Center for Networking and Information Security

De La Salle Univeristy, Philippines

De La Salle University

Manila, Philippines

“A leading learner-centered and research University bridging faith and scholarship, attuned to a sustainable Earth, an in the service of Church and society, especially the poor and marginalized.”

- ❑A private, comprehensive, non-stock/non-profit Catholic university founded in 1911
- ❑Ranked **1st among PH HEIs** in number of Scopus-indexed publications in 2021
- ❑**660+%** research output growth in 2010-2019
- ❑Times Higher Education (THE) World Ranking **1001+**
- ❑THE Emerging Economies Ranking **351+**
- ❑THE Asia Ranking **301+**
- ❑THE Impact Ranking **601+**
- ❑THE Subject Ranking (Phys. Sci.) **601+**
- ❑THE Subject Ranking (Soc. Sci.) **601+**
- ❑THE Subject Ranking (Eng. & Tech.) **601+**
- ❑THE Subject Ranking (Comp. Sci.) **601+**
- ❑THE Subject Ranking (Bus. & Eco.) **601+**

Advanced Research Institute for Informatics, Computing and Networking

- innovative world-class scientific research in computing towards the vision of a research DLSU

- set the directions and priority research activities in the various fields of computing, commissioning and encouraging research and development projects consistent with identified thrusts and priorities

- seeking collaborative ventures with partners in industry, government and academe to serve society through research.

Advanced Research Institute for Informatics, Computing and Networking

- Center for Human-Computing Innovations (CeHCI)
- Center for Language Technologies (CeLT)
- Technology, Education, Entertainment, Empathy, Design (TE3D)
- Graphics, Animation, Multimedia and Entertainment Laboratory (GAME Lab)
- Center for Automation Research (CAR)
- **Center for Networking and Information Security (CNIS)**
- Center for Complexity and Emerging Technologies (COMET)
- Center for ICT for Development (CITE4D)
- Bioinformatics Laboratory
- Center for Computational Imaging and Visual Innovations (CIVI)

CNIS Research Areas

The Center for Networking and Information Security (CNIS) follows a multi-disciplinary approach in solving complex communication problems and information security issued relating to the future of computers and communications.

CNIS focuses its research on various domains:

- **Traditional and programmable networks,**
- **Wireless sensor networks**
- **Network and information security**
- **Distributed systems**

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CNIS - Members

Center Head:

Marnel Peradilla (Mobility Management, WSN, SDN, Blockchain)

Ph.D. Students

- Fritz Flores (NDN)
- Gregory Cu (IoT Security and Privacy)
- Arlyn Ong (Context-Awareness)
- Kaye Solomon (Big Data Privacy)

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Past Undergraduate Thesis Projects

- A comprehensive review and performance evaluation of modern lossless compression algorithms for real-time WSNs
- An API for Secure Sharing of Immunization Records in a Public Blockchain
- Implementation of Double Voting Prevention Algorithm on Smart Contracts for E-voting Blockchain Applications
- A Symmetric Key Distribution Protocol Utilizing Network Steganography
- Implementation and Modification of a Lightweight Authenticationand Key Management Scheme for Wireless Sensor Networks
- Firewall Implementation in a Software-Defined Networking Environment
- Remote Configuration of Wireless Sensor and Actuator Network
- Interoperable System with Authentication and Authorization for IoT
- Mobility Management Services with NAT Traversal solutions for Private Mobile Nodes
- Entropy-Based Detection and Mitigation Against DDoS Attacks over SDN Network Environment
- Network Traffic Analysis Through Visualization
- IoT Stored: IoT Storage Redundancy and Balancing of Data
- Priority Based Routing In A Software Defined Network Environment
- Bandwidth Management Service for Group-Based Wireless Devices in Software Defined Networks
- Selective Packet Encryption Scheme For Video Streaming
- Implementation of Context-Sensitive Prioritization of Data Traffic in a Typical Smart Home Using SDN
- Automated Gateway Selection and Load Balancing (GLOBAL EMS)
- Securing the AODV Routing Protocol in Mobile Ad Hoc Networks
- Emergency Messaging System for Crisis and Natural Disaster
- Adaptive Packet Compression For Wide Area Network Using Machine Learning Technique
- Ad Hoc Routing and Synchronization Protocol for IoT Advertising
- Low Cost Long Range Asset Tag using ESP8266

Research Projects

Intelligent Structural Health Monitoring via a Mesh of Tremor Sensors (meSHM)

Dr. M. Peradilla, Dr. A. Azcarraga, C. Ong, F. Flores, Dr. L. Garciano

DOST-PCIEERD. February 2021- February 2024

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Background

1. Metro Manila as a Megacity
    a. **Life-line Systems** (high-rise, elevated rails, skyway, etc)
    b. Large **vertical and horizontal structures**
    c. Other **metropolitan areas** and cities around the country

2. Metro Manila is exposed to four major seismic generators including the West Valley Fault (WVF)
    a. Structures are **used by hundreds of thousands of people everyday**
    b. **Ambient vibration (or micro-tremors)** that continuously put pressure to the structures
    c. Over time these tremors may **lead to structural degradation**

3. Structural Defects
    a. May be caused by **unforeseen weather, environmental conditions,** or even **seismic activities**
    b. May be due to the **structures weakening over time**

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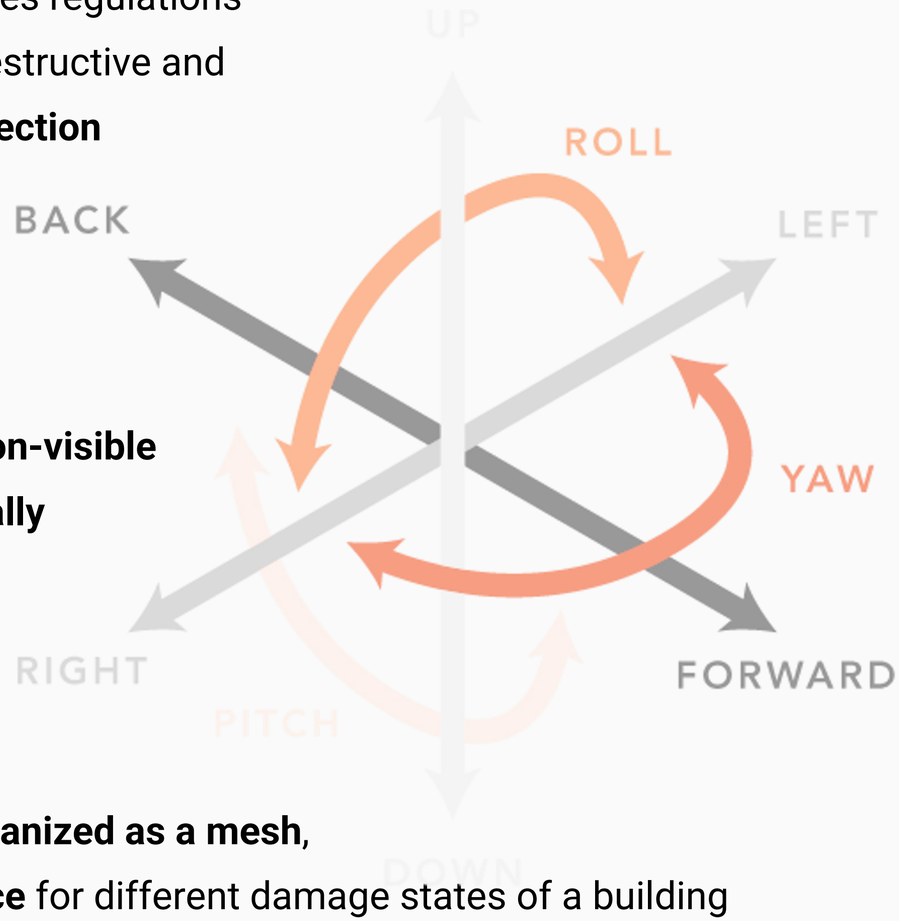
Background (cont)

4. Stringent building code
   a. The National Structural Code is mostly based on the strict United States regulations
   b. **Periodic structural inspection,** focusing on visual observation, non-destructive and destructive test, are **limited to the duration and frequency of the inspection**

5. Periodic inspection
   a. May have **difficulty inspecting a structure if it is continuously being used** throughout the day
   b. **Human inspection** may become **tedious** and **difficult** especially for **non-visible defects**, including small or occluded, which are **tough to inspect visually**



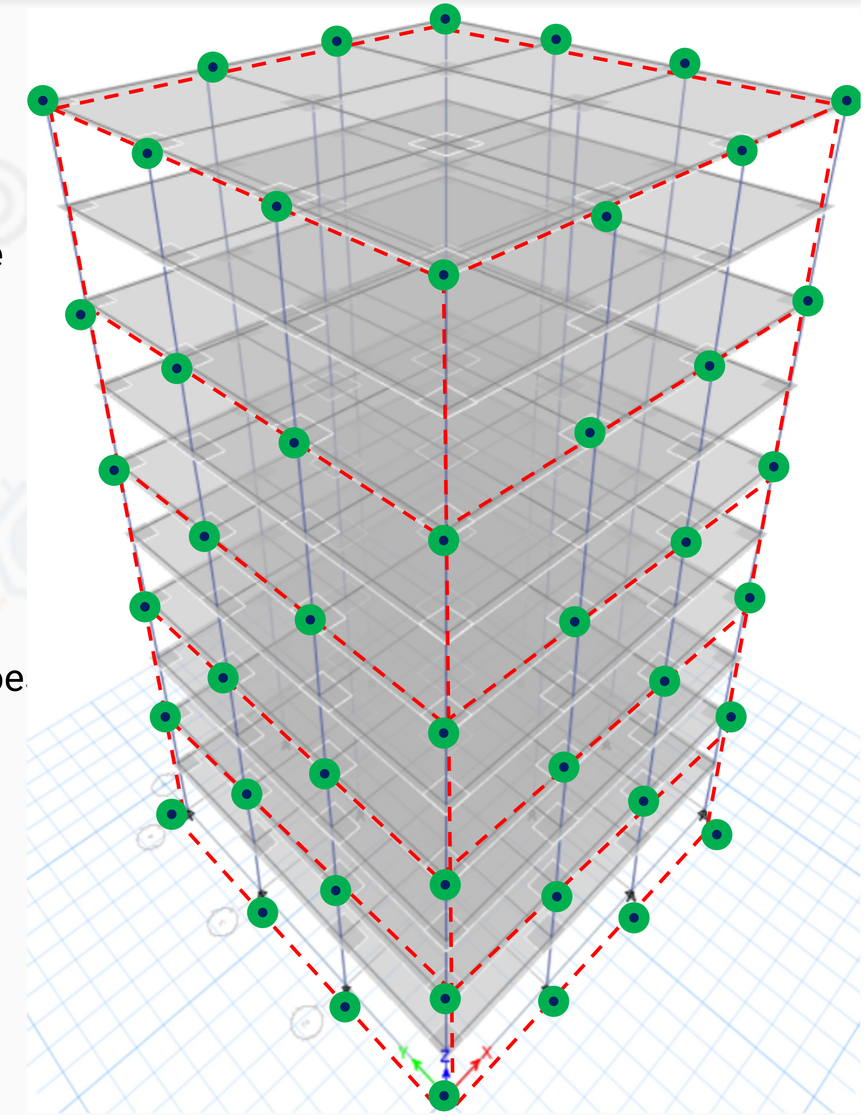
6. One solution is to use accelerographs
   a. **High accuracy industry grade** accelerographs tend to be **expensive** and are limited at specific floor level/s only (1-3 per building)
   b. meSHM's alternative solution is to use multiple **low-cost sensors**, **organized as a mesh**, that can **envelope a building** to provide **more data** and **better inference** for different damage states of a building

Background (cont)

6. Sensor Mesh
    a. Overcomes the reduced accuracy of the low-cost sensors by **depending on the relative signals** of the **multiple adjacent nodes**
    b. Provide **continuous** reading and monitoring for over a **long period of time**
    c. May **detect possible asymmetries** in the vibration, indicative of **localized structural defect**, by comparing signals from sensors on different floors

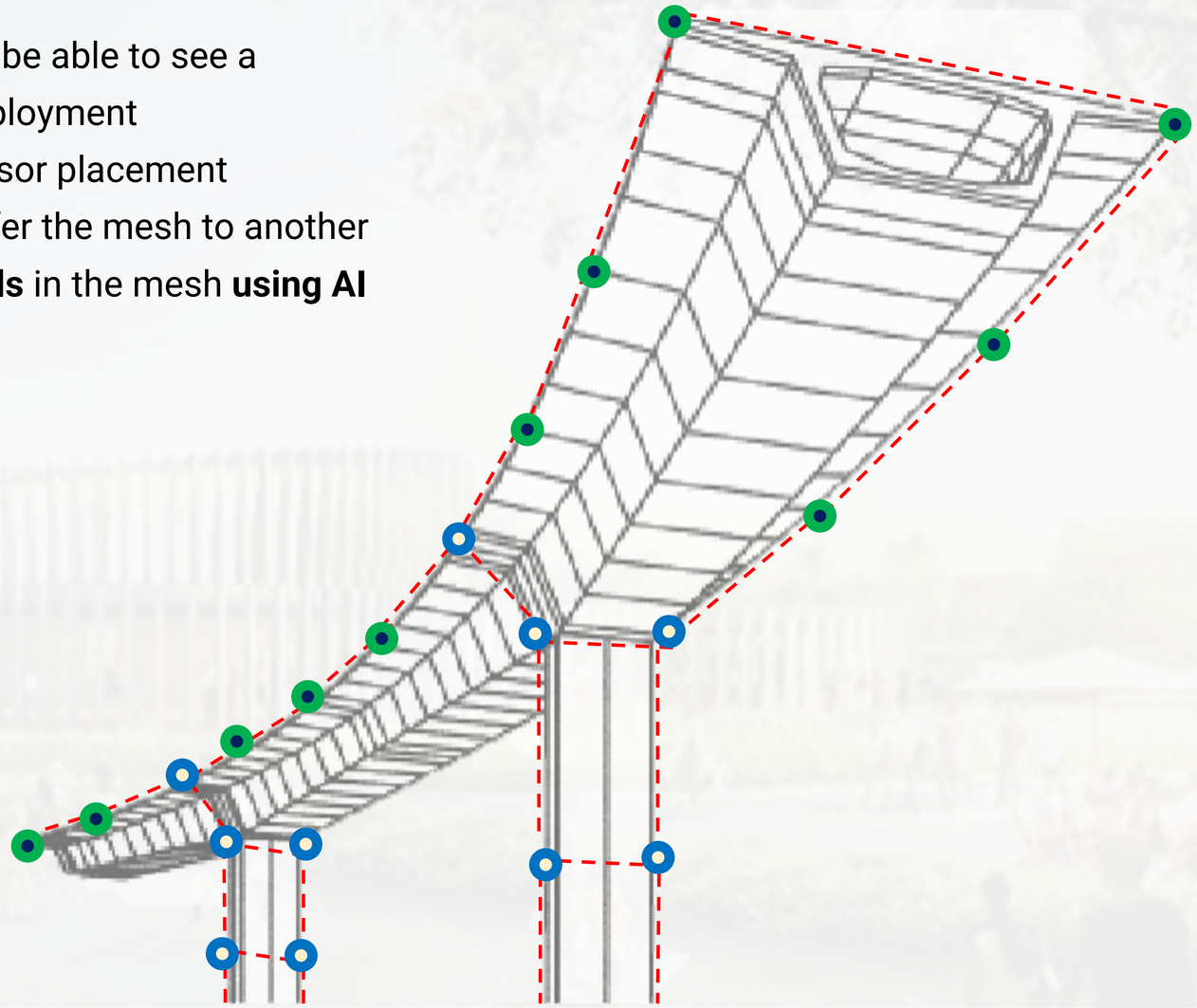
7. Without a localized means of detecting structural defects
    a. Need to implement **blanket reinforcement** instead of focusing **on reinforcing hotspots** or specific areas in a structure that **has a defect**
    b. May **not be cost effective** if an area is structurally sound but still undergoes reinforcement

8. Detecting localized structural defect
    a. Allows **prioritization**, to **focus on more critical areas** to reinforce first
    b. **Save time** from inspecting areas in a structure which are still stable



Background (cont)

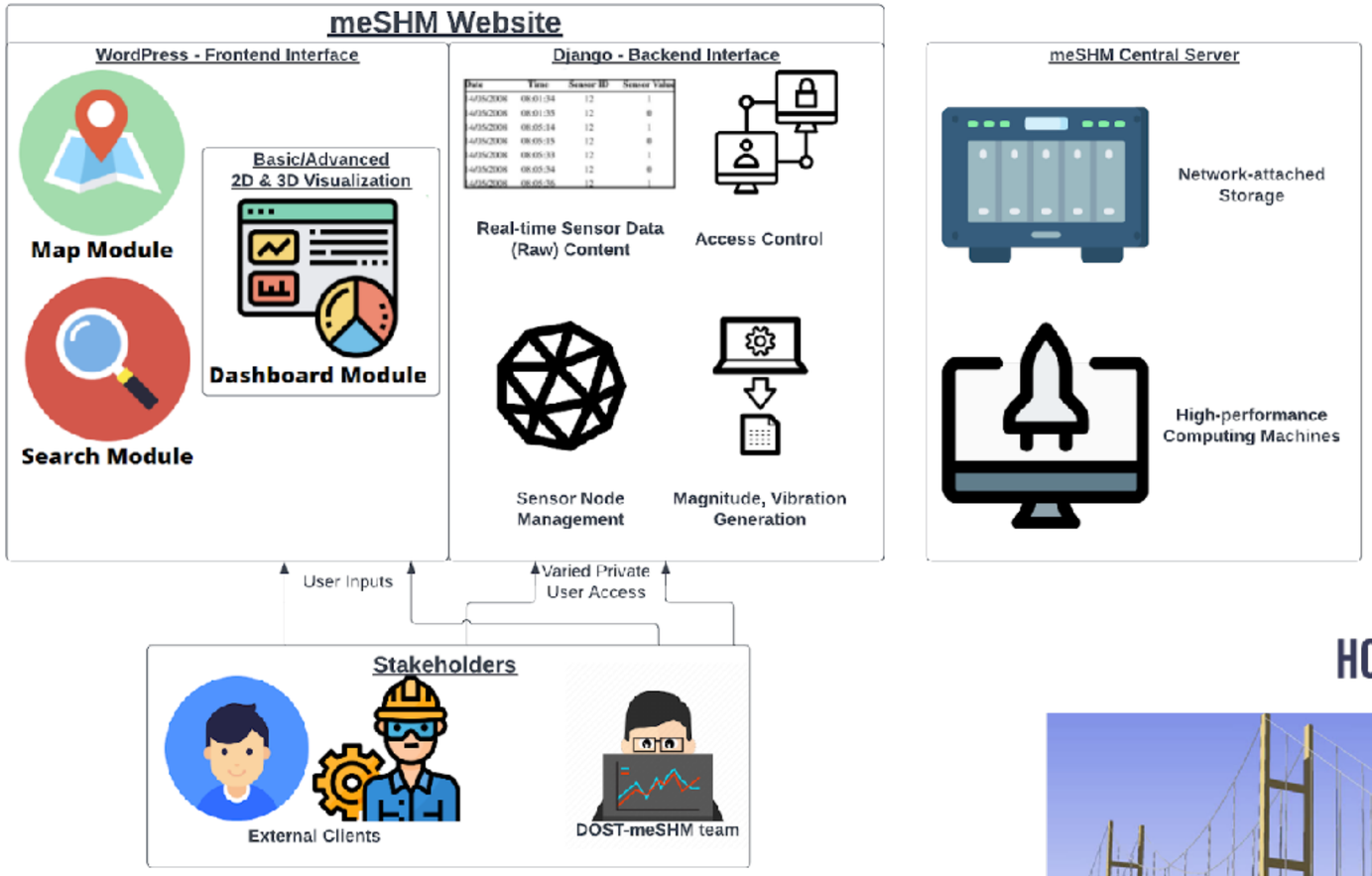
9. meSHM's idea
    a. Design **low cost multi-sensor nodes** which are to be able to see a vibration wave travel throughout the structure deployment
    b. Allow **ease in deployment** and **mobility** in the sensor placement
    c. Wrap a structure for a month, analyze, then transfer the mesh to another
    d. **Detect structural defects** based on **relative signals** in the mesh **using AI**



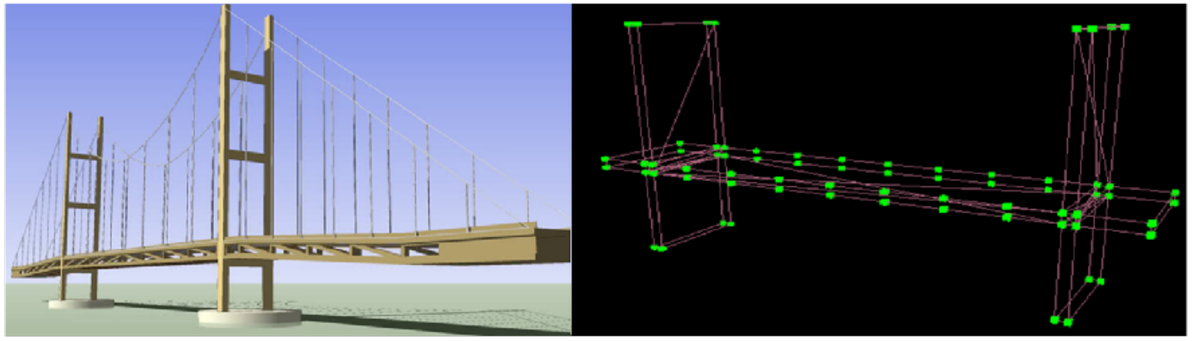
Project Objectives

The main objective of this project is to develop an intelligent, financially viable structural health monitoring system through the application of Internet of Things (IoT) and wireless mesh networks that would detect possible structural anomalies in buildings.

1. Design and fabricate wireless vibration sensors suitable for detecting subtle movements of the different segments of a target building during mild tremors;
2. Design and develop wireless mesh communication protocols for sensor nodes which include:
    a. Real-time data synchronization
    b. Data Prioritization
    c. Load balancing and routing optimization
3. Design and develop a visualization tool based on the time-series sensor data that will be equipped with the following functions:
    a. Real-time monitoring of building segments using a web-based application
    b. Statistical analysis of collected information to detect out-of-the-ordinary behavior of the different segments of a building
    c. Predictive simulation in case tremors are of higher magnitudes
4. Information dissemination among stakeholders.



HORIZONTAL STRUCTURES (CONT.)



- Sample 2: Suspension Bridge
- 68 Nodes
- Performance: Average
  - Some delays in
    - Camera zoom in/out
    - Camera Panning (Up, Down, Left, Right)

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Research Projects (2)

Preparedness Assessment for Wireless Internet of Medical things (IoMT) for Philippine Locale Contextualization

Dr. L. Materum (ECE), Dr. M. Peradilla, M. Manguerra (ME), A. Ong-Tiu

The project seeks to provide a means of measuring the widespread use of wireless Internet of medical (WIoMT). Since the comprehensive deployment of WIoMT in many countries is missing, the authors attempt to draw out assessments to ensure future private and public healthcare and health informatics experts have a better grasp of pushing for policies and guidelines for a healthy populace. The proponents aim to develop assessment instruments to reach that information conglomeration if a country or a locality is prepared for WIoMT given WIoMT scenarios for their placements.

Research Projects (3)

Manufacturability Assessment of an Ocean Energy Conversion Turbine

Dr. A. Ubando (ME), Dr. C. Sy (IE), Dr. M. Peradilla, I. Marforri III (ME),

This project explores the Archimedes Screw Turbines (ASTs) that has been introduced recently to the hydropower sector that has high efficiency, low cost and are fish friendly. A lot of research has been conducted on developing models and optimizing the geometry of AST to produce higher efficiency, but none has focused on assessing the ease of its manufacturing process. This research aims to evaluate the manufacturability and the manufacturing process of the AST. Easing its manufacturability will increase the adoption of this technology across the Philippines which can lead to satisfying the energy demand. Documentation will be done to assess the ease of manufacturability.

Research Projects (4)

Optimization of Microstrip and Planar Inverted-F Antennas using Rough Set Theory

Dr. A. Africa, Dr. R. Bedruz, Dr. M. Peradilla

To evaluate two specific types of antennas and their capabilities- the Microstrip Antenna and the Planar Inverted-F Antenna. It also aims to address specific objectives: (1) To assess the antennas' parameters and restrictions; (2) To identify the numerous applications these antennas can work in; (3) To determine and compare the advantages and disadvantages of MSA and PIFA; and (4) To perform simulation using the Matlab software. With the given constant values of these antennas during simulation, individual results will be processed into fuzzy values. From here, the rough set theory approach will be applied to optimize the values generated.

Named Networking Framework for Edge AI

Fritz Flores

Creating and implementing a framework for Edge AI using a networking design that uses names as resource identifiers, would enable applications to benefit from the advantages of a data-centric communication paradigm.

A physical implementation of the framework would also ensure the feasibility of creating a fully functioning Edge AI network design using named resources, which performs the full end-to-end process from data collection, data processing, inferencing or prediction, to actuation.

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Named Networking Framework for Edge AI

Fritz Flores

This study aims to formulate a Named Networking framework for Edge AI with accompanying protocol designs and algorithms, as well provide actual use case implementations.

1. Formulate a framework with Named Networking for Edge AI
2. Incorporate existing as well as design new protocols in accordance with the Named Networking design
3. Redesign existing protocols and algorithms in accordance with the Named Networking design
4. Implement and evaluate the Named Networking framework, protocols, and algorithms on use cases

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Scope of the Research and Methodology

Formulate a Framework	Incorporate existing and design new protocols	Redesign existing protocols and algorithms	Implement and evaluate on use cases
Research IoT and Edge Computing **frameworks and architectures**	**Incorporate** the Named Data and Function Networking protocols	Redesign a **network management and monitoring** protocol	Create and configure **edge application environments**
Research on **Named Data, Function,** and **AI**	**Design additional** protocols, services, and algorithm workflows as needed	Redesign a **network storage protocol**	**Deploy and monitor** the application environments
Research on existing **Edge Computing performance metrics**		Redesign and integrate existing **data processing methods and algorithms**	**Collecting metrics** on network, security, and functionality
Formulate a framework for the Named Networking design			**Evaluate and analyze** the collected data from the deployed application
			Determine the performance and capability of the design

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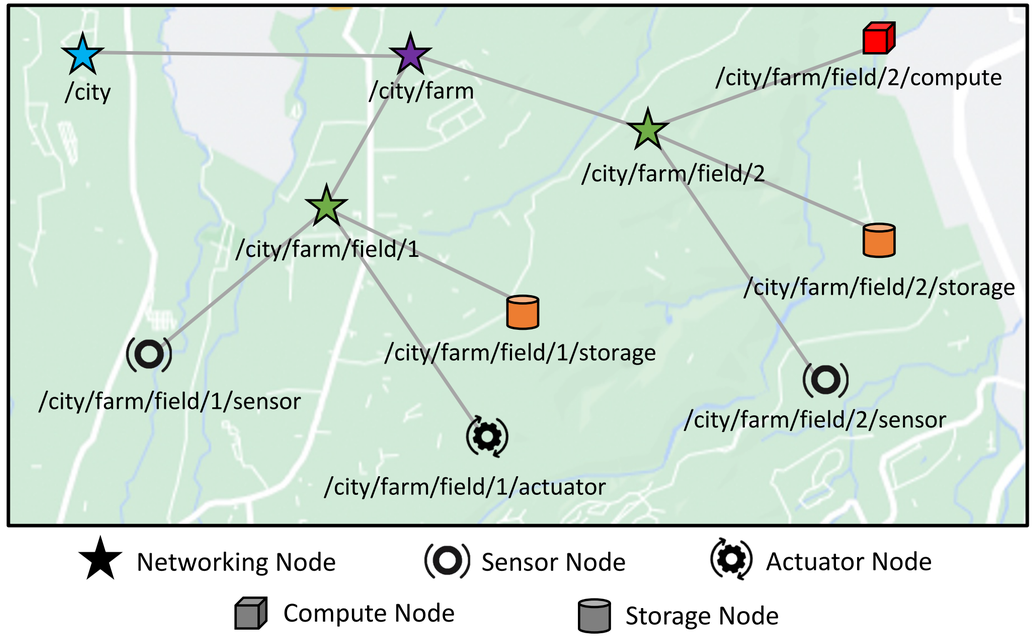
Use Cases – Smart Agriculture

Smart Agriculture Environment



Scenario

- Little to no Internet connectivity
- Large areas and use of wireless transmission
- Cluster-based setup for different areas
- Low-bandwidth communication
- Long communication intervals
- Sparse resource-constrained node deployment
- May have resource-rich node depending on setup
- Fixed deployment and focus on functionality
- May have an in-house computing facility due to difficulty or cost-effectiveness in computation

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An IoT Framework Based on SDN and NFV for Context-Aware Security

Arlyn Ong-Tiu

IoT and its Security Challenges

- Conventional security approaches for traditional data networks are inadequate
  - Typically designed for protected environments and unconstrained devices
  - Static rules - lack of flexibility to changing network conditions
  - Require human intervention to adjust - lack of responsiveness
- Need a context-aware, dynamic security approach supported by an automation-compatible infrastructure

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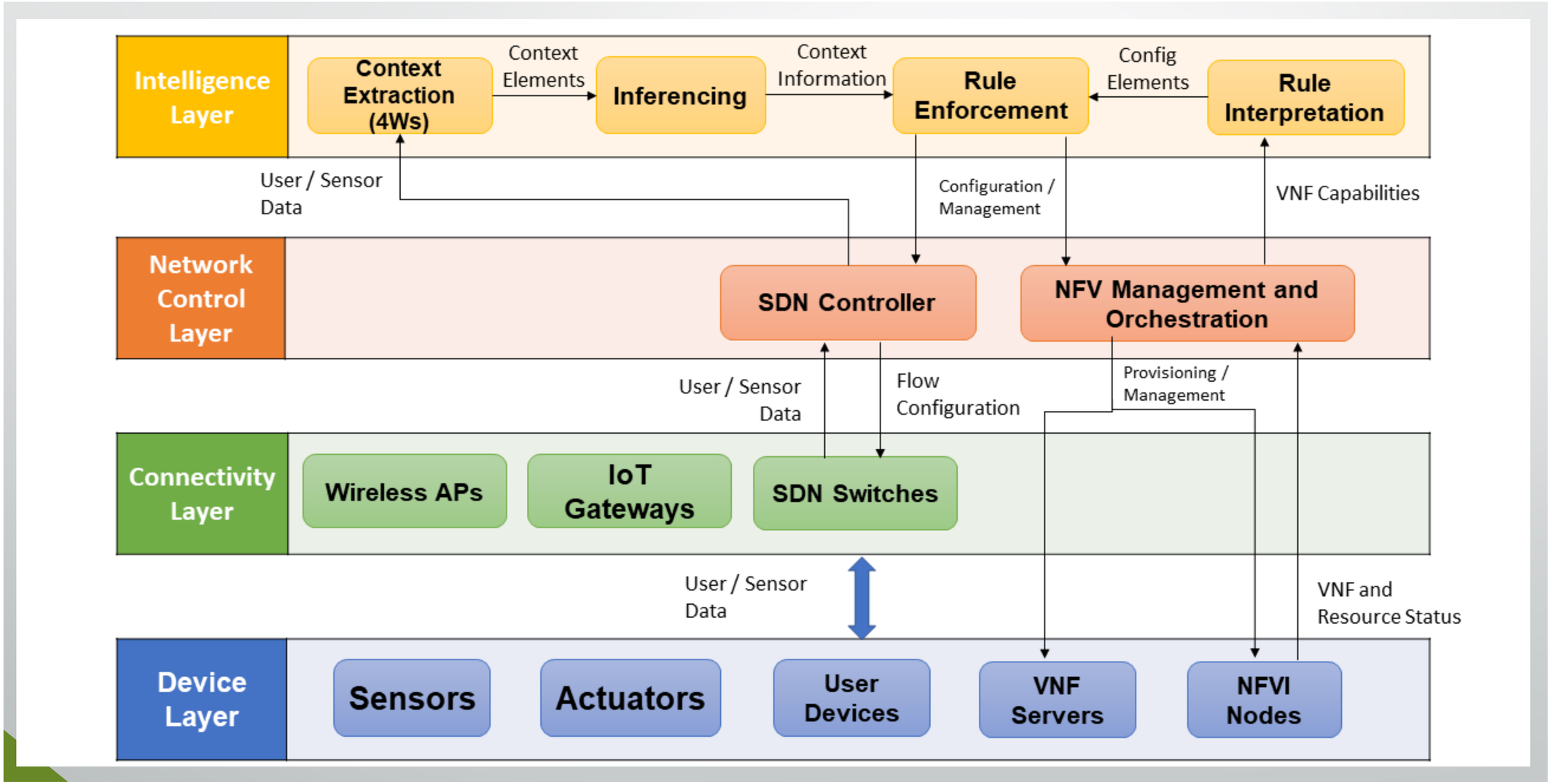
An IoT Framework Based on SDN and NFV for Context-Aware Security



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