Panel 1

Ubiquity: Challenges at Horizon!

(mobility, resilience, service quality penetration, affordability, energy, communication speed, health, etc.)

NexTech 2020

Panellist Position

In God we trust. Everyone else bring data … especially in healthcare.

Prof. Dr. Les Sztandera, Thomas Jefferson University, USA; Les.Sztandera@Jefferson.edu

- **Data Analytics**
- **Computational Intelligence**
- **Electronic Medical Records**
- **Artificial Intelligence in Medicine**

→ **Big data is the new gold, especially in healthcare**

→ **Big data promises more personalized and precision medicine for patients with improved accuracy and earlier diagnosis, and therapy geared to an individual's unique combination of genes, environmental risk, and precise disease phenotype**

→ **Advances in collecting and processing Electronic Medical Records (EMRs), coupled with increasing computer capabilities have resulted in an increased interest in the use of big data in healthcare**

→ **Ophthalmology has been an area of focus where results have shown to be promising**

In God we trust. Everyone else bring data … especially in healthcare.

→ Big data is the new gold, especially in healthcare

Recent outbreak, of the coronavirus disease 2019 (SARS-CoV-2) caused by Severe Acute Respiratory Syndrome coronavirus 2 (SARS-CoV-2) is a pandemic disease having dire consequences. As of October 22nd, 2020 **forty one and a half million** people have been affected by this disease. However, consolidated data to analyze the progression of corona virus worldwide is not available. This trend can be analyzed using Machine Learning and Artificial Intelligence techniques.

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Folding at Home (Folding@Home) is a distributed computing platform based at Washington University School of Medicine in St. Louis, Missouri [Bowman, Chodera, & Voelz, Folding At Home, 2020]. Folding at Home is a project to aid scientific and medical research for finding causes to diseases with currently unavailable medical treatments.

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→ Advances in collecting and processing Electronic Medical Records (EMRs), coupled with increasing computer capabilities have resulted in an increased interest in the use of big data in healthcare

A study was designed by merging a dataset obtained from the Telangana State Development Society to an existing EMR of approximately 1 million patients, who presented themselves with different eye symptoms and were diagnosed with several diseases from the years (2011-2019) [Alalawi et.al., 2020].

In God we trust. Everyone else bring data … especially in healthcare.

→ **Ophthalmology has been an area of focus where results have shown to be promising**

The findings of the study based on a dataset obtained from the Telangana State Development Society in India revealed that there is a high presence of Cataract in the state of Telangana, mostly in rural areas and throughout the different weather seasons in India [Alalawi et.al., 2020].

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Panellist Position

Using Connected Vehicles to Prediction of Traffic Flow

Alejandro Quintero, Ranwa Al-Mallah Polytechnique Montreal

- A transportation system is a highly correlated network
- Communication and cooperation is the key
- macroscopic and microscopic problems
- Collectively attribute a cause to it into the forecasting of traffic flow
- Machine learning a promising approach for transportation research

Panellist Position

Cancer Caregivers' Needs for Their Well-Being in Information Era

Koo Ah-Choo, Multimedia University; ackoo@mmu.edu.my

- Creative Multimedia; Interactive Multimedia
- Green and Wellness Research Programme
- Education Technology; E-Learning; Mobile Learning; Online and Virtual Learning
- Digital Cities; Creative Cities

→ Health prevention is better than cure

→ Increasingly caregiving service is required due to health challenges

→ Health communication and promotion through digital media is crucial

→ Communication as the tool / method for improving wellness

Panellist Position

Ubiquity in Agriculture and Aquaculture

Prof. Navid Shaghaghi, Santa Clara University, USA; nshaghaghi@scu.edu

- Proliferation of the Internet of Everything (IoE) to Agriculture and Aquaculture
- Energy Efficiency challenges in the Internet of Things (IoT)
- Enhancement of IoT energy efficiency by individual device Sleep Cycles
- Energy Aware Communications Protocol (EACP)

→ By applying data analysis and analytic techniques such as machine learning and data visualization to data gathered via IoT networks, farmers can not only make sense of the data, but also make predictions regarding the state of the crops and the environment in the field.

→ For example: the status of crops, water tanks, and various other components of modern agricultural irrigation systems can be sensed and valves and pumps can automatically be actuated to ensure the distribution of adequate water to all parts of the system.

→ A difficulty in taking maximum advantage of the sleep cycles of the varying components of a communications network is the unpredictability of the time of arrival for incoming packets.

→ An Energy Aware Communication Protocol (EACP) is a protocol that takes advantage of each individual network component's low power modes using sleep cycle duration synchronization in order to save battery life and reduce the system’s overall energy usage.

Jefferson
Philadelphia University + Thomas Jefferson University

A Data-Driven Approach for Eye Disease Classification in Relation to Demographic and Weather Factors Using Computational Intelligence Software

Les Sztandera, PhD

Professor
Computational Intelligence
Distinguished Fulbright Chair' 03 of Computer Science
Kanbar College of Design, Engineering, and Commerce
Thomas Jefferson University

Study participants

Amna Alalawi[1], Les Sztandera[2], Parth Lalakia[3], Anthony Vipin Das[4], Gumpili Sai Prashanthi[5]

[1,2,3] Thomas Jefferson University, Philadelphia, PA, USA

[4,5] Department of EyeSmart EMR & AEye, Indian Health Outcomes Public Health and Economics Research Centre (IHOPE), LV Prasad Eye Institute, Hyderabad, Telangana, India

Study Outline

The study was designed by merging a dataset obtained from the Telangana State Development Society to an existing EMR of approximately 1 million patients, who presented themselves with different eye symptoms and were diagnosed with several diseases from the years (2011-2019). Our findings revealed that there is a high presence of Cataract in the state of Telangana, mostly in rural areas and throughout the different weather seasons in India. Men tend to be the most affected as per the number of visits to the clinic, while home makers make the most visit to the hospital, in addition to employees, students, and laborers. While cataract is most dominant in the older age population, diseases such as astigmatism, conjunctivitis and emmetropia, are more present in the younger age population.

Study Publications

1. Partial results will be published in the peer-reviewed Conference Proceedings – Big Data Track - The Ninth International Conference on Data Analytics DATA ANALYTICS 2020, October 25-29, 2020 - Nice, France

"A Data-Driven Approach for Eye Disease Classification in Relation to Demographic and Weather Factors Using Computational Intelligence Software"

2. An extended version is under review for publication in the peer-reviewed International Journal.

Future Research

Big data can serve to boost the applicability of clinical research studies into real-world scenarios, where population, race, and climate create a challenge. It equally provides the opportunity to enable effective and precision medicine by performing patient stratification. This is indeed a key task toward personalized healthcare. A better use of medical resources by means of personalization can lead to well-managed health services that can overcome the challenges of a diverse population where poverty is high. Thus, creative featuring and data merging for health management of EMRs can have an impact on future clinical research.


Jefferson
Philadelphia University +
Thomas Jefferson University
HOME OF SIDNEY KIMMEL MEDICAL COLLEGE

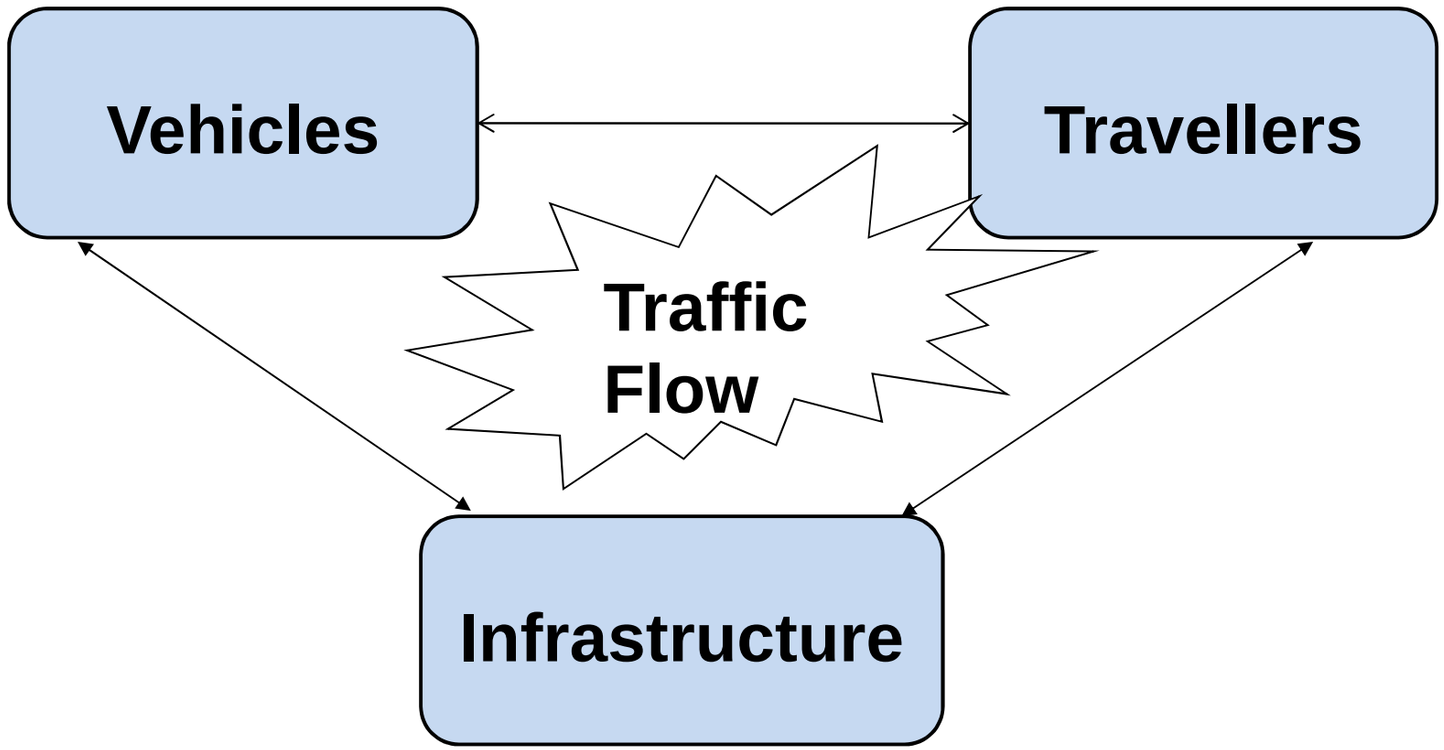
Using Connected Vehicles to Prediction of Traffic Flow

Ranwa Al Mallah, Alejandro Quintero

Department of Computer and Software Engineering
École Polytechnique de Montréal

SOURCE:
http://www.worldrecordacademy.com/transport

Introduction



Road traffic network

CHALLENGES

- In Internet of vehicles (IoV) the rapidly growing number of connected elements creates data at an exponential rate
- IoV bring new research challenges when it comes to achieving real-time and high accuracy situational awareness for connected and autonomous vehicles
- Changes in mobility behavior
- Validate new protocols and context-aware model-communications
- IoV services will need to operate within an environment that supports their mutual understanding

Introduction

Traffic data collection

- **Infrastructure:**
  - ✓ Inductive-loop detectors
  - ✓ Cameras
  - ✓ Microwave radar, ultrasonic, and passive infrared sensors
- **Vehicles:**
  - ✓ Technologie *Floating Car Data*
  - ✓ GPS-based mobile sensors
  - ✓ Cellular-based sensors
  - ✓ Technologie de réseau
- **Connected vehicles (CVs)**

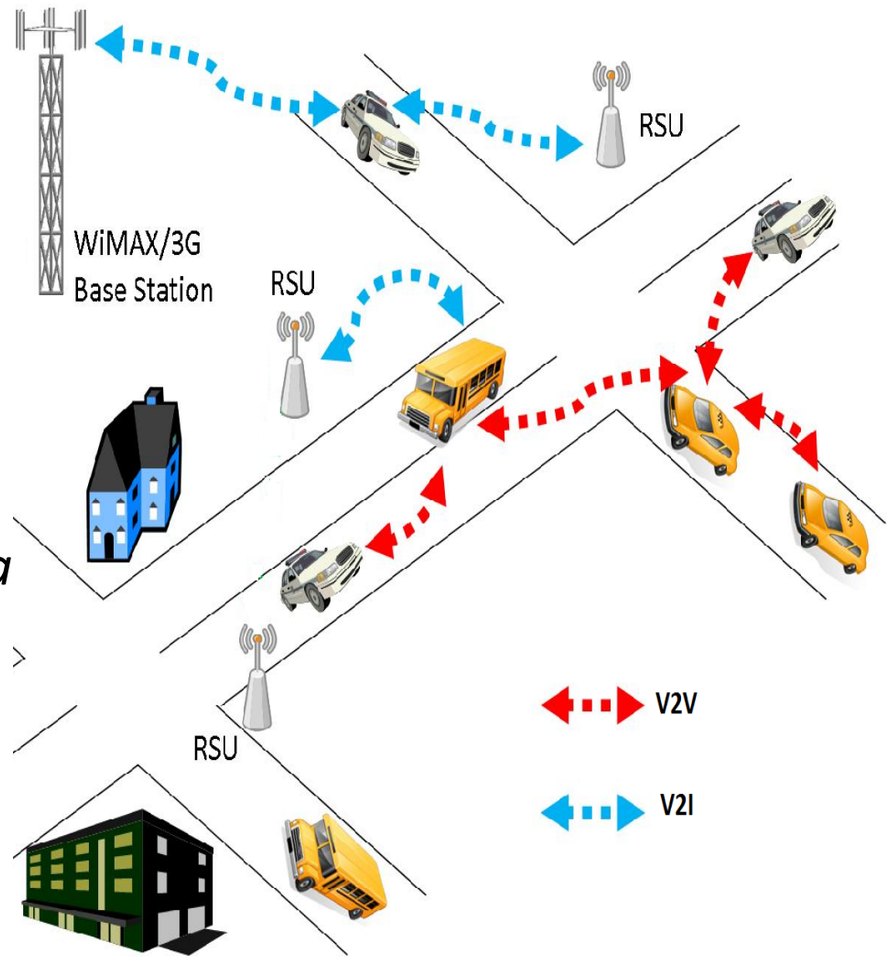


Figure: Vehicular ad hoc networks of CVs

Phases

- **Phase 1: Classification of traffic congestion**
  - ✓ Development of an algorithm for the distributed and real time advanced monitoring and evaluation of road traffic condition.
  - ✓ Classification of congestion into its components via machine learning methods.
- **Phase 2: Cooperative evaluation of the cause of congestion**
  - ✓ Implementation of a cooperation process to increase estimation accuracy.
  - ✓ Proposing simulation generated scenarios to build a synthetic dataset to train the machine learning methods.
- **Phase 3: Prediction of traffic flow in an urban traffic network**
  - ✓ Forecasting of short term traffic flow on a target road segment via input from CVs.

POLYTECHNIQUE MONTRÉAL
LE GÉNIE EN PREMIÈRE CLASSE

Distributed Classification of Urban Congestion

Phase 1

Monitoring of traffic variables

- **Incidents and workzones:**
  - ✓ Problematics spot on the road, then the congestion is caused by either an incident or a work zone.
- **Weather condition :**
  - ✓ Higher minimum following distance
  - ✓ Reduced desired speed
  - ✓ Higher travel times on some segments of the trajectory.
- **Special event:**
  - ✓ Vehicle necessarily in the impact region of the event.
  - ✓ If some road segments of the vehicle's path are inside the impact region, and the travel time on those segments are abnormally high.
  - ✓ Observed demand along a vehicle's path: presence of a sharp traffic surge.

Classification models

- **Naive Bayesian classifier (NB):** The aim is to assign a target variable to one of a discrete set of categories based on its observable features.

Cooperative Evaluation of the Cause of Urban Traffic Congestion via Connected Vehicles

Phase 2

Data mining methods

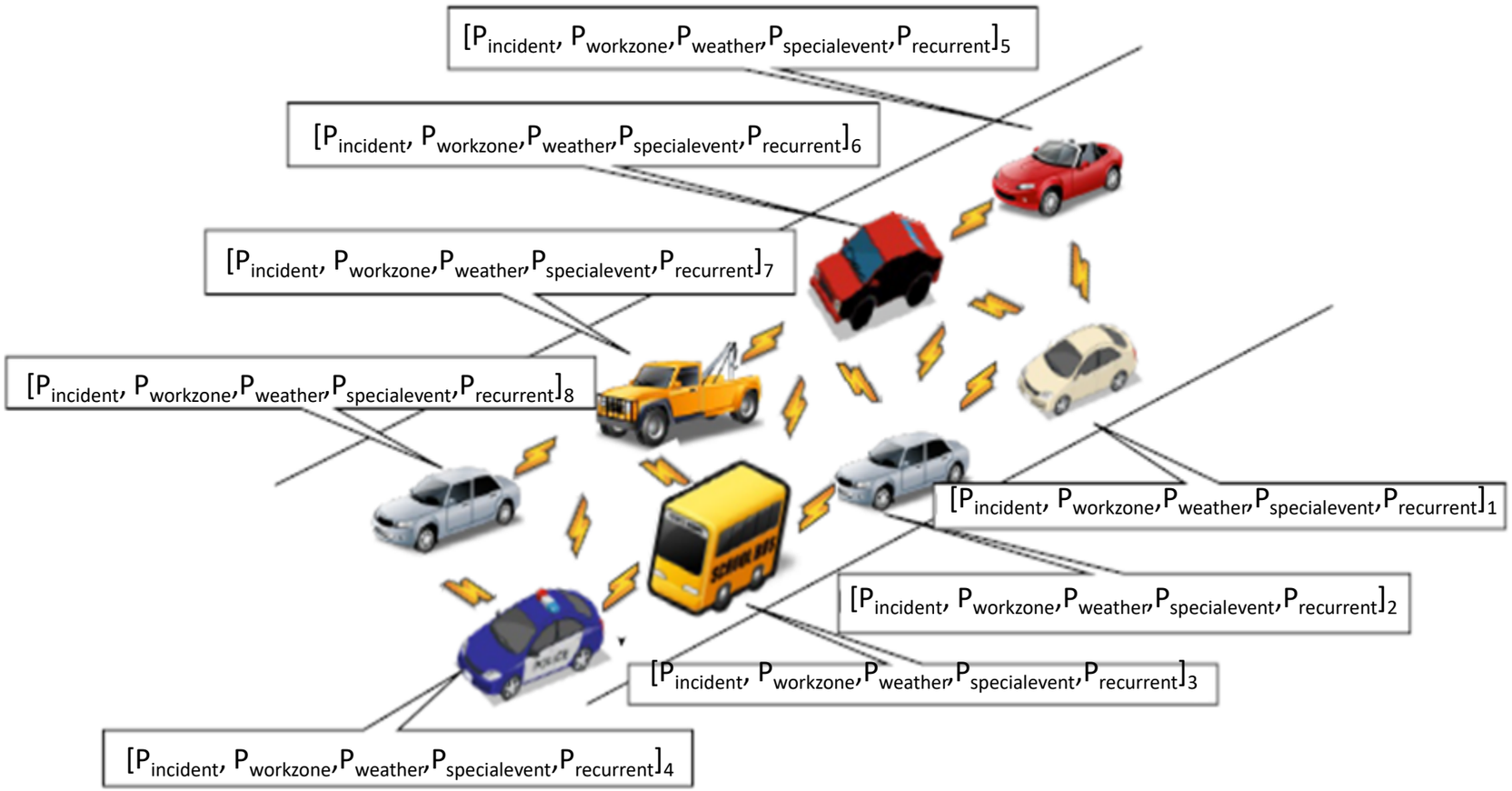


Figure: Vehicles exchanging via geographic routing information about the cause of congestion

Voting Procedure (VP)

- **Each vehicle has a vector, one cause having the highest probability:** $C = [\, P_{incident}, P_{workzone}, P_{weather}, P_{specialevent}, P_{recurrent}]$
- **Decision module computes counts for each cause:**
  - ✓The one having the highest count is highlighted by the VP as the cause of congestion.

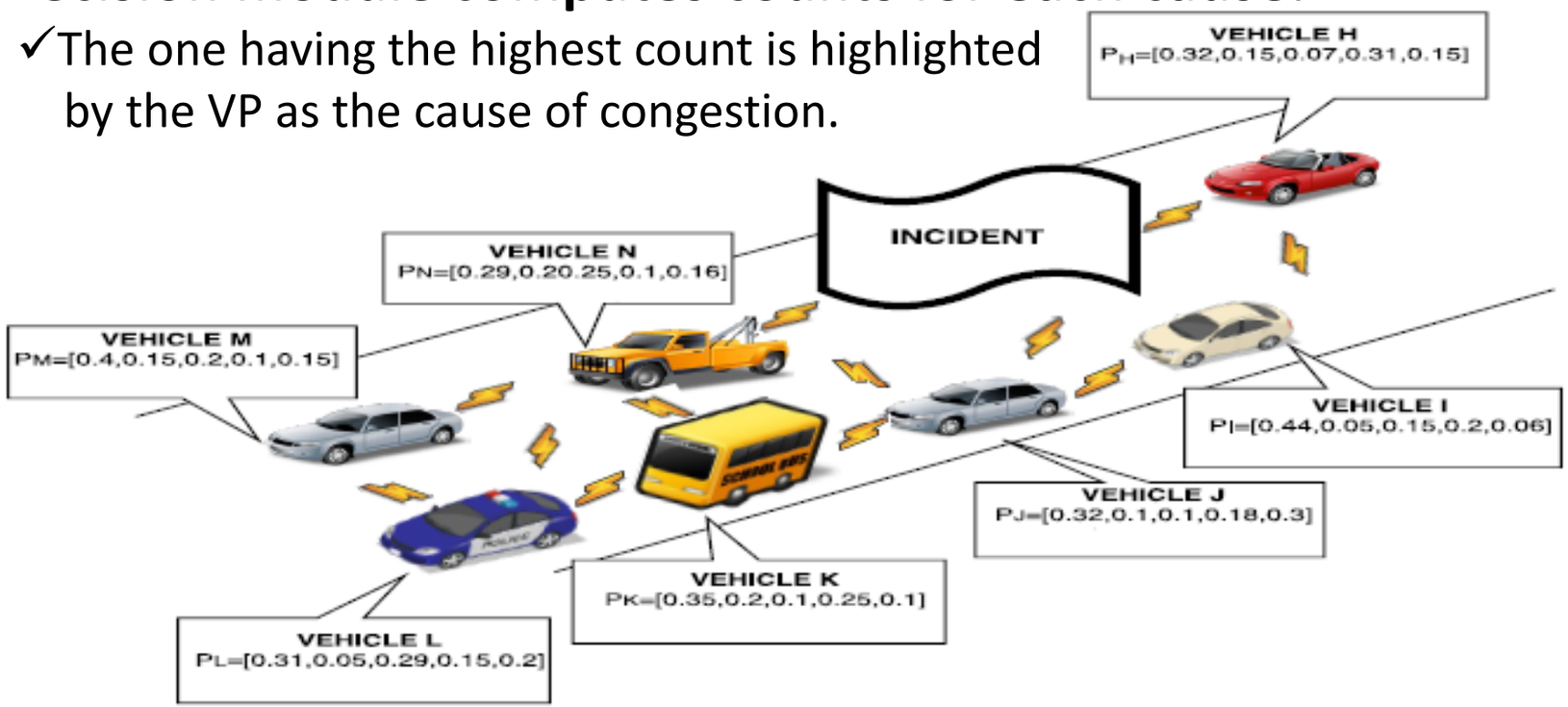


Figure: Vehicles broadcast probabilities vector and others collect messages received.

Prediction of Traffic Flow via Connected Vehicles

Phase 3

Short-term traffic flow prediction problem (STP)

Classification problem:

- ✓Task: Predict the range of flow Y that the current traffic situation will generate at a near future time.
- ✓Target variable Y: multiple classes of discrete interval of flows.
- ✓Supervised learning: given the feature *X* and task *Y* pairs obtained from history traffic flow *{(X1, Y1), (X2, Y2), . . . , (Xn, Yn)}*, learn the best parameters for a predicting model that minimizes a loss function.

Proposed framework

- **Semi-centralized architecture**
  - ✓ Distributed architecture through V2V communication.
    - ➢ *Data collection by CVs: TT, TTindex, events*
  - ✓ Centralized : road side unit (RSU) monitor the parameters for a period of time via V2I communication.
    - ➢ Computes and stores current flows on the segment.
    - ➢ Collects TTindex, flows and events on other segments
    - ➢ Mapping between all influenced road segments.

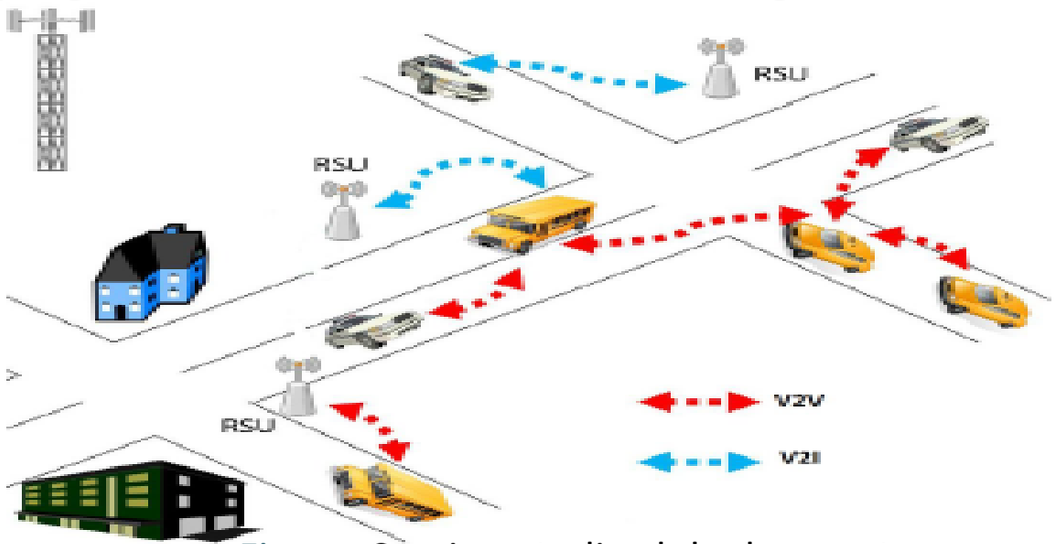


Figure: Semi-centralized deployment

STP model

- **Feedforward artificial neural network (MLP)**
  - ✓ MLP is a series of logistic regression models stacked on top of each other.
  - ✓ Hidden units learn non-linear combinations of the original inputs.
- **Multi-Task Learning (MTL)**
  - ✓ Train a model for solving different tasks simultaneously.
    - ➢ The classifier will prefer hypotheses that explain more than one task, improving generalization.
  - ✓ Inductive transfer between semantically connected tasks:
    - ➢ learning done offline, features can be collected for the training set and used as extra MTL tasks.
    - ➢ provide extra information to the learner during training.

Deep neural network (DNN)

The characteristics of transportation systems, such as the large amounts of data and the high dimensions of features, makes machine learning a promising approach for transportation research

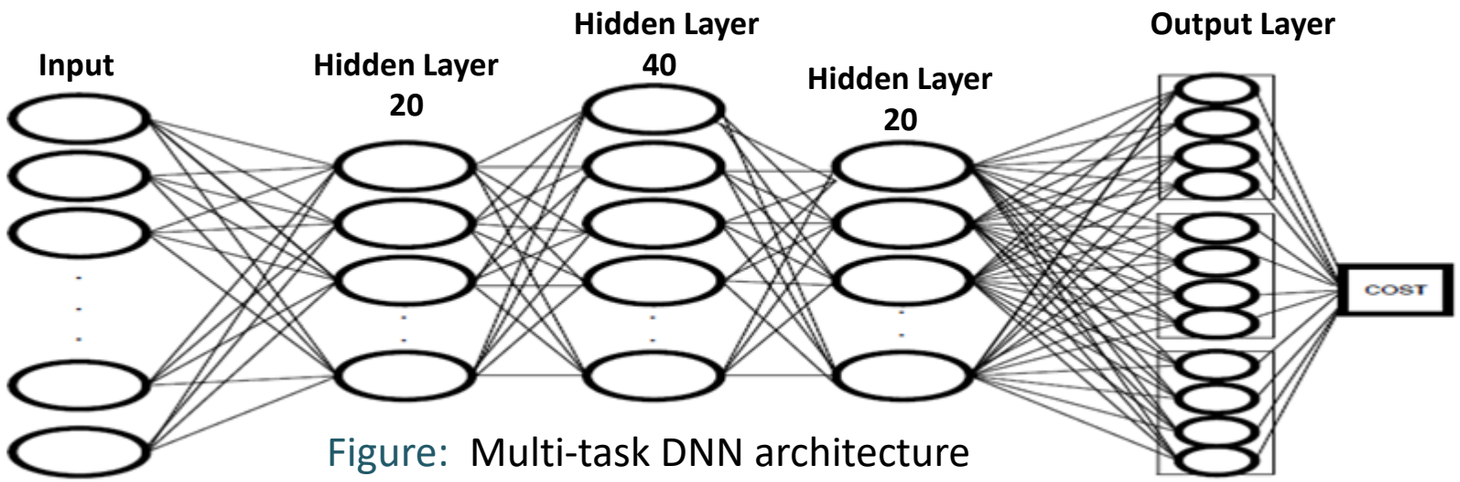


Figure: Multi-task DNN architecture

Cancer Caregivers' Needs for Their Well-Being in Information Era

Koo Ah-Choo, Peter Charles Woods, Tenku Putri Norishah, Ang Kok-Yew, Teoh Sian-Hoon, Chin Weng-Ping

Acknowledgement:

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Presenter: Dr Koo Ah-Choo
e-mail: ackoo@mmu.edu.my

Multimedia University, Cyberjaya, Malaysia

- Dr Koo Ah-Choo is an Associate Professor at the *Faculty of Creative Multimedia* (FCM), *Multimedia University* (MMU). Dr Koo received her B.Sc (Hons) from the *Technology University of Malaysia* and her PhD from *Multimedia University*. She is active in the research of media usage, interactive multimedia, creation and methods especially in the promotion of education, communication, collaboration and life-long learning.
- She was appointed as the deputy director of *MMU Digital Cities Research Institute* (2018-2019), Deputy Dean (2010 - 2013) for FCM and Dean (2014-2016) for the *Learning Institute for Empowerment*. Dr Koo is an alumna of the *International Deans' Course (IDC 2014 / 2015)*. She is a senate representative to Senate Committee of her university for the cluster of *Creative Multimedia and Cinematic Arts*. She is a *Tzu Chi Foundation* volunteer for charity and recycling at her local community.

Research Interest and Workgroup

- **Research Interest**: Interactive multimedia, media contents & usage; creation & methods especially in the promotion of education, communication, collaboration and life-long learning.
- **Workgroup:** Currently she is the Chairperson for the Research Centre for Interactive Multimedia in the Faculty of Creative Multimedia (url: creative.mmu.edu.my) and the lead for the Research Programme of Green and Wellness at her university (www.mmu.edu.my). Dr Koo is keen to facilitate / work with any collaborative group under the research area(s) of Interactive Multimedia and Creative Multimedia.
- She published her research in the *Journal of Educational Technology and Society*, *International Journal of E-Health and Medical Communications*, *The Turkish Online Journal of Educational Technology*, and *Int. J. Innovation and Learning*.
- She is currently the project leader for a *Fundamental Research Grant Scheme* (FRGS) by the *Ministry of Higher Education*, entitled, "*eHealth Modality for Mental Wellness among Digital Talents*". She also led research and creative projects funded by various agencies:- 1) *Affective Roles of Ubiquitous Learning in a 'Patient Centred Health Care Model'* for Malaysian Hospitals; 2) ProbMobile: An interactive mobile learning framework for Probability; 3) UNHCR's Health Media Production project; 4) Members of many other research projects.
- Her CV: https://mmuexpert.mmu.edu.my/ackoo

Position of the current research:

>> Background & Issue

- Caregivers face with competing sources ("infodemic") => to identify accurate / trustworthy resources; required Internet and Information Literacy.
  - >> Mis- and disinformation can be harmful to people's physical and mental health;
  - >> mHealth/eHealth services and applications are able to offer opportunities on health / cancer education
- Increasing cases of cancer rate; challenges of caregiving (Being informal caregivers)
- Caregivers - "someone who performs hands-on care and / or provides emotional support to patients, such as a partner, relative or friend"; caregivers can be partners and family caregivers, who are mostly informal
- Literature was conducted on the aspects of dealing with cancer, information access on caregiving and cancer caregivers' need, one aspect of needs is Learning Needs too.

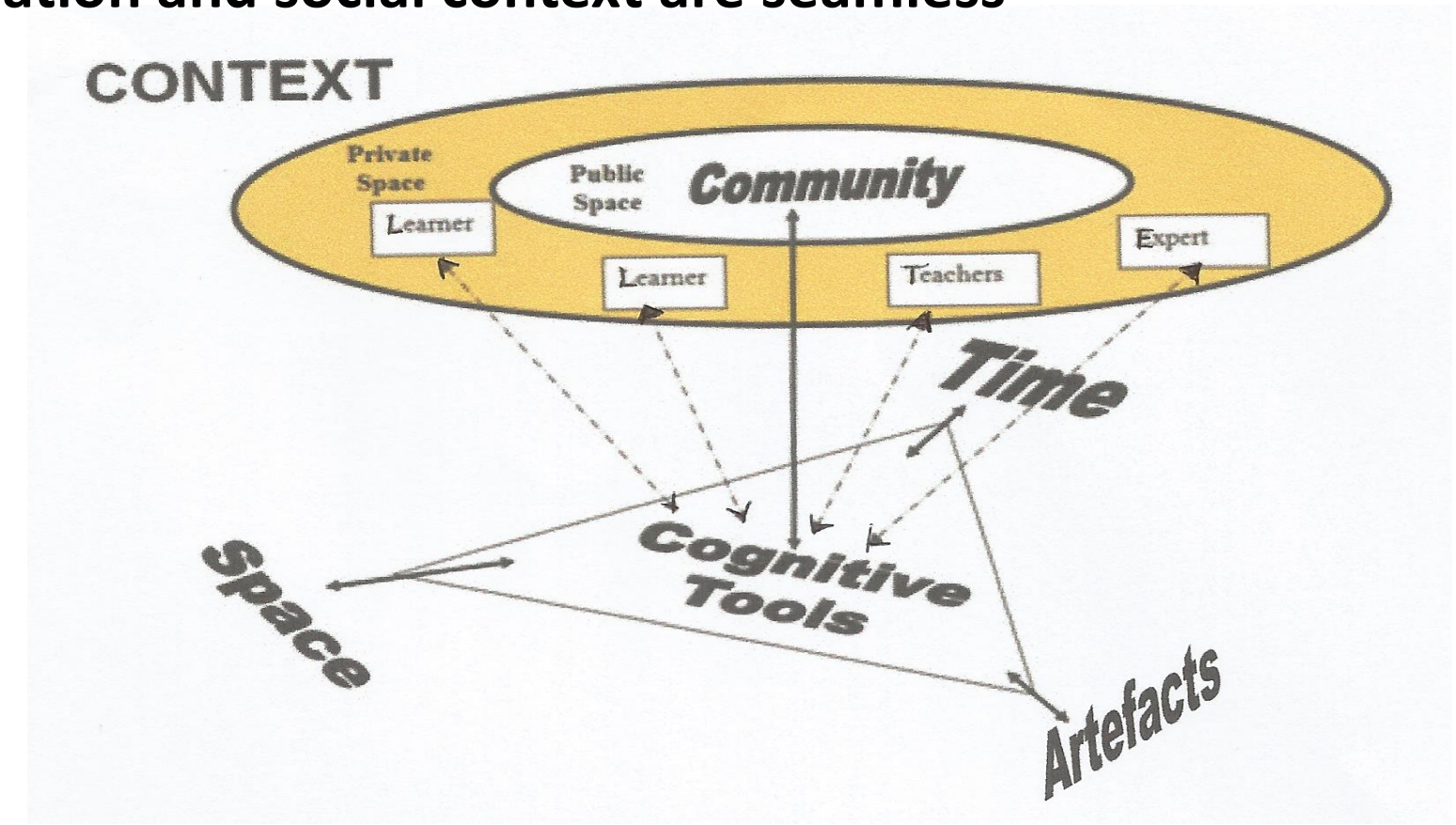
>>Purpose

The study explored the four + one dimensions (of needs) faced by cancer caregivers, namely:

1. Healthcare service
2. Psychological & emotional
3. Work & social
4. Information + 5. Learning need

Girgis et al. (2011) suggested the four dimensions.

Why Learning as another dimension?
>> Information and social context are seamless



A Seamless Learning Framework (Looi, et al. 2010.)

>>Methods

- A survey was conducted at two private cancer clinics in a hospital; with support from an NGO.
- Number of survey respondents: 84 informal caregivers; mostly Malaysian Chinese.
- Instrument –adapted from Girgis et al. (2011).
- Factor analysis is employed in analyze the data with two main stages of analysis
  - Stage 1: Extracting factors → Stage 2: Factors rotation

>> Findings

The six-factor of needs were identified in this study, they are elaborated based on research items:

Factor 1: Communication Need – Regular communication for better understanding and balance of needs between caregivers and person with cancer;

Factor 2: Personal Well-Being Need -- Especially on the control of emotion, communication and spiritual beliefs mainly on the quest of meaning of life and the faith in the healing process;

Factor 3: Basic Health Need – Healthcare need, counselling and service;

Factor 4: Information Need -- Access to Information related to cancer or patient care information and Services;

Factor 5: Need for Coping with Change in Life – Cope with the changes of life routine and perspective on life;

Factor 6: Learning Need – Learning through online information and connections with other people on caregiving / cancer care.

>>Discussions, Conclusion and Future Work

- The known domain of needs emerged (as predicted):- Basic Healthcare Service, Psychological & Emotional (Personal Well-being Need), and Access to Information.
  >> Additional needs identified in this study: Communication Need, Coping with Change (In life), Learning Need.

- Communication Need – being the moderate need by the caregivers (the higher need of all factors); learning need is low need. Other need-factors are between low to moderate need.
  >> Communication Need for caregivers are multifaceted in nature: communication target, content, style, timing and preferences (Li et al., 2020; Yuen et al., 2014); it has influenced on Information Need; effective communications influence caregivers' well-being.

>>Discussions, Conclusion and Future Work (continued…)

- Communication aspect and all other need-factors should be considered for any policy or training modules for caregivers.

- The study has sampling limitation; data from respondents may has some biases.

- Future directions >> Consider the different duties of caregivers and the level of quality of treatment received by patients; >> In depth study on specific well-being dimensions due to the reason that well-being is large construct.
- During pandemic time, caregivers' well-being should be safeguarded; research on Covid-19 caregivers is urgent, to study their unmet needs and also to compare their needs at different regions.
  >> Future collaborative research on this area is welcome.

Panellist Position

Ubiquity in Agriculture and Aquaculture

Prof. Navid Shaghaghi, Santa Clara University, USA; nshaghaghi@scu.edu

- Proliferation of the Internet of Everything (IoE) to Agriculture and Aquaculture
- Energy Efficiency challenges in the Internet of Things (IoT)
- Enhancement of IoT energy efficiency by individual device Sleep Cycles
- Energy Aware Communications Protocol (EACP)

→ By applying data analysis and analytic techniques such as machine learning and data visualization to data gathered via IoT networks, farmers can not only make sense of the data, but also make predictions regarding the state of the crops and the environment in the field.

→ For example: the status of crops, water tanks, and various other components of modern agricultural irrigation systems can be sensed and valves and pumps can automatically be actuated to ensure the distribution of adequate water to all parts of the system.

→ A difficulty in taking maximum advantage of the sleep cycles of the varying components of a communications network is the unpredictability of the time of arrival for incoming packets.

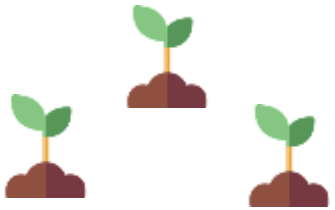
→ An Energy Aware Communication Protocol (EACP) is a protocol that takes advantage of each individual network component's low power modes using sleep cycle duration synchronization in order to save battery life and reduce the system’s overall energy usage.

Agriculture / Aquaculture Challenges

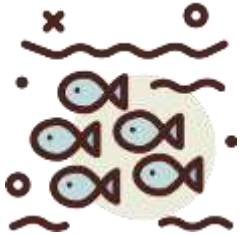
- Systems are operated manually:
  - Labor intensive
  - Time consuming
  - Prone to human error
- Labor is:
  - In high demand due to growth
  - In short supply (especially in industrial countries) due to:
    - Outsourcing of jobs
    - Automation
  - Often tied to immigration
  - Thus Political
- Industrial level systems exist but are:
  - Expensive
  - Complex
  - Energy Inefficient
  - Hardwired

Automation of Agriculture / Aquaculture using IoT - Sensing

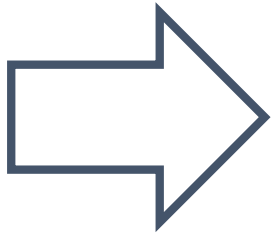
Water tank



Plants and Soil



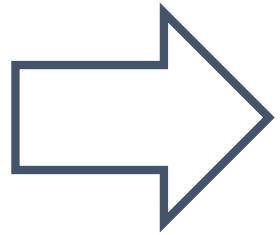
Fish Farms



Water Level

Temperature

Other Data



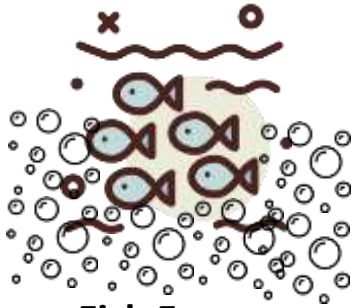
Data Wearhouse

Data Analytics

Automation of Agriculture / Aquaculture using IoT - Actuating

Ranches

Farms



Fish Farms

Water Pump

Water Valve

Oxygen Pump

Remote control of Farms and Ranches

Energy Efficiency Considerations and Problems

- Agricultural / Aquacultural IoT devices are often placed in locations without access to electricity sources such as the power grid.
- It is extremely expensive or impossible to extend the power grid to locations such as
  - rural farms in developed countries
  - most farms in developing countries
  - fish farms located far off of the coastline
- Therefore they need to be battery operated
- And the batteries (rechargeable or not) need to last as long as possible in order to minimize the number of times they need to be replaced
- Hence, Agricultural / Aquacultural IoT devices need to make use of device sleep cycles in order to minimize the energy usage of the system especially when the device is not in use or in standby mode.

Difficulty in taking advantage of Sleep Cycles

- IoT systems are ideally comprised of energy efficient sensors and actuators which are individually placed in a low power state (i.e. sleep mode) when each is not in use.
- A difficulty in taking maximum advantage of the sleep cycles of the varying components of a communications network is the unpredictability of the time of arrival for incoming packets.
- A global synchronization of clocks is extremely difficult as even a single asynchrony can result in complete system failure.
- However, sleep cycle duration synchronization is possible using a regional arbiter of the time remaining in the system's overall sleep cycle.

Energy Aware Communication Protocol (EACP)

- What is an EACP? It is any communication protocol that
  - takes energy usage into consideration, and
  - prioritizes energy efficiency

- Further requirements/constraints on the use of an EACP in IoT / IoE:
  - Memory efficiency
  - Communicate through terrain with physical obstacles
    - Hills and Trees – Agricultural use cases
    - Buildings and vehicles – smart cities applications
    - Walls and furniture – indoor systems

ÂB - An EACP Prototype

- ÂB is an Energy Aware Communication Protocol (EACP) that takes advantage of each individual network component's low power modes using sleep cycle duration synchronization
- It is a prototype which has been developed for the communication subsystem of Hydration Automation (HA) --- an agricultural Internet of Things (IoT) system currently under research and development at Santa Clara University's Ethical, Pragmatic, and Intelligent Computing (EPIC) laboratory
- ÂB allows for multi-hop communication between Sensing Units (Sus) and their assigned Actuating Units (AUs) without the loss of the low power (sleep mode) cycle of the SUs and intermediary Relay Units (RUs).
- It is not envisioned to be exclusive to HA, irrigation systems, or agricultural IoT systems; but rather as a new general purpose IoT communication protocol which is extremely energy efficient.
- For instance, ÂB is also currently being built into two other of SCU's EPIC lab's Agricultural / Aquacultural IoT systems:
    1. HiveSpy - which is a solution for monitoring and reporting the weight of every frame of a hive with a specific focus on labor shortage and the prevention of hive swarming and
    2. DOxy - which measure dissolved oxygen in water for fish farms.

ÂB - An EACP Prototype

Single Hop

Multi Hop

Sensing/Actuating Units(S/AU)

Relay Units (Rus)

Base Station

Cloud Infrustructure

User

ÂB Sponsors

Frugal Innovation Hub
SANTA CLARA UNIVERSITY SCHOOL OF ENGINEERING

EPIC
ETHICAL, PRAGMATIC, AND INTELLIGENT COMPUTING LABORATORY

Forbes AGTECH SALINAS

SANTA CLARA UNIVERSITY 1851

EPICS IN IEEE

THRIVE