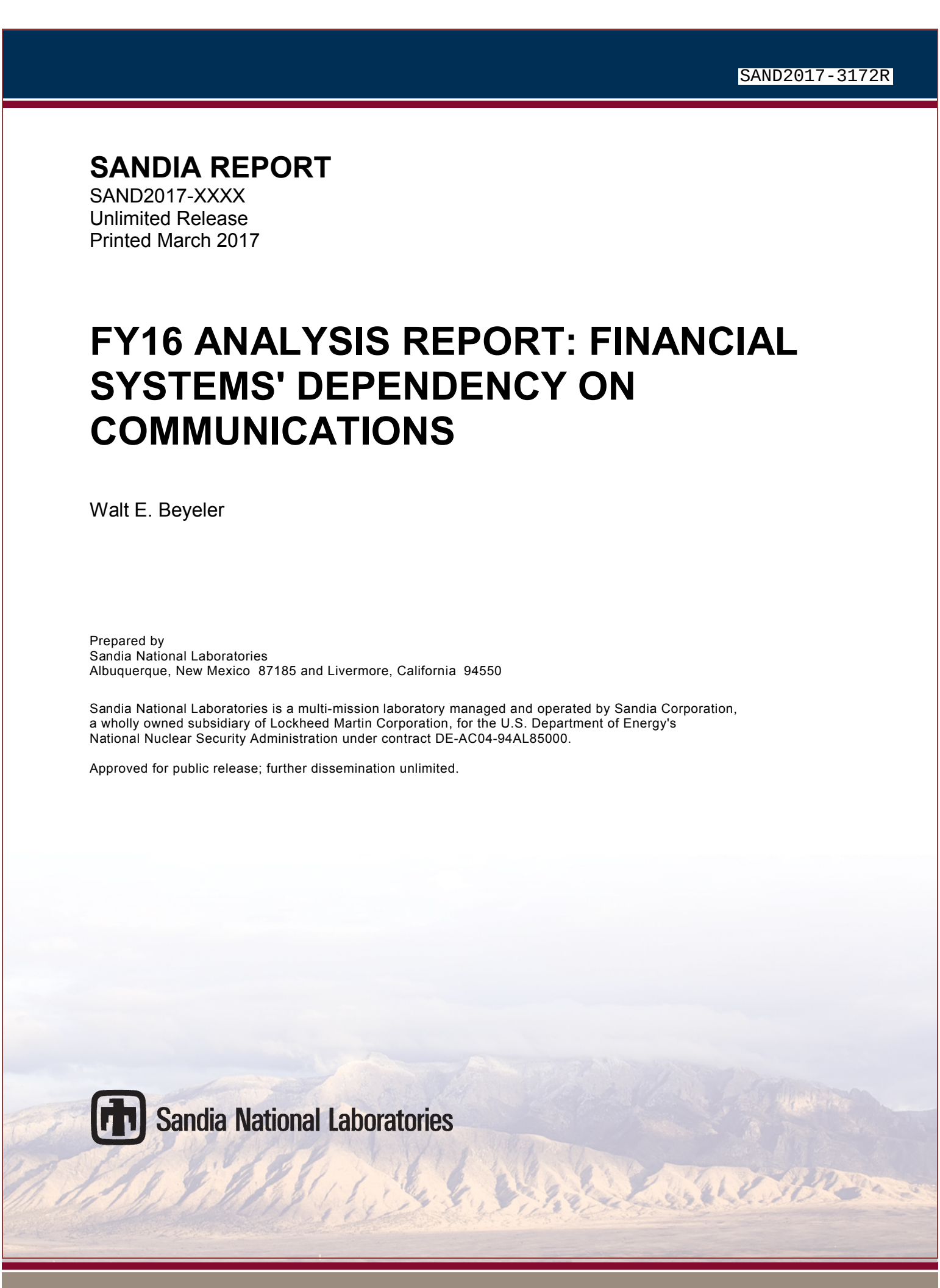

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Abstract

Within the Department of Homeland Security (DHS), the Office of Cyber and Infrastructure Analysis (OCIA)'s National Infrastructure Simulation and Analysis Center (NISAC) develops capabilities to support the DHS mission and the resilience of the Nation's critical infrastructure. At Sandia National Laboratories, under DHS/OCIA direction, NISAC is developing models of financial sector dependence on communications. This capability is designed to improve DHS's ability to assess potential impacts of communication disruptions to major financial services and the effectiveness of possible mitigations. This report summarizes findings and recommendations from the application of that capability as part of the FY2016 NISAC program plan.

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We would like to thank Brian Tishuk of ChicagoFirst for his help in organizing our interactions with financial firms, as well as the anonymous representatives of those firms who contributed their time and ideas to our work.

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NOMENCLATURE

DHS	Department of Homeland Security
ICE	Intercontinental Exchange
NASDAQ	National Association of Securities Dealers Automated Quotations
NISAC	National Infrastructure Simulation and Analysis Center
S&P	Standard and Poor's
SNL	Sandia National Laboratories
STIM	Securities Trading Infrastructure Model

1. LONG-TERM GOAL

The long-term goal for this capability is to assess the potential for high-consequence disruptions to the financial system from accidental or deliberate disruption to communication infrastructure by mapping and characterizing information flows associated with trade processing under ordinary and disrupted conditions. Analysis of information network topology may suggest an investigation of disruption scenarios for their potential systemic impact. NISAC has developed a set of modeling tools to support consequence assessments of this kind.

Modern finance depends on the integrated operation of many markets that trade securities, commodities, currencies, and an ever-increasing number of derived financial products. Financial markets must be reliably accessible to traders, and they depend on clearance and settlement systems to process millions of negotiated transactions daily. The financial system has mature processes to manage numerous risks associated with system component failures, including operational failures that might impede trading. While firms may have protections against localized service disruptions, which often occur, they may not have protections against disruptions that have not occurred and may concurrently affect many non-localized institutions or services.

Seemingly disparate communication pathways can overlap to create common modes of failure across otherwise independent systems, raising the likelihood of concurrent function loss from disruption of a single communications node. Many firms try to manage communications reliability by contracting their services from dominant providers. These providers often share large collocation facilities, which provides them with economies of scale as well as interconnection opportunities, at the same time creating cross-provider concentrations of communications flow. This creates a dilemma for consumers of communications services such as financial firms: reducing institutional risk by contracting with established providers tends to create common-failure-mode risk through the tendency of providers to co-locate. Analysis of the topologies of a firm's information flow pathways can help them understand and manage this risk. Assessing mitigation strategies requires a capability to model and assess these information flows and underlying communications system dependencies. Estimation of possible consequences of disruption to individual firms and to markets can help prioritize mitigations.

2. OVERVIEW

The Financial Services Sector depends on reliable communications to conduct and coordinate essential functions. A deliberate or accidental communications disruption could have significant consequences for this sector. Through work associated with this sector in previous years, NISAC established partnerships with financial service providers and examined the workings of the retail payment system and financial markets. This analysis uses accumulated knowledge and developed models to estimate possible disruption consequences to financial firms with a significant presence in Chicago. NISAC analysts collected information about internal processes, dependencies on external service providers, and network connectivity from three providers of core market services. Analysts reviewed this information to identify potential chokepoints in the firms' network connections, and to develop recommendations for managing risks arising from common dependencies on external network assets.

3. BACKGROUND

In FY2014, NISAC held discussions with industry contacts regarding basic business processes, dependencies on intra- and inter-firm information flows, and external disruptions of most concern. These discussions were initiated through the cooperation of ChicagoFirst and selected member firms. These discussions provided basic insights into dependencies, and some initial information regarding network connectivity. They also identified continuous access to timely market data as essential for many derivative pricing and portfolio management operations.

NISAC combined process information obtained from these contacts with existing modeling tools to create a Securities Trading Infrastructure Model (STIM), which incorporates basic trader behavior and couples it with trade-matching algorithms to simulate execution of a trade. It also includes clearing and settlement of trades and the information flows required for operation of the business layer to operate. This allows NISAC to model the operations of the financial market and to overlay them on infrastructure assets to analyze the consequences of asset disruption on financial market activity, should such disruptions block crucial information flows.

In FY2015, NISAC analysts sought further engagement with established industry contacts to supplement information obtained in FY2014 about their data network connections and data service providers. Two of the three firms were able to provide answers to very specific questions about their systems; however, this input was not obtained from the third firm. Delays in obtaining industry data limited the scope of possible analyses. Given the expressed importance of timely market information, NISAC's analysis focused on the possibility of concurrent connectivity loss to each of the data providers identified by the two securities firms. Possible data pathways between firms and providers were identified to pinpoint any common assets.
In FY2016, NISAC analysts again sought network data from the third firm, but were unable to obtain the information needed to assess their external network dependencies, or any common dependencies involving them and the other two firms.

4. ANALYSIS

Network data provided by two of the three firms were analyzed to discover possible chokepoints for intra-business information flow. Because network information from two of the three contact firms was available, some evaluation of common dependencies among inter-firm information flows was possible. Given the geographic distribution of company data centers and their associated providers, and likely traffic routes, NISAC analysts found no points of constriction in intra-firm data traffic that could be ameliorated by diversifying carriers or routes. However, since likely routes may change due to changes in the status of various parts of the network, firms should take additional actions discussed in the recommendation section to ensure that routes continue to be diverse.

Market data providers are important suppliers, and timely access to market data is important for product pricing and account management. The firms that NISAC contacted maintain supply diversity by contracting with multiple services. Thompson/Reuters, Bloomberg, Dow Jones, ICE, and S&P are common suppliers. NISAC analysts were provided with some information about connections between our industry contacts and these firms; however, NISAC analysts were unable to obtain that information for all of the firms contacted, nor were we able to investigate the topology of those firms' networks, both of which are required to assess the degree of network redundancy secured by having diverse suppliers.

NISAC analysts found information on connection points to some market data suppliers online—for example, NASDAQ[1] and the ICE's Secure Financial Transaction Infrastructure[2]. These suggest plausible connection points for Chicago-based operations, such as the Equinix CH4 facility, and these connection points might constitute a common point-of-failure. However, this is conjectural. A technically defensible identification of possible points of common dependency would require a better understanding of the degree of redundancy in the information available from market data providers with respect to the needs of each firm. This would greatly benefit from a description of the provider firms' networks.

Because no scenarios involving concurrent disruption of information flows were identified, consequence estimates were not conducted.

5. RECOMMENDATIONS

Based on the understanding of business practices and network connectivity provided by industry contacts, NISAC analysts identified no obvious vulnerability associated with data network topology. This result, however, is based on incomplete information from one of the three firms NISAC contacted, and was not drawn from network information about market data providers or other key service providers. Network providers and connection points may have changed since the inception of this analysis, and they can be expected to continually adapt in response to the evolution of providers' technology and offerings. For these reasons, NISAC analysts can make

[1] https://www.nasdaqtrader.com/TraderNews.aspx?id=OTA2015-10
[2] http://www.nyxdata.com/doc/243266

some general recommendations for guarding against dependencies on common assets both within and among firms:

- Periodic packet route tracing can be conducted and analyzed to insure that firms are seeing the path diversity they have negotiated with suppliers.

- Contracts with providers can encourage or require route diversity for a single firm's traffic. Insuring some redundancy among a set of firms is more difficult due to the firms' need to protect information about their data service providers and interconnections. Network providers can, however, be encouraged to separate traffic among a set of firms if they happen to provide services for those firms. This stipulation protects the proprietary interests of both network customers and providers

.

6. FOLLOW-ON ANALYSES

The current analysis, which focused on firms with significant presence in Chicago, could be expanded to include all major participants in financial asset markets. Industry contacts consistently emphasized the irrelevance of geography in establishing the boundaries of the financial system. Extension to the New York operations of industry partners contacted during this project would strengthen collaboration and the technical quality of the analysis.

NISAC has found more success in dealing with the firms individually than in relying on an industry consortium to coordinate interactions. This is likely due to the logistical difficulty of coordinating a single meeting among four organizations compared to scheduling three independent conference calls. The latter strategy eventually produced detailed information from two of the three firms.

A specific focus on market data provider networks would be useful. They are critical suppliers to the firms NISAC engaged and to the financial industry in general. NISAC learned of occasional loss of access to individual providers, which was mitigated by supply redundancy. Given that market data providers all require timely access to trade data from major markets, some common assets in their information networks can be expected. The conjunction of the potential for common points of failure in information networks, and the widespread use of these services, suggests that an analysis would be worthwhile.

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