Project Title: Research and development on short distance communication and imaging for applications in ASEAN region

Background:

Targets:

- **Target #1**: Evaluation of the short-distance communication and imaging technologies independently first.
- **Target #2**: Design, evaluation, testing and demonstration of developed devices and subsystems are performed by each institute with their expertise.
- **Target #3**: Integration of these technologies will be also discussed in the project through the meetings, the seminars or the workshops.
- **Target #4**: Sharing the knowledge by publishing the paper and presenting the advanced research results in conferences:
- **Target #5**: Providing contributions to international standardization bodies for societies in the ASEAN region

Speaker: Vo Nguyen Quoc Bao (PTIT, Vietnam)
Project Title: Research and development on short distance communication and imaging for applications in ASEAN region

Project Members: 10

- National Institute of Information and Communications Technology (NICT, Japan)
- Posts and Telecommunications Institute of Technology (PTIT, Vietnam),
- HCM city Department of Information and Communications (DIC, Vietnam),
- Radio Frequency Department (RFD, Vietnam),
- Chiang Mai University (CMU, Thailand),
- Chulalongkorn University (CU, Thailand),
- Suranaree University of Technology (SUT, Thailand),
- Universiti Teknologi Malaysia (UTM, Malaysia),
- Telekom Malaysia R&D (TMRD, Malaysia),
- Indonesian Institute of Science (LIPI, Indonesia),
- Telkom Indonesia (TI, Indonesia).

Project Duration: 36 months starting from April 2016
Project Activities: First Year Timeline

The first year:

- **Feb. 15, 2016**
  Meeting for Project Preparation and Submission

- **Jun. 2, 2016**
  Project Acceptance

- **Jul. 27, 2016**
  Kickoff meeting at Ha Long Bay

- **Dec. 2016**
  Field trial site check (NICT & PTIT)

- **Jan. 2017**
  The trial field test at HCMC

- **Feb. 2017**
  Workshop on Convergence of radio and optical technologies at Chiang Mai University (all members)

Kickoff meeting

Kickoff meeting

Workshop on CRO
Project Activities:

Project Activities: Second Year Timeline

The second year

April 14, 2017
Approved for the second year

May, 2017
IVO meeting in Bangkok

Nov. 2, 2017
Special Session on “Linear Cell Technology” in ISAP 2017, Phuket, Thailand

Nov. 29, 2017
NICT workshop at ISEE 2017 and ASEAN IVO Project meeting

Jan. 8, 2018
Filed experiments in HCMC (Path loss curve)

IVO meeting in Bangkok

ISAP 2017 SS on “Linear Cell Technology”
Project Activities: Third Year Timeline

The third year

- **April 13, 2018**
  - Approved for the third year
  - 27,000 USD

- **Feb. 22, 2018**
  - 6th International Workshop on CRO, Malaysia

- **Aug. 7, 2018**
  - Project meeting, Matsue, Japan

---

CRO workshop in Malaysia

Project meeting in Matsue
R&D results:

- **Target #1:** *Evaluation* of the short-distance communication and imaging technologies independently first.

- **Target #2:** *Design, evaluation, testing and demonstration* of developed devices and subsystems are performed by each institute with their expertise.

*Results*

**Two** Field trial of mm-wave radio system in HCMC, Vietnam
R&D results:

The first Field trial of mm-wave radio system in HCMC, Vietnam

Investigators
- PTITHCM, HCMC DIC, NICT

Purpose of Field Trial
- To investigate the possibility of millimeter-wave radio communication for urban railway systems as a backhaul network to 4G and future 5G mobile communications.


Vietnam side:
- Dr. Quoc Cuong [HCMC DIC]
- Prof. Vo Nguyen Quoc Bao [PTIT]
- Mr. Pham Minh Quang [PTIT]
- Ms. Nguyen Phuong Thao [PTIT]

Japan side:
- Prof. Tetsuya Kawanishi [NICT/Waseda-U]
- Dr. Naruto Yonemoto [ENRI]
- Mr. Nobuhiko Shibagaki [Hitachi]
- Mr. Kyosuke Ishikawa [HiKE]
- Mr. Wataru Sawada [HiKE]
- Mr. Kosei Naito [Variable Energy]

2019.11.21 Manila, the Philippines
ASEAN IVO Forum 2019
R&D results:

The first Field trial of mm-wave radio system in HCMC, Vietnam

- Two investigation sites:
  - **Site #1**: PTIT campus in District 9, Ho Chi Minh City
  - **Site #2**: Van Thanh Station, Metro line #1, Binh Thanh District, Ho Chi Minh City

- Planned experiments have been successfully done.
- The field trial clarifies issues of configuration of cells and possible suggestion for direction how to configure for railway systems.
- The current transceiver system is not enough for railway systems. It will be optimized and redesigned.
R&D results:

The first Field trial of mm-wave radio system in HCMC, Vietnam

- Two investigation sites:
  - Site #1: PTIT campus in District 9, Ho Chi Minh City
  - Site #2: Van Thanh Station, Metro line #1, Binh Thanh District, Ho Chi Minh City

- Planned experiments have been successfully done.
- The field trial clarifies issues of configuration of cells and possible suggestion for direction how to configure for railway systems
- The current transceiver system is not enough for railway systems. It will be optimized and redesigned.
R&D results:
The second field trial of mm-wave radio system in HCMC, Vietnam

Investigators
- PTITHCM, HCMC DIC, NICT

Purpose of Field Trial
Propagation characteristic measurement for clear understandings. In January 2018, radio propagation characteristics will be measured for understanding fundamental properties in the millimeter-wave bands.

Duration: Jan. 8, 2018 – Jan. 12, 2018
R&D results:

The second field trial of mm-wave radio system in HCMC, Vietnam

![Graph showing pass loss (dB) vs distance (m) for different models and measurements.](image)

Figure from New elements towards a REVISION TO RECOMMENDATION ITU-R P.1411-8
R&D results:

Target #3: Integration of these technologies will be also discussed in the project through the meetings, the seminars or the workshops.


✓ Event 2: Workshop on Convergence of radio and optical technologies at Chiang Mai University, February 27th, 2017, The Empress Hotel, Chiang Mai, Thailand

✓ Event 3: IVO Project meeting in Bangkok, May 3, 2017, Hotel Pullman Bangkok Grande Sukhumvit Asok, Bangkok, Thailand


✓ Event 5: Special Session on ISEE 2017, Nov. 2017, Ho Chi Minh City University of Technology, Ho Chi Minh City, Vietnam

✓ Event 6: The 6th International Workshop on CRO, Feb. 22, 2018, Malaysia

✓ Event 7: The first fiscal year of 2018 Project meeting, Matsue, Japan
Target #4: **Sharing** the knowledge by publishing the paper and presenting the advanced research results in conferences:

- **2 papers**
- **5 papers** (2 joint papers with PTIT)
- **2 papers**
- **1 papers**

10 international conference and some technical reports

Keywords:
- antennas
- application
- based
- beach
- broadband
- communication
- conference
dec
digital
distribution
- electrical
electro
electronics
- energy-harvesting
- engineering
- fiber
- fiber-wireless
- generated
- international
- ieee
- isee
- linear
- measurement
- millimeter-wave
- modulator
- multihop
- multiple
- network
- nov
- optical
- patch
- pon
- power
- propagation
- radio
- receiver
- relay
- security
- sideband
- signal
- stacked
- study
- symposium
- systems
- technologies
- train
- transmitter
- vsb-nrz
- yagi
R&D results:

- **Target #5:** Providing contributions to international standardization bodies for societies in the ASEAN region
  - Propose preliminary work item on Millimeter-Wave Radio over Fiber Backbone for Train Communication Networks
  - Study on Rain Attenuation Effects to millimeter wave in Indonesia: Dr. Hazim Ahmadi (in the next APT-AWG meeting)
<table>
<thead>
<tr>
<th>No:</th>
<th>Paper title:</th>
<th>Author names</th>
<th>Affiliation</th>
<th>Conference name:</th>
<th>The date of the conference</th>
<th>The venue of the conference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Radio over fiber signal generation and distribution and its application to train communication network</td>
<td>Atsushi Kanno, Pham Tien Dat, Naokatsu Yamamoto, Tetsuya Kawanishi, Naruto Yonemoto, Vo Nguyen Quoc Bao, Tan Hanh, Le Quoc Cuong, Kenichi Kashima, Nobuhiko Shibagaki</td>
<td>NICT, PTIT, HCMC DIC</td>
<td>CLEO-PR, OECC and PGC 2017</td>
<td>2017</td>
<td>Singapore</td>
</tr>
<tr>
<td>No:</td>
<td>Paper title:</td>
<td>Author names</td>
<td>Affiliation</td>
<td>Conference name:</td>
<td>The date of the conference</td>
<td>The venue of the conference</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------------------------------------------</td>
<td>----------------------------------------</td>
<td>-------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>---------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>7</td>
<td>Demonstration of Receiver Generated Optical Doubinary and VSB-NRZ for Next-Generation PON</td>
<td>Sevia Idrus</td>
<td>UTM</td>
<td>The 2017 International Symposium on Electrical and Electronics Engineering (ISEE)</td>
<td>Nov. 28 – Nov. 30, 2017</td>
<td>Ho Chi Minh City, Vietnam</td>
</tr>
<tr>
<td>8</td>
<td>A Study on WiFi Hotspot Model for Vietnam Cities</td>
<td>Vo Nguyen Quoc Bao, Le Quoc Cuong, Tran Trung Duy</td>
<td>PTIT, HCMC DIC</td>
<td>The 2017 International Symposium on Electrical and Electronics Engineering (ISEE 2017)</td>
<td>Nov. 28 – Nov. 30, 2017</td>
<td>Ho Chi Minh City, Vietnam</td>
</tr>
</tbody>
</table>
Societal Impact:

- Propose preliminary work Items on millimeter-wave radio over fiber backbone for train communication networks
- Study on Rain Attenuation Effects to millimeter wave in Indonesia: Dr. Hazim Ahmadi (in the next APT-AWG meeting)
Conclusion:

- Short distance communication and imaging will be the key technologies for near future communications networks and applications.
- The research project has provided basic guidelines for
  - Design of photonic integrated devices
  - Millimeter-wave propagation, channelization, and its availability
  - Device evaluation technique
  - Feasibility of short-distance communication by both optical and radio technology in access networks numerically and experimentally
  - Feasibility of short-distance imaging by optical and radio, and their combination techniques
  - New hardware implementations for short-distance communication and imaging based on radio-over-fiber and its related technologies.
The collaboration among ASEAN institutes including universities, manufactures, operators and government
- Increasing the number of research scientists, engineers in the field of the convergence of radio and optical technologies for realization of 5G networks.
- Enhancing civil security and safety by imaging as well as to increase user experiences in future networks.
- Harmonizing the fundamental research based on the seeds for innovative technologies and strong demands from the operators, and finally, the institutes and governments can organize for international standardizations by these outputs.
Future prospects:

- Short-distance communication and imaging technologies are very potential with many future applications and networks. Their applications and performance can be improved if can be combined with other advanced technologies, such as AI and ML.
- More research collaboration activities are expected to make the project cooperation more efficient, i.e., trial tests and workshops are not enough.