Asia-Pacific Telecommunity

Survey Report

"ICT Expert Mission to study Climate Change and Disaster Management leading to creation of Community "E-Centers" in Tuvalu"

Survey Period: 6th to 19th December, 2017

JTEC

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Executive Summary

Considering importance of minimizing digital divide and use of ICT in assuring public safety in Tuvalu, it was decided to study current status and to identify possible models of creating disaster resistant "E-Community Centers" in order to collect and disseminate information on related issues directly from and to a community.

The study was carried out on the status of ICT system and services for developing E-Community Centers. Apart from Funafuti main island Fongafale, the team visited Funafala, a small island at the south west of Funafuti within the Funafuti lagoon to identify ways and means to collect and disseminate Govt. decision as well as status of disaster emergency related information to the endangered area. Survey was carried out on programmes and constraints on disaster risk management with immediate issues observed in Tuvalu.

The information from the islet of Funafala is very useful and effective to understand the situation in small inhabited islets which will be very much helpful to formulate a Pilot project on broadband ICT for public safety enhancing ICT activities on developing established culture on preparedness and safety.

Information on Tuvalu's current and future climate, and meteorological service data flow was made available by the Tuvalu Meteorological department. Tuvalu Disaster Management plan, known as National Disaster Risk Management Arrangements, prepared under the guidance of the National Disaster Committee following thorough extensive consultations with the Government, non-government organizations, civil society, and also with partner organizations at a Pacific regional level.

Actions to reduce vulnerability and increase resilience in DRR context is necessary to address climate change hazards. Therefore it is urgently required to create an environment for mainstreaming DRR and Climate related programs in the planning context. In order to achieve these functions, need of appropriate ICT network, related applications and services are extremely necessary.

During the mission it revealed that Tuvalu Govt. has a plan on fiber optic network running from the north tip to the south tip of Fongafale Island while another one from the Tuvalu House (Govt. Buildings) up to the Wharf realizing a loop within the island. At the start, the network services for major communities in Fongafale area of Funafuti and locations in two nearby islets can be selected for implementation. A pilot project could assist to materialize minimum ICT services as primary initiative.

Considerably urgent need is also to connect all the 8 island groups (provinces) to enhance ICT education, improved medical needs, gathering & dissemination of disaster information which in turn assist public safety requirements.

Key challenges with Tuvalu Telecom Corporation (TTC) are connectivity to other Islands for ICT services to other islands, billing system. The Meteorological Department (METEO) are highly affected with inadequate communication network system. No communication available in most of the island groups, and no internet available. PC network situation is very poor due to insufficient bandwidth where Broadband is very essential to extend ICT services. It has been observed that damage caused on ICT infrastructures due to natural disasters in recent years caused subsequent delay in recovery process.

Considering the current status of communication facilities, a fiber of 3km is recommended to start with. At the initial stage there will be 12-16 cable access branching points where almost half of which could be pulled from the Tuvalu house to complete the network in minimum lead time. A complete reliable network that will include the whole 9 provinces could be implemented with funding from International Donors in near future.

Funafuti-Tuvalu

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Glossary

DP	Disaster Prevention
DM	Disaster Management
DRRM	Disaster Risk Reduction and Management
DRR	Disaster Risk Reduction
EMWIN	Emergency Managers Weather Information Network
ICT	Information & Communication Technology
ISP	Internet Service Provider
IT	Information Technology
kbps	Kilo Bits per second
LAN	Local Area Network
MB	Megabytes
METEO	Meteorological Services Section
MIC	Ministry of Internal Affairs and Communications
NDC	National Disaster Committee
NDMO	National Disaster Management Office
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PIF	The Pacific Islands Forum
PITA	The Pacific Islands Telecommunications Association
PTC	The Pacific Telecommunications Council
PTWC	Pacific Tsunami Warning Center
SPC	Secretariat of the Pacific Community.
SPREP	SPC Regional Environment Program
TBC	Tuvalu Broadcasting Corporation
TC	Tropical Cyclone
TTC	Telecom Tuvalu Corporation
USP	The University of the South Pacific

International Organizations Specific to Pacific Nations

The Pacific Community

The Pacific Community (SPC) is the principal scientific and technical organisation in the Pacific region, supporting development since 1947. It has 26 members including, American Samoa, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Pitcairn Islands, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, and Wallis and Futuna, plus Australia, France, New Zealand and the United States of America.

The focus of activities are on major cross-cutting issues, such as climate change, disaster risk management, food security, gender equality, human rights, non-communicable diseases and youth employment. Using a multi-sector approach in responding to our members' development priorities, drawing upon skills and capabilities from around the region and internationally.

It supports the empowerment of Pacific communities and sharing of expertise and skills between countries and territories.

SPC Geoscience Division
(http://gsd.spc.int/)

The SPC Geoscience Division (GSD) (formerly SOPAC) began operation on 1 January 2011. The mission of the SPC is "to help Pacific island people position themselves to respond effectively to the challenges they face and make informed decisions about their future and the future they wish to leave for the generations that follow." The goal of the SPC Geoscience Division is to apply geoscience and technology to realize new opportunities for improving the livelihoods of Pacific communities.

The SPC Geoscience Division (GSD) has been established as an outcome of the regional institutional framework reform process called for by the Pacific Island Leaders Forum over recent years. Part of that process was to transfer and integrate the core work program of the Pacific Islands Applied Geoscience Commission (GSD) (GSD "The Commission") into the SPC. The purpose of establishing SPC Geoscience "The Division" is to ensure the preservation of the identity of the GSD work program that has built up an excellent reputation, amongst both Members and donor partners over nearly 40 years.

PIF: The Pacific Islands Forum

(http://www.forumsec.org/)

In 1971 founded as the South Pacific Forum and in 2000, the name changed to the Pacific
Islands Forum is a political group of 16 member countries; Australia, Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, New Zealand, Niue, Palau, Papua New Guinea, Republic of Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu. There are also a few countries participating as Associate Member. The annual Forum meetings are chaired by the Head of Government of the Host Country who remains as Forum Chair until the next meeting.

The Secretariat to the Forum was initially established as a trade bureau in 1972 and later became the South Pacific Bureau for Economic Co-operation (SPEC). In 2000, when the name of the Forum changed, the Secretariat became the Pacific Islands Forum Secretariat.

PTC: The Pacific Telecommunications Council

(https://www.ptc.org/)

First organized in 1978, PTC held its first annual conference in 1979 in Honolulu, Hawaii. PTC was incorporated as a non-profit, non-governmental organization in the State of Hawaii in 1980. An international, non-profit, non-governmental membership organization, PTC is the leading membership organization for telecommunications and information and communication technology (ICT) professionals with interests in the Asia-Pacific region. Through its annual conference, committees, community, events, and initiatives, PTC brings together senior industry leaders and provides them with opportunities to build partnerships with one another and share insights on industry trends, business strategies, policy and regulations, best practices, and new communication technologies and services.

PITA: The Pacific Islands Telecommunications Association

(http://www.pita.org.fj/)

The Pacific Islands Telecommunications Association (PITA) is a non-profit organization formed to represent the interests of Pacific Islands in the field of telecommunications.

PITA was formed in response to specific regional circumstances back in 1996 with the goal of providing a forum for those involved with telecommunications in the Pacific, to exchange experiences, to help formulate solutions relevant to the region, to provide training opportunities and the regular exchange of information, and to be a Pacific voice in the international communications environment. The objective of the association is to improve, promote, enhance, facilitate and provide telecommunications services within Member and Associate Member countries. As of 2016, there are 40 Members, 131 Associate Members and 16 Government Members. PITA's Office is based in Suva, Fiji.

The University of the South Pacific

(http://www.usp.ac.fj/)

The University of the South Pacific (USP) is the premier institution of higher learning for the Pacific region, uniquely placed in a region of extraordinary physical, social and economic diversity. Established in 1968, USP is jointly owned by the governments of 12 member countries: Cook Islands, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu and Samoa. The University has campuses in all member countries. The main campus, Laucala, is in Fiji. The Alafua Campus in Samoa is where the School of Agriculture and Food Technology is situated, and the Emalus Campus in Vanuatu is the location for the School of Law.

The University also offers programs through distance and flexible learning in a variety of modes and technologies throughout USP's 14 campuses and a number of small capacity learning centers based in its member countries.

Advanced communication technologies through USPNet are used to reach distance and flexible learning students across the Pacific Ocean. The USPNet is a satellite VSAT network that connects all the campuses and centers using satellite communication technology. The USP is also capable of providing region wide ICT Services including post disaster communications.

Pacific Regional Environment Programme (SPREP)

(http://www.sprep.org/)

SPREP is the regional organization established by the Governments and Administrations of the Pacific charged with protecting and managing the environment and natural resources of the Pacific. The head office is based in Apia, Samoa with offices in Fiji, the Federated States of Micronesia, and Republic of the Marshall Islands, Solomon Islands and Vanuatu.

SPREP has 21 Pacific island member countries and territories (American Samoa, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Northern Marianas, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu and Wallis & Futuna) and 5 developed countries (Australia, France, New Zealand, United Kingdom and United States of America) with direct interests in the region.

The establishment of SPREP sends a clear signal to the global community of the deep commitment of Pacific island Governments and Administrations for better management of the environment within the context of sustainable development.

Acknowledgements

Officials visited and interviewed for contribution

Mr. Tapugao Falefou	Permanent Secretary (CEO), Ministry of Communications Transport and Aviation, Government of Tuvalu
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Mr. Kisione Finau	Director of Information Technology Services The University of the South Pacific (USP, Suva, Fiji

Program Itinerary of the Expert Mission

Date	Day	Location	Activities
6-Dec	WED	Travel	Leave Tokyo
7-Dec	THU	Travel	Arrive Suva via Sydney
8-Dec	FRI	Suva/Fiji	Information gathering at Tuvalu Embassy & SPC on recent activities and developments in Tuvalu
9-Dec	SAT	Travel	Leave Suva / Arrive Funafuti
10-Dec	SUN	Funafuti	Visual survey of surrounding area vulnerable to hazards
11-Dec	MON	Funafuti	Meetings, discussions and visit facilities / Ministry of Communications Meeting with the PS, discuss and confirm Mission Schedule Courtesy call: Hon. Minister (If available) Tuvalu METEO Service Tuvalu National Disaster Management Office (NDMO) Tuvalu Telecommunications Corporation Tuvalu Broadcasting
12-Dec	TUE	Funafuti	Survey nearby community Survey on items related to Disaster and safety Site survey for future possible installations
13-Dec	WED	Funafala Islet (~30km)	Travel by boat Discuss with residents on situation in cyclone/ Tsunami Survey local church and installations available
14 Dec	THU	Funafuti	Works at the Govt. Offices to Correlate obtained data Hearing on opinion of officials on immediate future needs
15 Dec	FRI	Funafuti	Meetings, presentation and summing up Formulation of future ICT Projects on disaster management and for public safety
16-Dec	SAT	Travel	Leave Funafuti /Arrive Suva
17-Dec	SUN	Travel	Leave Suva/ Arrive Nadi
18-Dec	MON	Travel	Leave Nadi Arrive Sydney
19-Dec	TUE	Travel	Leave Sydney/ Arrive Tokyo

Inception Report of the Mission

<div align="right">December 11, 2017</div>

Subject: ICT Expert Mission to Tuvalu

Mission Title:
ICT Expert Mission to study of climate change and disaster management leading to creation of community "E-Centres" Tuvalu

1. Scope
Study on Disaster Risk Reduction and climate change issues to develop projects on sustainable models of broadband ICT systems in gathering information from sites and disseminating them to the sites for public safety preparing on 'saving anyone and anything that can be saved'.

2. Introduction
Tuvalu consists of nine separate islands, six of which are atolls and three are reef islands. Since an atoll typically consists of several islets, there are more than 124 islands and islets in total. The three remaining islands are also atolls but have a completely closed rim of dry land with a lagoon surrounded by a coral reef. The total land area is 26sq km and the population is 11,690. The flat islands rise approximately 5metres above sea level. Large lagoons are enclosed within the coral reef.
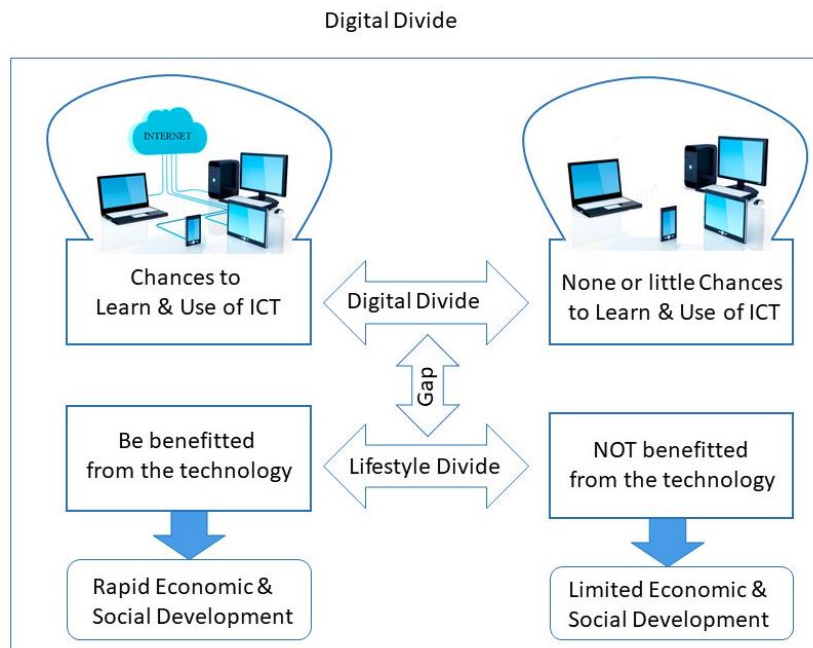
3. Background
There is limited communication system between the 9 main Islands of Tuvalu.
In the capital Funafuti, network speed is considerably low compared to many similar island nations. The disaster management information network including climate monitoring and message distribution networks are not developed. Severe tropical storms are usually rare, but there were cyclones, low levels of islands make them sensitive to changes in sea level.

4. Topics to study (Facts leading to needs and gaps)
Disasters are events occur beyond the capacity of the people, and take time to recover from the devastation caused. Understanding types of disasters that affect a locality provides a basis for developing disaster preparedness, and assists process for assessing

risks. In order to motivate inhabitants for disaster management, it is important to disseminate information to the community for their preparedness at all times.

Realizing digital divide and the importance of ICT in assuring public safety in Tuvalu, it is necessary to study the current status, key success factors, appropriate and sustainable models of creating disaster management "E-Community Centers" that can also gather firsthand information on related issues directly from site.

① Tuvalu's current climate

② Tuvalu's future climate

③ Major Meteorological Disasters in Tuvalu

④ Tuvalu Meteorological Service Data Flow

⑤ Standard Operating Procedure in Disseminating Strong Wind Warnings

⑥ National Cyclone response plan

⑦ Storm/Tidal Surges

⑧ Storm Surge from Hurricane

⑨ Standard operating procedure of message flow

⑩ Issues & Challenges

⑪ Tuvalu Telecom Corporation (TTC): Key Challenges & Way Forward:

⑫ Meteorological Department (MET): Key Challenges and Way Forward

⑬ Current status of communication

⑭ Related matters in progress

Points on survey related to ICT system in DM/DRR for public safety

To conduct study on ICT system in disaster and climate matters, to designate specific community vulnerable to hazards for developing E-Community Centers, identify ways and means to collect and disseminate Govt. decision as well as status of disaster and related information to the endangered area.

To survey means and constraints with disaster risk management in the country with environmental and humanitarian issues applicable to Tuvalu. In order to work out further issues and to identify means on improving the situation, visit to communities are considered essential.

The information from local communities will be utilized to formulate a Pilot project on broadband ICT for public safety, enhancing ICT activities on developing established culture on safety and preparedness.
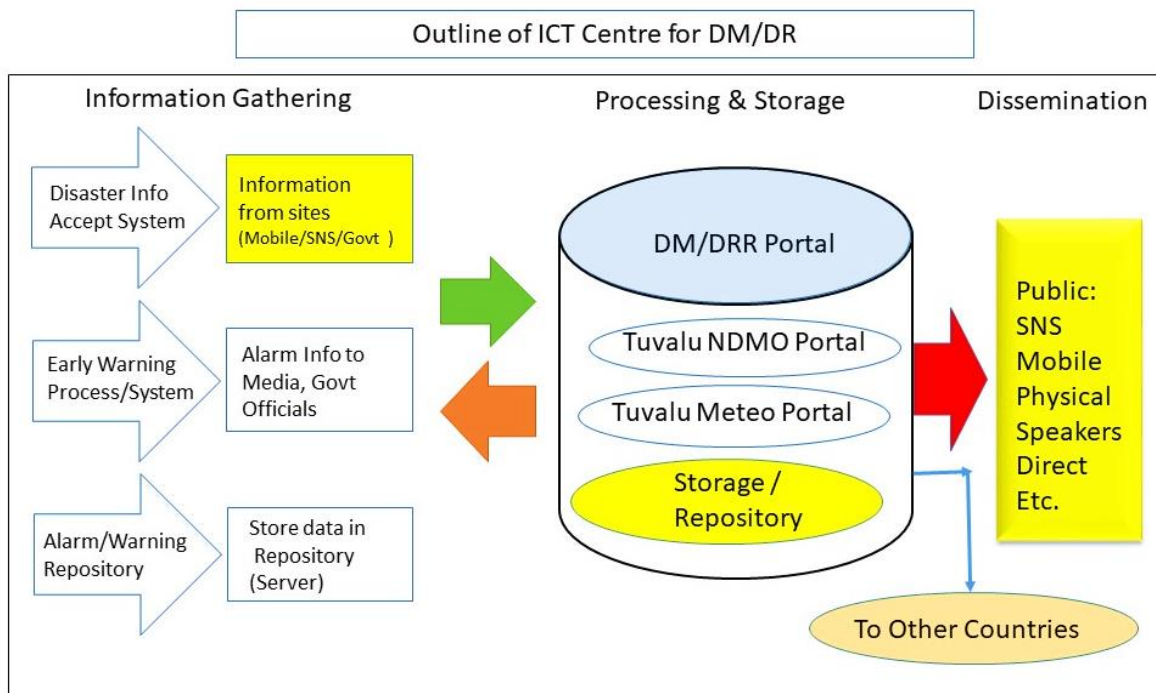
The above diagram shows a broader outline of ICT center for Disaster Management and Disaster Risk Reduction. In this survey and possible immediate future pilot projects, gathering information from the remote sites and disseminating Alarms and information to them for public safety will be considered (shown in yellow color).

Visits and survey locations

➢ Government Executives, Ministries for ICT & Broadcasting,

➢ Meteorological Department,

➢ Disaster Management Organization (DRM/DRR)

➢ International Organization,

➢ Telecommunication Operators

➢ Broadcasters

5. Items & issues to consider in this survey

Status of natural disasters in recent years, damages caused on ICT infrastructures with subsequent recovery process.

① Government Policies and Plan for Disaster Management.

② Actions with Meteorological Agency, Disaster management organization, Coordination between Organizations, Disaster Management Training activities in recent past.

③ ICT Status in Tuvalu (Telephone, Internet, Mobile Phone, Radio Communication, Satellite communication, Television, Radio, Satellite broadcasting).

④ Actual status of Disaster Information Management, Practical situation and problems on Telecommunication and ICT in Disaster management.

⑤ Status of Social Infrastructure such as Road, Electric Power, Transportation etc.

⑥ International Cooperation by donors from countries and international organizations in ICT and other sectors, Regional collaborations.

⑦ Possibility, effectiveness and issues of further deploying ICT systems.

⑧ Formulating an ICT development Pilot Project (Draft proposal).

Chapter 1

Introduction Mission Objectives and Background

1.1 Scope
Study on Disaster Risk Reduction and climate change issues to develop projects on sustainable models of broadband ICT systems in gathering information from sites and disseminating for public safety.

1.2 Background
A disaster is defined as a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources

There is limited communication system between the 8 main Islands group of Tuvalu. Around the capital Funafuti, network speed is considerably low compared to many similar island nations. The disaster management information network including climate monitoring and message distribution networks are not developed. Severe tropical storms are usually rare, but there were cyclones, low levels of islands make them sensitive to changes in sea level.

The Tuvalu Meteorological Service (TMS) is the principal Meteorological observatory of Tuvalu and is responsible for providing weather services to the islands of Tuvalu. A Meteorological office was established on Funafuti at the time the islands of Tuvalu were administered as parts of the Gilbert and Ellice Islands colony of the United Kingdom. The meteorological office is now an agency of the Government of Tuvalu.

The main observational office is on Funafuti. TMS operates outstations on Nanumea, Nui and Niulakita. TMS operates or monitors:

4 synoptic stations

5 rainfall stations

1 upper air research program

1 tide gauge with Tsunami warning system

1 Continuous Global Positioning System (CGPS) station

1 Seismic station (USGS).

The TMS publishes weather forecasts, warnings as to tropical cyclones, weather charts and weather satellite images on its website with weather forecasts and storm

warnings also broadcast by the Tuvalu Media Corporation, which operates Radio Tuvalu.

1.3 Changes in the Tuvalu climate

Temperatures have warmed and will continue to warm with more very hot days in the future. Little or no rain season causes draught leading to water shortage. Since the inhabitants heavily depends on rain water, no rain days cause severe life threatening situation.

Rainfall shows no clear trend since 1927. Projections of annual rainfall are unclear, with models indicating little change. Wet and dry years will still occur as a result of natural variability. Extreme rainfall events are projected to become more frequent and more intense. Drought frequency is projected to decrease by the end of the century.

Ocean acidification has been increasing in Tuvalu's waters. It will continue to increase and threaten coral reef ecosystems.

Sea level near Tuvalu has risen and will continue to rise throughout this century.

## 1.4 Facts and basic data of Tuvalu

Tuvalu means "group of eight," refer to the eight traditionally inhabited islands. Today it consists of nine small islands, six of which are atoll islands with lagoons and three are reef islands. Since an atoll typically consists of several islets, there are more than 124 islands and islets in total. The three remaining islands are also atolls but have a completely closed rim of dry land with a lagoon surrounded by a coral reef. Six of the nine atolls have lagoons open to the ocean, and three does not have a lagoon. The flat islands rise approximately 5metres above sea level. Large lagoons Funafuti, Nanumea, Nui, Vaitupu, Nukufetau, and Nukulaelae are enclosed within the coral reef. Funafuti, the capital is an atoll of 29 islets. Govt. administrative offices and other major businesses are in Vaiaku on Fongafale Islet. Administrative divisions consists of Funafuti town council, and 7 island councils Nanumaga, Nanumea, Niutao, Nui, Nukufetau, Nukulaelae, and Vaitupu.

Funafuti is a narrow sweep of land between 20 and 400 meters wide, encircling a large lagoon 18 km long and 14 km wide. The average depth in the Funafuti lagoon is about 36.5 meters. With a surface of 275 square kilometers, it is the largest lagoon in Tuvalu.

The land area of the 33 islets aggregates to 2.4 square kilometers, less than one percent of the total area of the atoll. There are at least 33 islets in the Funafuti atoll where three islands are inhabited. Fongafale, the main island in the east, Funafala in the south, and Amatuku in the north. There are 6000 inhabitants in the island of Fongafale followed by 60 in Funafala.
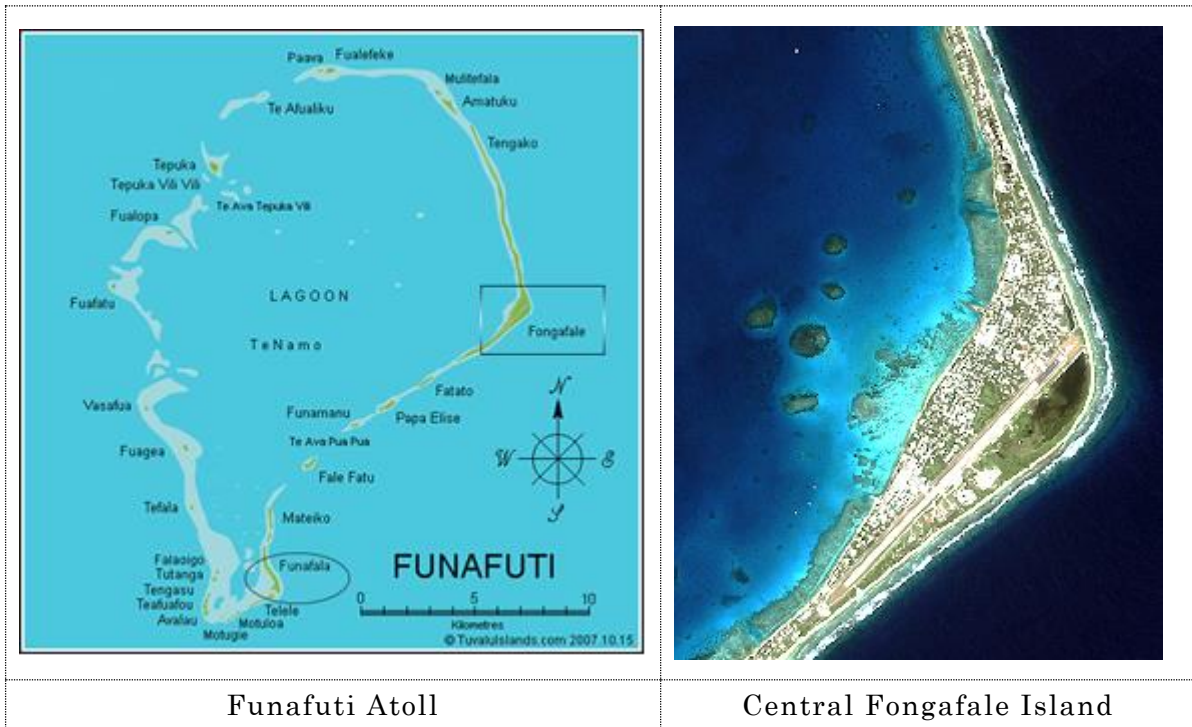
Funafuti Atoll	Central Fongafale Island

The Capital Funafuti is located on the island of Fongafale within the Funafuti lagoon as shown with a rectangle in the map. The capital of Tuvalu is sometimes called as Fongafale or Vaiaku, however the entire atoll of Funafuti is officially the capital. Amatuku is an islet on which the Tuvalu Maritime Training Institute is located. Access to Amatuku is from Tengako, which is the peninsula at the north end of Fongafale islet.

During the current survey, the island of Fongafale as well as the island of Funafala (circled) was visited and consulted with the local residents and the village head regarding their needs and challenges.

Location	8°31'27.68"S, 179°11'40.09"E
Land area	26sq km
Exclusive Economic Zone	200 nm
Population	11052
Inhabitants in Funafuti	6,000
Language	Tuvaluan, English
Telephone Land lines	1,200 (approx.)
Mobile 3G	2,800

Mobile 4G	Planned for end 2017

Poor Connectivity, and low bandwidth hinders development and disaster related issues. During Tropical Cyclone PAM (2015) most of the copper wire network for landline phones were inundated with sea water, thereby limiting the speed of activities or improvement in all sectors. Commercial satellite phones are very expensive to operate in smaller economy like Tuvalu. PSTN network and Domestic network to outer islands are poor and need quick improvement. Inter-island communications are even poorer to receive warnings and send observations. Reliable telecommunications with outer islands for weather and climate information is rarely available.

As of December 2017, TTC plans to phase out 3G and therefore no SIM or phones for 3G are sold.   As of December 2017, 4G facilities were under installation. Plan to cut over by the end of 2017. 4G will replace 3G instantaneously.

Maps of Tuvalu Islands & Administrative Zones (not to scale)

Funafuti

Funafuti_Central

Nanumaga

Nanumea

Niutao

Nui

Nukufetau   Nukulaelae   Vaitupu

Tropical cyclones occur around the equator at 5 ° - 30 ° but also have varying names depending upon where in the world they form.

In the northern hemisphere, tropical cyclones occur between June and November peaking in September. In the southern hemisphere, the season lasts from November to April but storms remain less common here than in the northern hemisphere. More than one tropical storm can occur in the same ocean and region at once. Due to the Coriolis Effect, the storms surface wind will be deflected to the right in the northern hemisphere to rotate counter-clockwise and to the left, to rotate clockwise in the southern hemisphere.
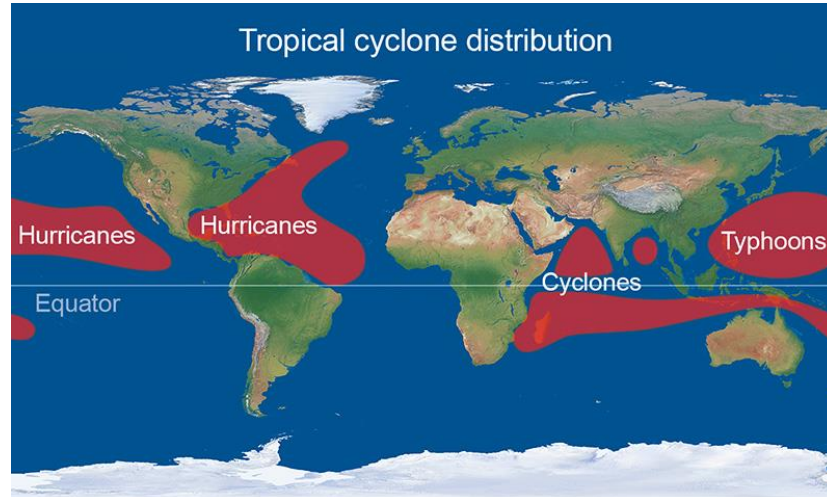
The tropical cyclone is classified by various different names globally despite resulting from the same process as shown in the picture below.

Tropical cyclones are most frequently seen to make landfall and impact in the USA and Asia. There are seven basins in which tropical storms are seen to form regularly at different times throughout the year, these are sometimes referred to as seasons.

NASA produced and published the actual observed tracks of tropical cyclones over 20 years from 1985 to 2005 and clearly shows their formation in the zones displayed in there as shown below.

Tracks of all tropical cyclones formed from 1985 to 2005
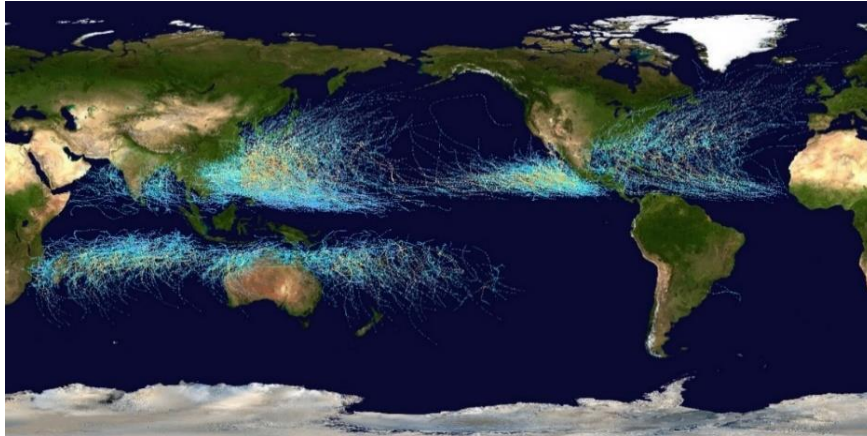
1.5 Survey objectives

Speaking about natural hazards, severe tropical storms are usually rare, but there were cyclones; low levels of islands make them sensitive to changes in sea level. No rivers exists, and no potable groundwater available. Damage to coral reefs from increasing ocean temperatures and acidification observed. Tuvalu is concerned about global increases in greenhouse gas emissions and their effect on rising sea levels. The main objectives of this survey are:

National Environment Management Strategy (NEMS) was first developed in 1997 with assistance from the South Pacific Regional Environment Programme (SPREP) to guide sustainable development policy and management and reverse the loss on environment resources. It identified a number of priorities and programmes including:

① Keep global warming on the international agenda
② Monitor sea level rise
③ Undertake environment impact assessments (EIA)
④ Legislate an Environment Protection Act
⑤ Train meteorological officer on forecasting tropical cyclones

1.6 Survey methodology

① Study documents prior to visits to that country
② Investigate current status by requesting to reply a questions
③ Interview high officials of respective department to correlate information
④ Set up discussions sessions to share information
⑤ Coordinate with APT and seek cooperation from APT where necessary.

1.7 Topics and facts leading to needs

Disasters are events beyond the capacity of the people, and take time to recover from the devastation caused. Understanding types of disasters that affect a locality provides a basis for developing disaster preparedness, and assists process for assessing risks. In order to motivate inhabitants for disaster management, it is important to disseminate information to the community for their preparedness at all times.

Realizing the importance of ICT in public safety in Tuvalu, it is necessary to conduct an expert mission to study the current status, key success factors, appropriate and sustainable models of disaster management "E-Community Centres" that can also gather firsthand information on climate change issues directly from site.

1.8 Survey items & issues

① Status of natural disasters in recent years, damages caused on ICT infrastructure

② Government Policies and Plan for Disaster Management

③ Meteorological Agency, Disaster management office, inter agency Coordination, ICT application Status in Tuvalu

④ Status of Disaster Information Management, Practical situation and problems on Telecommunication and ICT in Disaster situation

⑤ Status of Social Infrastructure such as Road, Port/wharf, Electric Power, etc.

⑥ International Cooperation by other countries and international organizations in ICT sector and other sectors, Regional collaboration

⑦ Possibility, effectiveness and issues of deploying ICT systems

⑧ Hearing opinions and comments on a possible ICT Pilot Project (Draft proposal)

1.9 Environment sustainability

① Challenges, opportunities, strategies and priorities for the environment sector.

② Improve awareness programs on the relationship between human activities, climate change and sea level rise

③ Continue to realise Tuvalu's concern on climate change and sea level rise in the international arena

Chapter 2

Infrastructure and Services

Survey on the ICT infrastructure and services available in Tuvalu with those systems are explained here in this chapter.

2.1 Establish effective communications networks

① Review communications systems to improve communications between Ministries and Departments, and with Tuvalu overseas diplomatic missions
② Upgrade communications infrastructures in all islands
③ Establish focal points of contacts for in each Ministry.

2.2 Strategy and private sector development

① To improve ICT education, train the teachers
② Create adequate training infrastructure for Training Institute at Maritime
③ Close the large gaps in accessing affordable ICT including the upgrading of quality and quantity by increasing connectivity.
④ ICTs are critical to address some of the most urgent development challenges, including in the area of climate change and environmental degradation.
⑤ To provides all people with affordable access to ICTs to benefit from the rights and opportunities.
⑥ The most vulnerable population groups including those living in disaster-prone and rural areas could benefit most from ICTs.
⑦ To narrow the gap of broader socio-economic inequalities and specific barriers from fully benefitting from the Internet.
⑧ The structural changes triggered by ICTs often lead to new digital ecosystems and present both opportunities and challenges for people and societies. In order to create knowledge economies and benefit from the extensive availability and use of ICTs, a solid backbone infrastructure, and full access to ICTs is required.

2.3 ICT indicators for disaster risk reduction

The devastating effects of disasters on human beings and on economic development, and in particular on the world's most vulnerable population groups. It illustrated the important link between ICTs and disaster risk reduction, as well as monitoring of climate change, which increases the likelihood of weather-related disasters. ICTs provide unprecedented opportunities to effectively assess the impact of climate change and to provide critical tools for disaster monitoring, early warning, and emergency response efforts.

The important role of ICTs has been recognized in the recently (2015) adopted Sendai Framework for Disaster Risk Reduction. Panelists highlighted the need to identify specific ICT related indicators to track progress towards achieving the global targets of the Sendai Framework. ITU, in close cooperation with its Members States and Sector Members, should contribute to the development and promotion of these indicators. While some existing ICT indicators could be used, other areas, including in terms of regulation and last-mile connectivity, may require the development of new indicators.

This includes indicators to measure infrastructure resilience, the impact that disasters have on critical telecommunication infrastructure and to track the disruption of basic ICT services. To track Target G of the Sendai Framework, which is about access to multi-hazard early warning systems and disaster risk information, indicators should be developed to track the availability of communication networks, emergency alert standards and channels, and the dissemination of information to *at-risk* communities.

The need for high capacity and reliable communication links to effectively mitigate the impact of disasters, and showcased examples of progress made in disaster risk management. National disaster risk reduction strategies should include specific references and strategies in terms of telecommunication/ICTs, including quantitative targets and indicators. In this regard, national coordination between different stakeholders, including ICT policy makers, operators, national meteorological services and others is critical. Governments were encouraged to develop clear coordination mechanisms.

That data quality remains an important issue in the field of ICT statistics. In some countries, ICT data are not meeting international standards and are therefore impacting negatively on the status of a country's ICT performance. This needs to be addressed by all stakeholders involved in the national ICT data ecosystem.

2.4 Paradigm shift

Information on Disaster Risk Reduction and Management (DRRM) data should be accessible to the public. Effective DRRM requires use of all available E-Governance tools to disseminate information.

Earlier years	Today
Top-down and centralized disaster management	Bottom-up and participatory disaster risk reduction
Disasters as merely a function of physical hazards	Disaster mainly a reflection of people's vulnerability
Focus on disaster response and anticipation	Integrated approach to genuine social and human development to reduce disaster risk
Gross and General activities	Hazard specific, Time bound, Area focused

Tuvalu: Funafuti Telecom Broadcast/Tuvalu Media Dept. and Police headquarters
(Photo taken from the Hotel)

Government Buildings
Tuvalu

Funafuti Wharf

Govt Building & the Wharf

From left: Dr.Kader H Pramanik, Mr. Tauala Katea and Mr. Minoru Takahara

Chapter 3

Information Gathering related to this Survey

3.1 Literature on the use of ICTs in disaster management

The results of literature survey on disaster management on the use of ICT in Tuvalu was carried out from web information retrieval and printed available literature.
The following list is the excerpts of the information found particularly useful in the use of ICT in disaster management.

3.1.1 Studied documents in English

No.	Title / Content	Source
E05	Disaster Management Plan/Japan http://www.bousai.go.jp/taisaku/ keikaku/english/ disaster_management_plan.html	Cabinet Office/ Japan
E10	The Booklet of Best Practices of Resilient ICT systems in JAPAN http://www.soumu.go.jp/main _content/000372211.pdf	MIC, CTI Engineering
E11	The Booklet of Best Practices of Resilient ICT systems in the Philippines. http://www.soumu.go.jp/ main_ content/ 000372209.pdf	MIC, CTI Engineering
E13	MIC's International Cooperation in the field of ICT for Disaster Management. https://www.itu.int/en/ITU-D/Regional-Presence/ Asia Pacific/Documents/ Events/2016/.pdf	MIC Japan
E29	Learning from Megadisasters / Lessons from the Great East Japan Earthquake. https://openknowledge. worldbank.org/ bitstream/handle/ 10986/ 18864/9781464801532.pdf?sequence=1	Federica Ranghieri and Mikio Ishiwatari, The World Bank
E34	Challenges with ICT in disaster management and infrastructure for Disaster Risk Reduction http://www.apt.int/sites/default/files/2016/04/WDMC-7_ INP-27, _JTEC_Challenges_with_ICT_i n_DM_ver2.pdf	APT WDMC-7 Dr. Kader Hiroshi Pramanik

3.1.2 Studied documents in Japanese

No.	Title / Content　URL	Source
J11	日本の災害対策 http://www.bousai.go.jp/1info/pdf/saigaipamphlet_je.pdf	内閣府
J23	防災・減災等に資するサービス事例集 ICT http://www.cas.go.jp/jp/seisaku/resilience/dai2/siryou2.pdf	総務省
J24	災害医療・救護活動において確保されるべき非常用通信手段に関するガイドライン http://www.soumu.go.jp/menu_news/s-news/01tsushin03_02000176.html	総務省
J34	東日本大震災後の情報通信への取り組み http://www.riec.tohoku.ac.jp/sympo201106/pdf/2-2_izawa.pdf	井澤一朗／総務省東北総合通信局長
J37	防災 ICT システム及びサー ビスの日本におけるベストプラクティス集; http://www.soumu.go.jp/main_content/000372210.pdf	総務省／㈱建設技術研究所、㈱建設技研インターナショナル
J54	移動式ＩＣＴユニットに関するＩＴＵとの共同プロジェクト実施結果 http://www.soumu.go.jp/main_content/000406462.pdf	総務省/DOST
J60	プロジェクト研究「開発途上国における情報通信技術の適用のあり方に関する調査」 http://open_jicareport.jica.go.jp/pdf/12245437.pdf	国際協力機構 社会基盤・平和構築部,

3.2 International donor agencies initiatives on ICT utilization

Donors	Initiatives of international donor agencies
JICA (Japan International Cooperation Agency)	●Cooperation Focused on Dealing with Small Size, Isolation and Remoteness Issues/The Pacific, JICA Annual Report 2015 https://www.jica.go.jp/english/publications/reports/annual/2015/c8h0vm000 09q82bm-att/2015_09.pdf ●JICA International cooperation , JICA Annual report/Oceania JICA Annual report/Oceania https://www.jica.go.jp/english/publications/reports/annual/2014/c8h0vm000 090s8nn-att/2014_09.pdf ●The project report "Survey on the nature of the application of information and communications technology in developing countries," October 2015, The challenges and directions to actively promote the use of ICT in development assistance.
Asian Development Bank	●ADB activities: "Technical Assistance Report"/March 2015 Applying Space-Based Technology and Information and Communication Technology to Strengthen Disaster Resilience: Technical Assistance Report https://www.adb.org/sites/default/files/project-document/157926/48333-001-
Inter-American Development Bank	●Inter-American Development Bank's disaster risk management approach; Helping Latin America and the Caribbean manage natural disaster risks. http://www.iadb.org/en/topics/natural-disasters/natural-disasters,1441.html

World Bank	●The World Bank, opened the home page of the disaster risk management introducing its efforts /disaster Risk Management http://www.worldbank.org/en/topic/disasterriskmanagement
	●Efforts on the use of ICT in DRM; Information and Communications Technology for DRM; Japan-World Bank Program for Mainstreaming Disaster Risk Management in Developing Countries" Knowledge Program Many countries have developed policies to begin managing their disaster risk. However, most countries request and seek additional support to access the information, tools, and technology they need to implement these policies. Japan is one of the global leaders in ICT and has applied this expertise to managing its disaster risks for decades. Using sensor networks and satellite imagery, among other tools, ICT-driven applications and data are the backbone of Japanese early warning systems and decision-making processes to address the risks posed by disasters such as earthquakes, tsunamis, and flooding. ICT solutions also enhance coordination among institutions at various levels during disaster response, recovery, and reconstruction phases. The World Bank Disaster Risk Management Hub's ICT for DRM engagement is leveraging Japanese and global best practices to pilot a practical toolkit for practitioners to identify, prepare, appraise, and implement solutions for specific disaster types and DRM needs. The toolkit will showcase empirical case studies of ICT use for DRM in Japan, particularly from the 2011 Great East Japan Earthquake. http://www.worldbank.org/en/news/feature/2015/12/16/drmhubtokyo-knowle-information-and-communications-technology-for-drm ●A TOR issued by the World Bank related with DRM and ICT "Japan-World Bank program for mainstreaming disaster risk management in developing countries – smart disaster risk management (DRM) – ICT readiness and applications"

UNDP	●UNDP: Disaster Risk Reduction http://www.undp.org/content/undp/en/home/ourwork/crisispreventi onandrec overy/focus_areas/climate_disaster_risk_reduction_ and_recovery.html? country ●UNDP Innovation for 2030 / UNDP INNOVATION FACILITY ∣ 2015 YEAR IN REVIEW http://www.undp.org/content/dam/undp/library/ innovation/TheIF20 15Report-Webversion20June.pdf ●UNDP and the World Conference for Disaster Risk Reductin (2015) http://reliefweb.int/sites/reliefweb.int/files/resources/UNDP_at_the_ WCDR R_Introduction.pdf ●UNISDR Homepage (UN Office for Disaster Risk Reduction) https://www.unisdr.org/
ESCAP	●Disasters without Boarders / Regional Resilience for Sustainable Development http://www.unescap.org/our-work/ict-disaster-risk-reduction
ITU	●ITU-D　National ICT Policy: Knowledge-Based Report https://www.itu.int/en/ITU-D/Projects/ITU-EC-ACP/ICB4PAC/ Documents/F INAL%20DOCUMENTS/national_ICT_policy.pdf ●ITU-T Resilient pathways: The adaptation of the ICT sector to climate change (Report 2014) http://www.itu.int/en/ITU-T/climatechange/documents/ Publications/Resilient_Pathways-E.PDF
USAID	●USAID /Bureau for Democracy, Conflict and Humanitarian Assistance USAID/OFDA Disaster Risk Reduction Strategy https://www.usaid.gov/what-we-do/working-crises-and-conflict/ disaster-risk -reduction/usaidofda-disaster-risk-reduction ●Office of U.S. Foreign Disaster Assistance https://www.usaid.gov/who-we-are/organization/bureaus/bureau-dem ocracy- conflict-and-humanitarian-assistance/office-us

AUSAID	●Development assistance in the Pacific/ Pacific Regional—climate change and resilience http://dfat.gov.au/geo/pacific/development-assistance/Pages/resilience-pacific-regional.aspx ●Australian Support for Climate Change, Environment and Disaster Risk Management in the Pacific https://dfat.gov.au/about-us/publications/Documents/pacific-climate-change-review-aug2013.pdf
NZAID	The New Zealand Aid Programme is the New Zealand Government's international aid and development programme. Through the programme, New Zealand's aid efforts concentrate on activities that contribute to poverty reduction through sustainable economic development; create safe, secure and inclusive societies; fulfil basic needs; and focus on sustainability. The New Zealand Aid Programme delivers New Zealand's official support for developing countries. The purpose of New Zealand's aid is to develop shared prosperity and stability in the Pacific and beyond, drawing on the best of New Zealand's knowledge and skills.

3.3 Tuvalu National Disaster Risk Management Plan and organizations

The Tuvalu National Disaster Risk Management Plan is available as three documents as mentioned below. The documents which constitute the Arrangements are designed to provide a high level view of the Disaster Risk Management framework within which will sit both disaster risk reduction and disaster management components. The combined documents will be known as the National Disaster Risk Management Arrangements and are presented in three parts.

This is the Disaster Management component of the Arrangements and outlines operational imperatives. It includes activation plans and provides in detail roles and responsibilities, from ministerial to departmental level and lists the various functional plans that have been prepared for specific events. It also contains procedural guidelines for the key committees outlining key roles and responsibilities.

3.3.1 Tuvalu National Disaster Risk Management Arrangements

① Disaster Risk Management and Risk Reduction
② Legal & Regulatory Framework
③ DRM Principles and DRM Committees
④ Country Hazard Profile
⑤ Organization and Organizational Structure
⑥ National Disaster Management Office
⑦ National Activation System
⑧ Training & Awareness

3.3.2 Procedures, Guidelines and Templates

①Ministerial DRM Roles and Responsibilities;
②Guide to the Development of Divisional, Departmental and Office
③DRM Roles & Responsibilities Functional Plans
④National Disaster Committee Procedural Guidelines

3.3.3 Governance Audit

① Corporate Governance Framework
② Corporate Governance Audit Matrix
③ Guiding Legislation and Documentation
④ NDMO Position Description
⑤ NDMO Business Plan

## 3.4 National disaster management and control system

The National Disaster Committee (NDC) who have accountability for the monitoring and reviewing of all aspects of the Arrangements. They are also responsible for reviewing DRM strategy and plans on an annual basis and ensuring appropriate audits are conducted to provide assurance to Cabinet any disaster risks have been identified and appropriate mitigation strategies implemented.

The National Disaster Management Office (NDMO) provides secretariat support for the National Disaster Council and will provide internal DM consultancy services to ministries whilst monitoring and reviewing DRM Arrangements at local and Island level. Through the NDMO the National Disaster Preparedness Working Group (NDPWG) is responsible for development of both government and community training & awareness programs. The Group is responsible for developing policy and setting direction for training programs which align with the key DRM risks as determined by the NDC.

The NDMO is the liaison with Island Disaster Committees on all issues of DRM both under normal conditions and in times of crisis, whilst the Development Coordinating Committee is the forum for discussion regards ongoing integration of DRM strategy into mainstream government business.

The disaster risk management operational structure operates at two levels such as for normal operations and during times of emergency

In normal situation where there is no emergency the l operation structure is as follows.
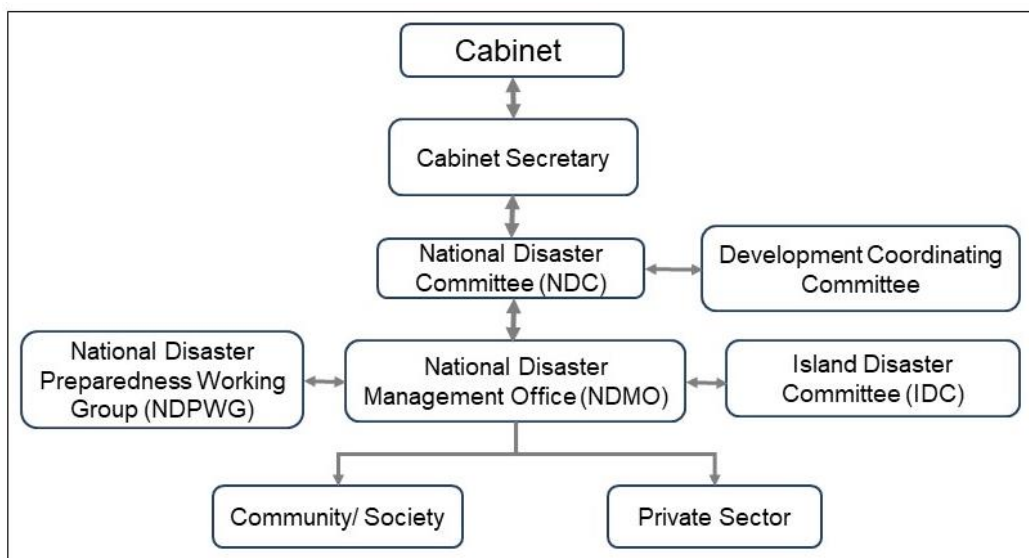
In Emergency situation the l operational organisation structure is as follows. The structure comes into effect when the National Activation System is activated and remains in place until the situation is cleared by the Disaster Controller.
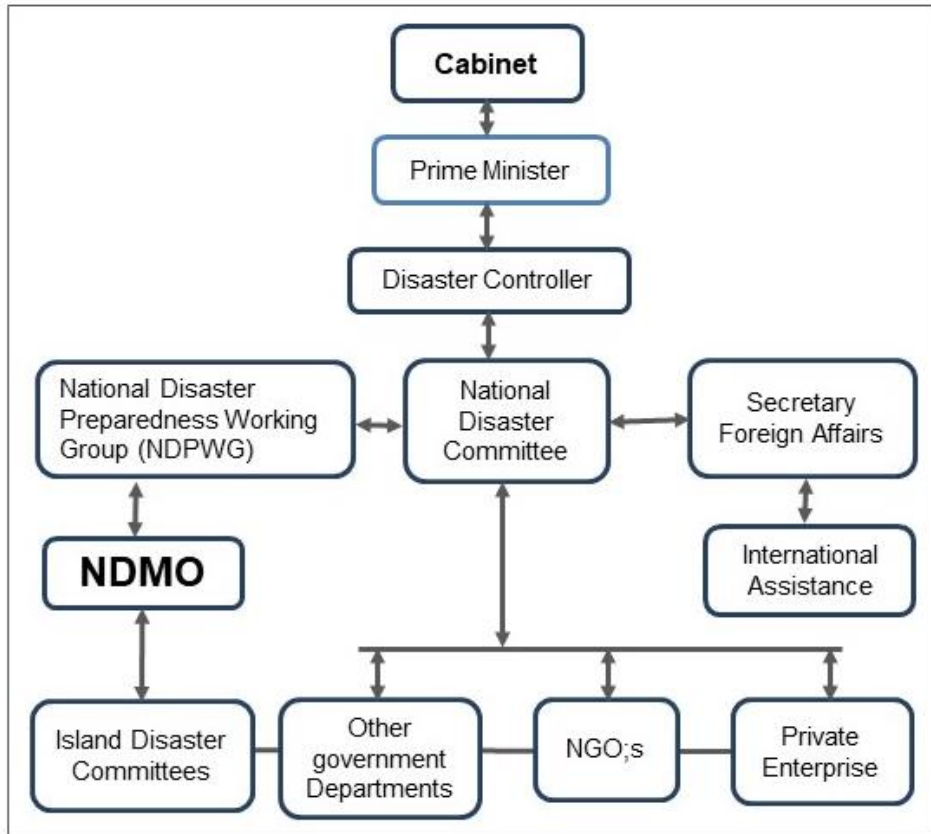
The National Disaster Committee (NDC) is comprised of:

- Secretary Home Affairs (Chair)
- All Secretaries of Government Ministries
- Commissioner of Police
- Director of Public Works
- Director of Disaster Management Office
- Director Meteorological Office
- Tuvalu Red Cross, and
- Representative from island communities (Funafuti Falekaupule)

The Island Disaster Committee (IDC) is comprised of:

- Chairperson
- Vice Chairperson
- Secretary
- The island Dresser or Nurse
- The Manager of the local Fusi
- A Red Cross Representative
- A Police Officer
- Radio Operator
- Headmaster of a local school
- The island Agricultural Officer (if present)
- TEC Supervisor and
- The Principal of Motufoua School (for Vaitupu atoll).

The functions of various committees are explained in the document "Tuvalu National Disaster Risk Management documents shown in reference".

The Police office explains their Disaster Emergency Alarm System

Chapter 4

Issues and challenges

There are extensive need to improve situation in Tuvalu such as improving service quality and delivery, in-country scientific research in support climate adaptation & mitigation projects with on timely decision making, strengthening capacity development on weather, climate and ICT systems and services.

Further, capability to prepare and deliver high quality early warnings, weather forecasts, climate and hazards, introducing modern infrastructure with training competent human resources to facilitate with improved reliable communication systems for rapid exchange of data and products.

4.1 ICT in disaster management and climate change in Tuvalu

4.1.1 Climate change in Tuvalu

The highest point of Tuvalu is 5 meters over sea-level where the sea-level rise is a major threat. The consequences of climate change will and already have considerable impacts on these islands. Due to sea-level rise, the ground of Tuvalu is prone to increasing salinization, threatening the habitats of local plants and coconut trees. Climate change is heating the ocean water which impacts the corals and the marine animal habitat. Tuvalu has been increasingly exposed to tropical storms and cyclones, tropical storms, hurricanes. The islands are experiencing more meteorological events in recent years.

### 4.1.2 Meteorological disasters and dissemination of information and warnings

Mainly in cyclone season between November and April are Tropical Storm, Storm surge, Wind gust/ mini tornado, Thunderstorms, High waves, and Inundation
In order to decrease the impacts of meteorological events like storm, cyclone and others to save the population, the country should have to implement of potential disaster alert and response system. The mode of communication for transmitting data from remote stations are; HF radios as primary and phone lines & Internet as secondary. The Tuvalu Meteorological Service publishes weather forecasts, warnings as to tropical cyclones, weather charts and weather satellite images on its website, with weather forecasts and storm warnings also broadcast by the Tuvalu Media Corporation, which operates Radio Tuvalu.

TUVALU METEOROLOGICAL SERVICE DATA FLOW
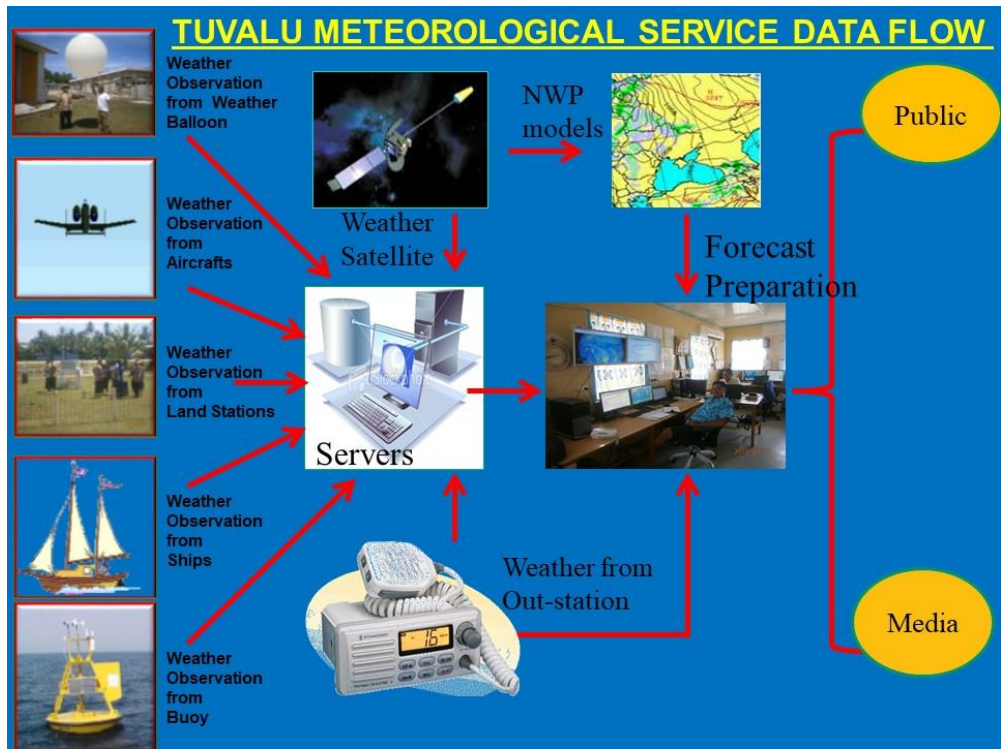
Source: Tuvalu Meteorological Service
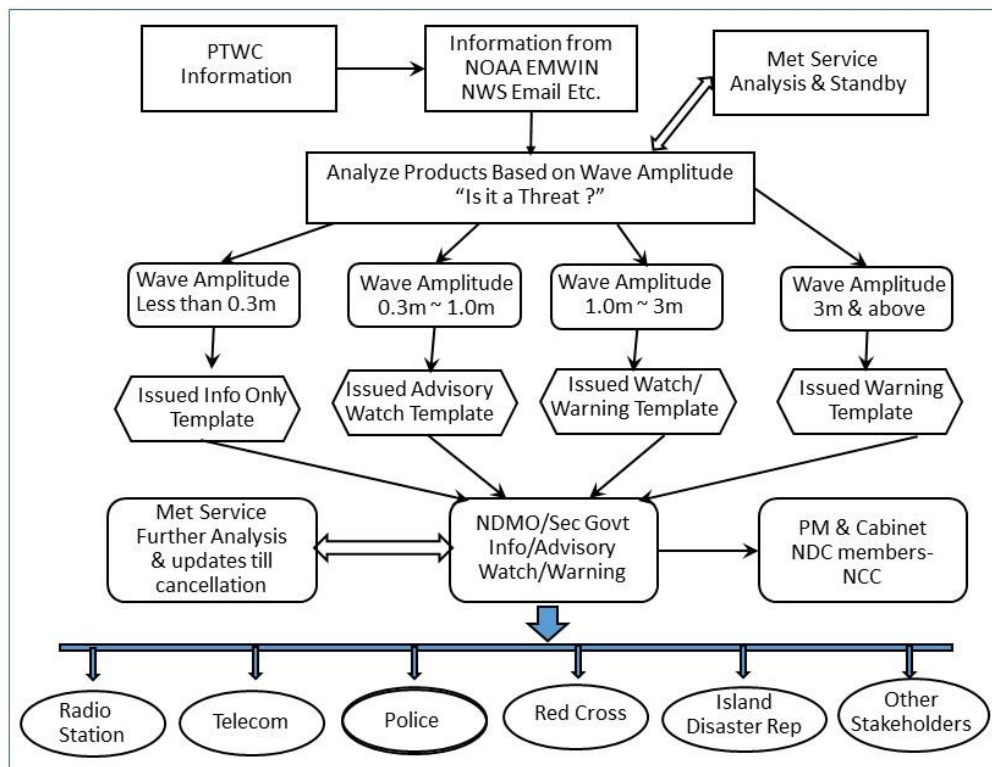
Tuvalu MET service standard operating procedures message lowchart

Tuvalu Meteorological Service data for Weather Observation are gathered from Land Stations, Ships, Buoy, Aircrafts, Weather Balloon, Out-station facilities, and used for forecast forecasts preparation which is then transmitted to Public and to the Media. Strong Wind Warning issued by Forecasting Division (TMS) and transmitted to the following departments/offices

• National Disaster Management Office
• Secretary to Government
• Media Department
• Police Department & NCC
• Marine Department
• Taiwan Embassy
• Relay warning to offshore vessel/mariners within Tuvalu waters: HF (freq. 6215)
• Met Out-Station & Funafala Islet & Amatuku via HF/Phone (freq. 4576 & 7669)

4.2 Key impacts with sea level rise, temperature rise and rainfall

① Higher King tides or Spring tides
② Salinity of groundwater
③ Impact on food crops e.g. swamp Taro plants
④ Adverse impact on coastal infrastructure
⑤ Inundation of low-lying & coastal areas
⑥ Accelerating coastal erosion
⑦ Increased in temperature trigger intensity of tropical cyclones formation
⑧ Extensive tidal & storm surges
⑨ Severe erosion
⑩ Coral bleaching.
⑪ Changes in rainfall patterns throughout the year
⑫ Frequent dry spells and longer periods of droughts

4.3 Disaster management: Strategic actions

① Share Expertise in DM
② Promote use of Broadband networks in DM
③ Importance of submarine cables and DM
④ Awareness of satellite communications in DM
⑤ Promote collaboration with International bodies and the private sectors on DM
⑥ Produce a standard model for effective ICT use in DM
⑦ High level workshops in DM-ICT

4.4 Cyclone Storm/Tidal Surges and National Response Plan

Potentially, the most destructive phenomenon associated with tropical cyclones that make landfall is the storm surge. Storm surge is a raised dome of water about 60 to 80 km across and typically about 2 to 5m higher than the normal tide level. If the surge occurs at the same time as a high tide then the area inundated can be quite extensive, particularly along low-lying coastlines.Predicting coastal/near shore damages from large waves, swells and surges, Especially when coincides with King Tides and strong winds.

The TMS will issue TC advice as appropriate to the given threat, from a TC alert (initial stage) to highest state of threat to NDMO, Govt., public, Media etc....

- Cyclone Alert   (issued every 6hrs)
- Cyclone Warning: Gale Force winds (issued every 6hrs)
- Cyclone Warning: Storm Force winds (issued every 3hrs)
- Cyclone Warnings: Hurricane Force winds (issued every hour)

4.5 Immediate issues & challenges with ICT

① Connectivity is poor: Very few phones are operational
② Low bandwidth: Internet in Funafuti is in very basic state. Service provided is only by volume and not by speed.
③ During TC Pam most of the copper wire network for landline phones were inundated with sea water;
④ Market is very small to support and sustain investment in the communication sector;
⑤ Satellite phones are very expensive to operate
⑥ Connectivity to other Islands: Connectivity via satellite but available only at clinics and schools.
⑦ Billing system: 4 types of billing system in effect. Data & Mobile are same charge

4.6 Climate change challenges Tuvalu

Tuvaluans don't want to leave the islands until the very last minute as they say that it is the god gifted island for them. How can it protect itself from this intangible threat, especially when there is no precedent for such action? Solutions will have to be created to avoid catastrophes.

Many small islands do not extend more than 3 to 4 meters above the mean sea level at their highest point. Tidal gauge data show that the global average sea level rose between 0.1 and 0.2 meters during the 20th century. The impacts of such a development will be tremendous and are already partially perceptible; these include the loss of coastal lands, flooding and soil salinization in addition to harm to crops,

ground water sources, and land and marine biodiversity. As most island homes, infrastructure, and commercial activities are along the coasts, Tuvalu is a high risk to the life and health of the inhabitants. The sea is intricately linked to Tuvalu's natural and social system, it has always maintained life on the islands. A change in sea level is therefore not an abstract risk but a challenging task to the everyday life of Tuvaluans. With a sea-level rise, salt-water intrusion and the increasing insecurity on more or less frequent rains, the problem of water resources arises. As an atoll country, Tuvalu relies on rainwater and is therefore sensitive to precipitation patterns that changes in storm tracks. This is the case for Tuvalu where many droughts are provoked by El Niño-Southern Oscillation (ENSO).Frequent unwavering ENSO events will pose an additional stress on the potable water sources, which already are suspected under current weather patterns.

If rainwater were to become insufficient, the residents of Tuvalu would have to turn to the very limited ground water supplies. These reserves are located in the community as well as in the state level. If no-rain situation persists for about a month, the water tanks of residents become empty, when the Govt has to provide water to the people from the reserve according the Disaster Coordinator Mr. Sumeo Silu. So there is a need for measuring the water contents of the tanks using suitable ICT technology.

4.7 Tuvalu's future climate approximation

• Temperature will continue to increase and is projected to be in the range of 0.4~1.0°C.
• As a results very hot days and warm nights will increase.
• Changing rainfall patterns in wet and dry seasons which may directly result in intensification of the South Pacific Convergence Zone.
• More extreme rainfall days
• Less frequent but more intense tropical cyclones.
• Sea level will continue to rise in Tuvalu; under a high emissions scenario this rise is projected to be in the range of 4 – 14cm by 2030.
• Ocean acidification; as the acidity level of sea waters in our region will continue to increase.

Chapter 5

Information from Interviews and Discussions with Executives

5.1 Telecom Tuvalu Corporation (TTC)

In order to obtain an exact picture of ICT development and services in Tuvalu, the team visited the CEO of Tuvalu Telecommunication Corporation (TTC) and had detailed information on ICT Status in Tuvalu through interview as follows.

Mobile 3G.	3G core is at FSM Currently only a few phones are in operation Soon TTC will phase out 3G No SIM, No 3G phones are sold now
Mobile 4G. Band 5, 850MHz (Plan 700MHz)	Currently under installation Plan to cut over by the end of 2017 No trial with public yet 4G will replace 3G completely and 3G will be discontinued
Land line: ADSL	Available for business. Speed not available. Sale in volume only (MB. GB)
Land line: PSTN	Available but problems of call setting. Many more problem of connection with U/G wire when rains. Service is poor. Only local calls. No International call possible. Billing system is not working, eventually not earning revenue.
Connectivity via satellite	4 islands are on ABS6 satellite Other 9 islands are on NSS9 Satellite bandwidth renting from Speedcast by volume NSS9 → 30MB ABS6 → 60MB
Service to other islands	Wireless via ABS6: 4Mbps Locations: currently in clinics and schools Public: not available

Billing system	4 types of billing system in effect. Data & Mobile are same tariff OCS (online charging system) billing system: uses only 100MB; planned for 300 MB
Operation and Maintenance	Self-sustained with operator support
Possible Fibre cable	No plan for inter-island fibre cable. Next 10 years will go on with satellite
New comer satellite	Kacific came 2 years ago and quote about $1000-per MB. Waiting to see. Ka band is deep problem for this rain dominated country. Speedcast contract until 2018. No dedicated link. CPD only. Interested in JC-Sat satellites in Ku band & C band.

From right : Mr. Simeti Lopati, CEO Telecom Tuvalu Corporation,
Mr. Minoru Takahara, and Dr. Ksder H Pramanik

5.2 Tuvalu Media Department

In order to obtain an exact picture of Media development and services in Tuvalu, the team visited the Managing Director, Tuvalu Broadcasting Corporation. (TvBC), and had detailed information on Media status in Tuvalu through interview as follows.

TV Broadcast	No local TV broadcast available. Satellite TV from Australia available
Population covered	6,000 inhabitants of Funafuti Atoll
Radio Broadcast Frequency and Power	AM 621 KHz Transmit Power 10KW at Funafuti FM 101.1 MHz Transmit Power 150W at Funafuti (now operating only with 2W)/ Equipment maker: Eddy Stone (UK), and other mixed makes (big problem)
Radio BC programmes Weekdays	AM 6:00~9:00 Local programme (except Sunday) AM 9:00~11:00 Relay BBC service (except Sunday) AM 11:00~PM13:00 Local programme PM 13:00~PM18:00 Relay BBC service PM 18:00~PM 22:00 Local programme PM 22:00 Closing
Radio BC programmes Sundays	AM 11:00~PM13:00 Local programme PM 13:00~PM18:00 Relay BBC service PM 18:00~PM 22:00 Local programme PM 22:00 Closing
Programme Language	Almost 100% Tuvaluan Language English news 5minutes atAM6:00, PM 12:00, & PM 18:00
Radio sets availability	Assume that every house has one radio set supplied from NAPA & NAPAR projects. Solar powered radio sets.
Operational problems	Transmit power of FM transmitter is down to 2W. No Problem with AM transmitting. ST link (station to transmitter link) poor due to FM low power
Media Publications	Newspaper: Yes Internet: None. Problem of access point.

|	
Public Internet	Available at Post Office
Other constraints	Financial Problem! Lack of Human Resources
Finance: From Govt	$180,000- for the year 2017 $100,000- approved for the year 2018
Emergency Broadcasting	Broadcast message received from Disaster Management Committee (DMC) and broadcast them any time as and so needed 24/7.
Broadcast equipment	Donated/supplied everything from Japan
Future Plans	To Publish Newspaper as media Dept. is responsible for. Publish Digital News (newspaper). Plan to install documentary programme facilities.
Affiliations	Member of ABU (formerly also member of PINA)

Mr. Stanley Manao Chief Engr (left) and Ms. Melali Taape CEO, TvBC(3rd from left)

5.3 Govt. ICT Department

In order to obtain a detailed and up-to-date information on ICT status & development in Tuvalu, the Director of Govt. ICT Department was very kind to discuss on the most recent data including the things on the shelf as follows.

① Buys 96MB for all of Tuvalu communications @$2000 per MB per month

② Govt. ICT Dept. has its own network. Govt. Buys bandwidth from TTC. (Buys 13MB from TTC @ $28,000- per month for Govt. use).

③ When submarine cable comes, TTC has to set up their own sites and facilities

④ No other island has network connection except in Funafuti

⑤ Nanti primary school at north of Funafuti has a IT lab but no Internet connection

⑥ Urgent need to establish an E center for 150 people which will provide services such as ICT education, E-education, Women's' community group activities, Ecommerce but there is no network service at this moment.

⑦ So a pilot project with network applications will be very beneficial for Tuvalu people.

⑧ If a pilot project can be designed for the Fongafale Island (main island of Funafuti atoll), it will be able to provide services at the Govt. and private establishments such as the town council, Island council, the Warf, the secondary school, the hospital, hotel, college (USP) and others. Local network could be with a short length optical fibre and the nearby island, Funafala will be on long range Wi-Fi connection.
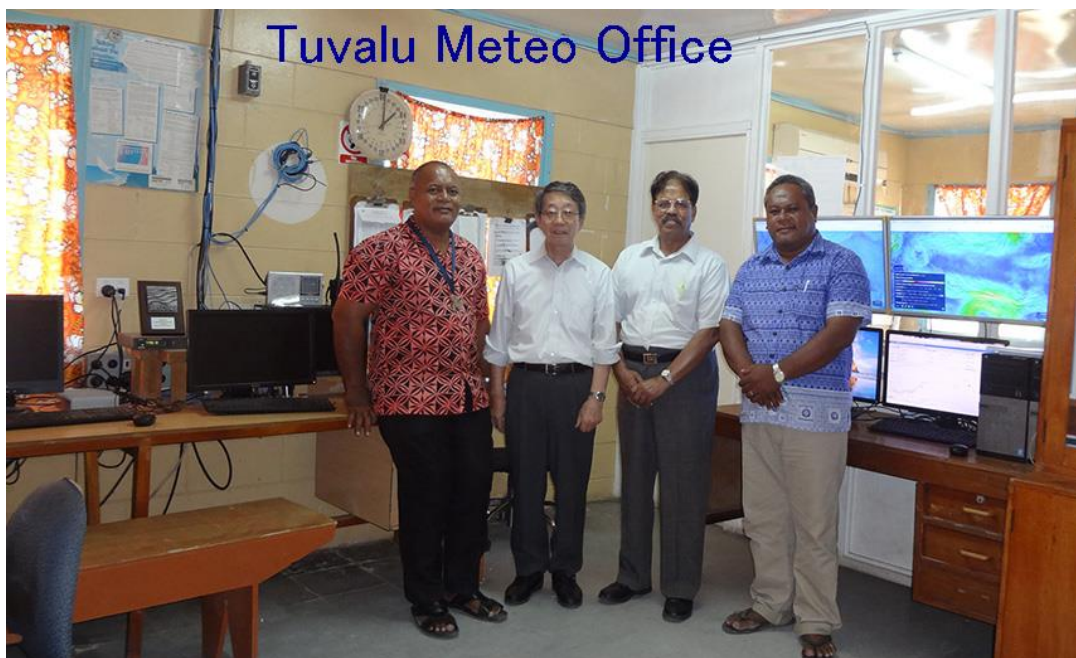

Mr. Opet Simathe, Director of Govt. ICT Dept. (left), and
Mr. Tauala Katea Director of Tuvalu Meteo Dept. (Right)

5.4 Tuvalu METEO Department

① Dissemination of Meteo information and Disaster warning alert to community & public

② Monitoring of warning alert sound

③ Network link with remote islands using "Chatty Beetle" equipment operates on Iridium satellite system.

④ *VSAT Station Chatty beetle* Iridium network is recently installed in several locations that can ignite a low power siren in case of emergency. Talking is possible via Iridium phone service if someone attends the site locally.

The chatty Beetle equipment is installed at Funafala island that operates a small siren remotely operated fron Funafuti. (Closed and open status).
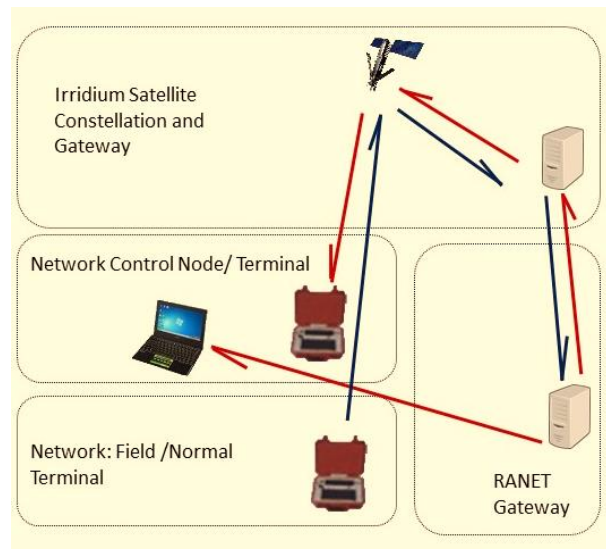
The Chatty Beetle network topology and connection via Iridium Satellite as implemented in Tuvalu (from Tuvalu Meteo)

① Wind speed, ocean current, ocean surface level and upper atmosphere (up to 16000m) data is collected from various sources.

② Tsunami information is received from Pacific Tsunami Warning Center (PTWC), Sea level and weather data received from National Oceanic and Atmospheric Administration (NOAA), other emergency related data received from Emergency Managers Weather Information Network (EMWIN) to do the daily and timely forecasting.

③ All of these data is gathered through Ku-band VSAT network (Speedcast), and data from Himawari receive only satellite dish.

④ Japanese weather satellite "Himawari" pictures that assists the daily weather forecast.

Receive Station for J-SAT C-band satellite Himawari (left)
Speedcast Ku-band VSAT antenna for Speedcast network (right)

⑤ Weather data and put them on the Meteo web pages.

⑥ A staff is on duty 24/7 who downloads all the data from 5:00 AM and issue warning at 6:00 AM and at 6:00 pm DAILY.

⑦ Data is collected from Tuvalu's own available island stations every six hours and the station roll call is done twice a month.

Problems regularly encountered:

① No communication available in most of the islands.

② No internet, Broadband is very essential

③ PC network situation is very poor due to insufficient bandwidth.

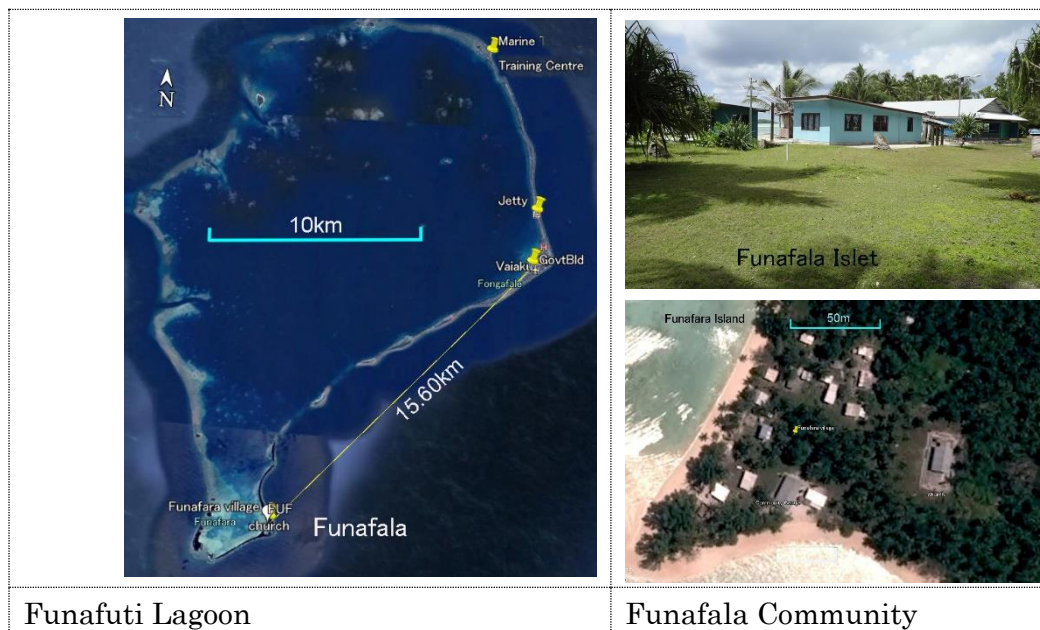# Chapter 6

Survey at Islet Funafala in Funafuti Lagoon

6.1 Current status in Funafala Islet

Meteo facilities	Meteo Chatty Beetle equipment exist where communication is established through Iridium satellite link.
ICT status	No landline, No Mobile, No Internet HF Radio: Not operational

6.2 Discussions with local community

Mobile phone and Internet desired	If mobile phone and Internet is available, the local people as well as the small fishing boats around will be benefitted from them. This will provide them assurance on weather and information needed which in turn save lives by taking shelter beforehand.
Disaster warning	Disaster warning signal will be transmitted through the system to reach people via mobile, flashing lamps, through Internet, and operating Siren (existing). Cyclones over 40kts are not rare here around the island.

Funafuti lagoon and the Funafala islet community location

Funafuti Lagoon	Funafala Community

6.3 Existing facilities in Funafala Island

Facilities and status	There is a Church in the island A community gathering house A guest house, connected with Solar powered lights No medical clinic No regular transport except small private boats as transport. In case of a medical emergency, they have to move the patient by small boats to Funafuti hospital that takes more than half an hour in calm seas. In case of rough seas it is very dangerous because there is no communication mode to get information of any form.
Population movement	Most families with children having home in Funafuti where the children study. They return to Funafala on weekends. If network system is available many will stay in the island and commute to work and school in Fongafale. Island Population= 60

6.4 Major items and their status

Items	Current Status
Space Land	Community lad available. Not personal property.
Equipment housing	Available. Existing Meteo equipment shelter has enough space for installing new equipment.
Solar Power space	Space available for solar power panel installation. Battery space is available at the Meteo location.
Community opinion	ICT system in the island will be highly beneficial to the island people and the people in the sea nearby.
Siren status	Siren is not yet used as there is no emergency since it is installed recently. Testing is done from Meteo at regular interval.

6.5 Recommendations

For E Centres	For ICT community centre needs specific purpose If it is built, it will be beneficial to public, women, youth and children.
Mode of ICT	Fibre is very efficient for Funafuti city inside. A long range Wi-Fi is necessary to connect the Funafala island.
Fiber Network	Optical Fiber connection within existing future plan Section from Govt. buildings to the Warf in Funafuti.

The fiber will connect within Funafuti Central Departments and organisations

- Govt. ICT Division
- TTC (Tuvalu Telecom)
- Meteo Department
- Media Department
- Tuvalu Police
- DMC
- Town Council

- Island council
- A Hotel
- Hospital
- USP Tuvalu campus
- School
- Warf
- Church

Other facts	Installation duct exists across the route Future international fibre connection possible This section will be very much useful for Funafuti Atoll.

Chapter 7

Possibility of ICT Pilot Project in Funafuti Atoll

These National Disaster Risk Management Arrangements have been prepared under the guidance of the National Disaster Committee (NDC). They have been prepared following thorough and extensive consultations with the Government, non-government organizations, and civil society with partner organizations at a Pacific regional level. Actions to reduce vulnerability and increase resilience in a Disaster Risk Reduction (DRR) context is designed to address climate change hazards. Therefore it is necessary to create an environment where the mainstreaming of DRR and Climate Change programs can be integrated in a policy, program and planning context. In order to achieve this, need of appropriate ICT applications and services are extremely necessary at an early date.

During the mission it revealed that Tuvalu govt. has a plan on fiber optic network running from the north tip to the south tip of Fongafale Island while another fiber from the Tuvalu House (Govt. Buildings) up to the Wharf realizing a loop within the island. The details are explained in this chapter below.

The purpose of all these communication networks is aimed at introducing services for the people as follows. At the start, the services for the major communities in Fongafale area of Funafuti and in two nearby islets can be considered. A pilot project could assist to materialize ICT services.

7.1 Basis for a possible ICT Pilot Project for Tuvalu

The equipment and the network management is planned to be supervised from the ICT Dept. Headquarters at the New Govt. Buildings.

E-Centre for the people	No communication to other islands. Nauti Primary School in Amatuku island in north Funafuti has an IT lab but no Internet
To improve	• E. Commerce; E-Education; ICT education • Women's Community Group • Connection to Remote island by TTC • Center of Excellence OLE

When a Fiber Optic cable is installed in Funafuti all the e-services will be within the reach of the local inhabitants in town. The network well be useful to gather and disseminate information to the public in the event of any disaster, emergency or factors related to climate monitoring. A pilot start with such a need can be briefly stated as follows in item 7.2.

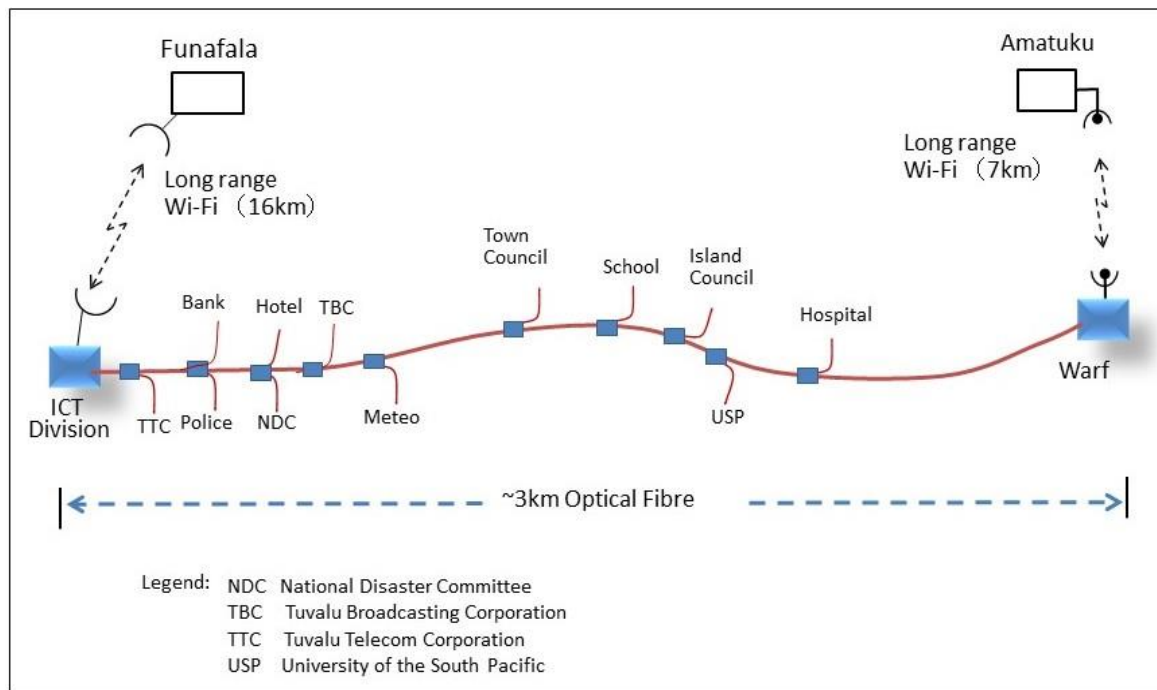## 7.2 Funafuti DM/DRR Optical Fibre Network Pilot Project Guideline

Fig.7.1 Optical fiber Network Pilot Project in Funafuti

So a pilot project with network applications will be very beneficial for Tuvalu people. If a pilot project can be designed for the Fongafale Island (main island of Funafuti atoll), it will be able to provide services at the Govt. and private establishments such as the town council, Island council, the Warf, the secondary school, the hospital, hotel, college (USP) and other installations. Local network could be with a short length optical fibre and the nearby islands could be connected via long range Wi-Fi.

7.2.1 Funafuti DM/DRR Network Pilot Project Outline

The overall network could be designed as shown in the figures below.
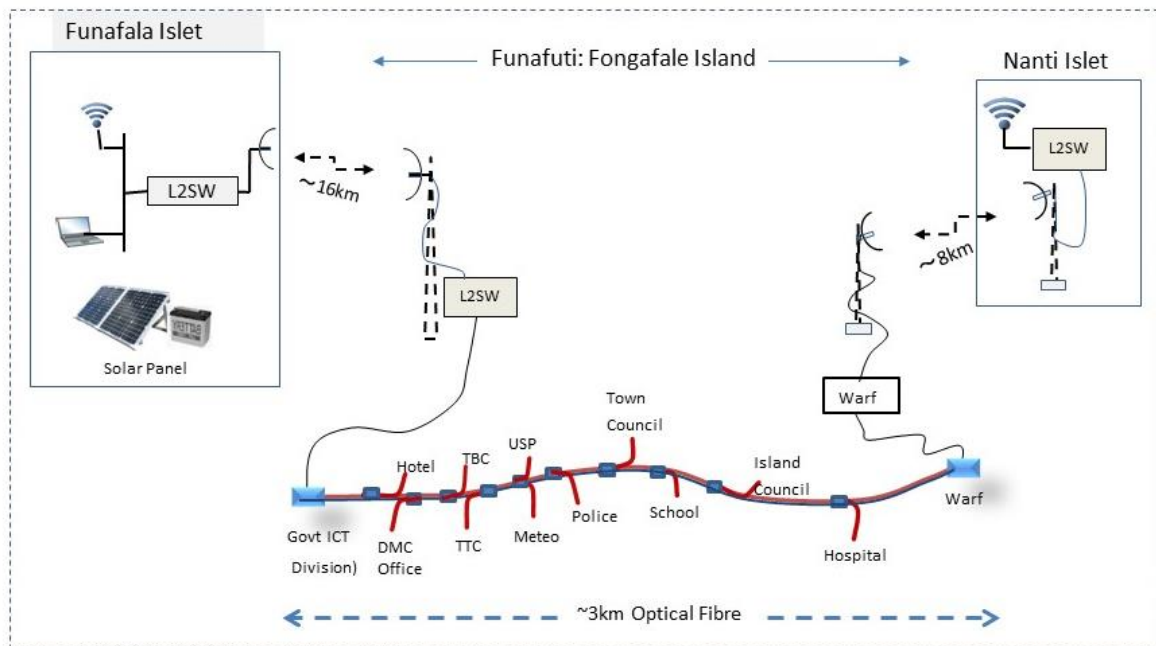

Fig. 7.2 DM/DRR Network Pilot Project Outline

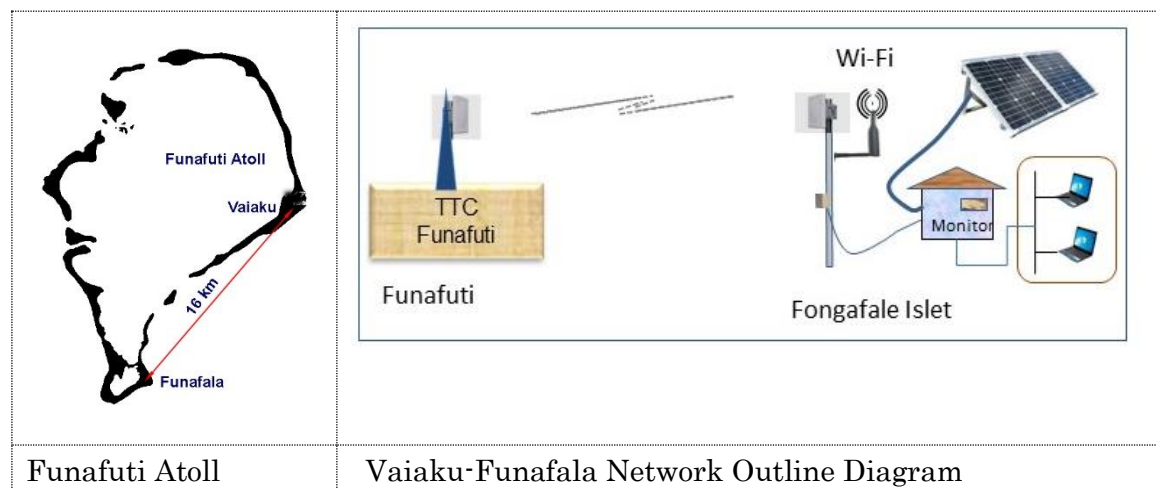| Funafuti Atoll | Vaiaku-Funafala Network Outline Diagram |

Fig. 7.3 Wi-Fi Network via Radio Link to Funafala

7.2.2 Primary school at Amatuku north of Funafuti

The primary school at north of Funafuti has IT lab but have no Internet connection. Urgent need to establish an E center for 150 people which will provide services such as ICT education, E-education, Women's' community group activities, Ecommerce but there is no network service at this moment. When the Optical Fibre network in Funafuti is realised, it will be possible to connect Amatuku with a Wi-Fi direct from the Warf area.

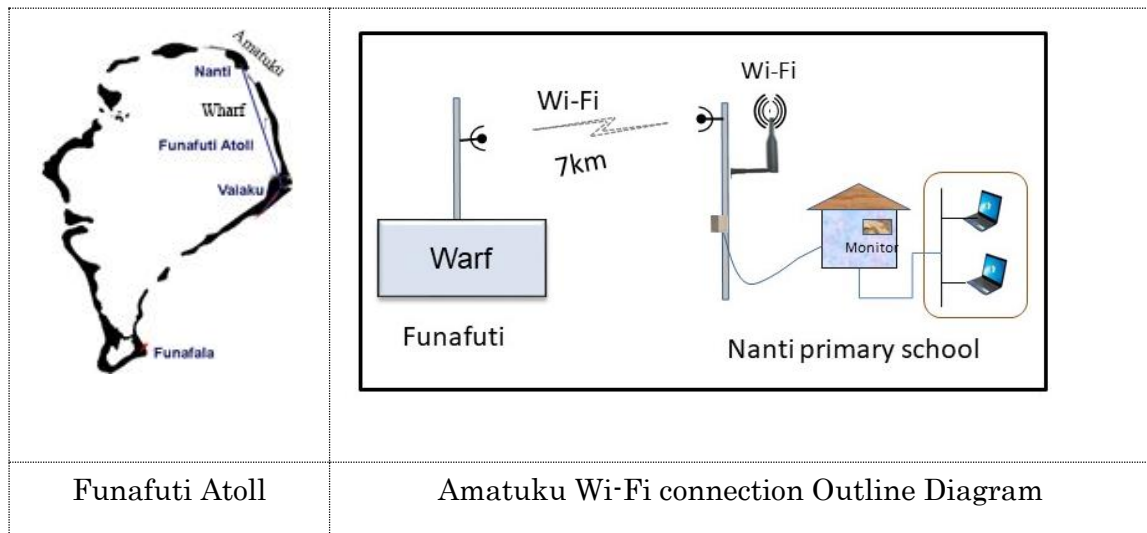| Funafuti Atoll | Amatuku Wi-Fi connection Outline Diagram |

Fig. 7.4 Wi-Fi Network via Radio Link to Amatuku (Nanti)

The total possible optical fiber network is shown below where the north south extreme will be connected by optical fiber as shown by the blue line. The red line shown is the optical fiber connection for immediate communication need for the Funafuti town at the installations as stated in Fig. 8.5
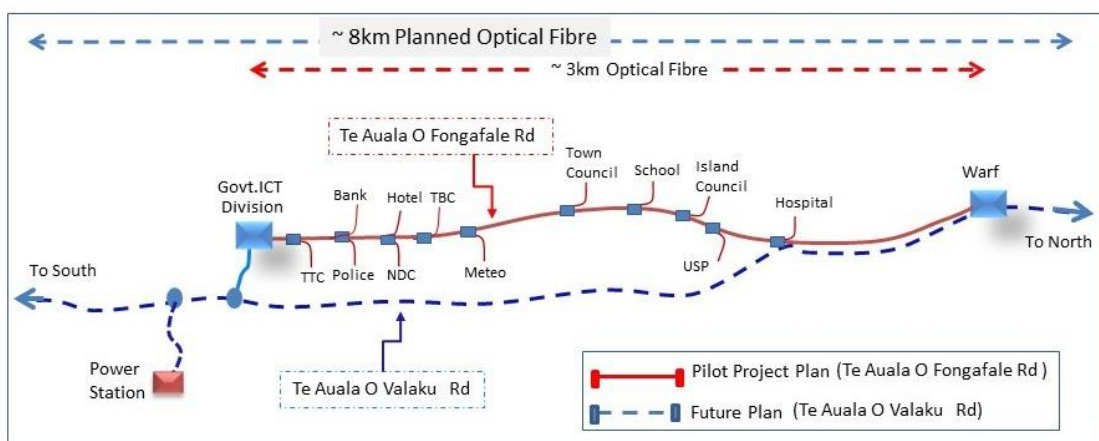

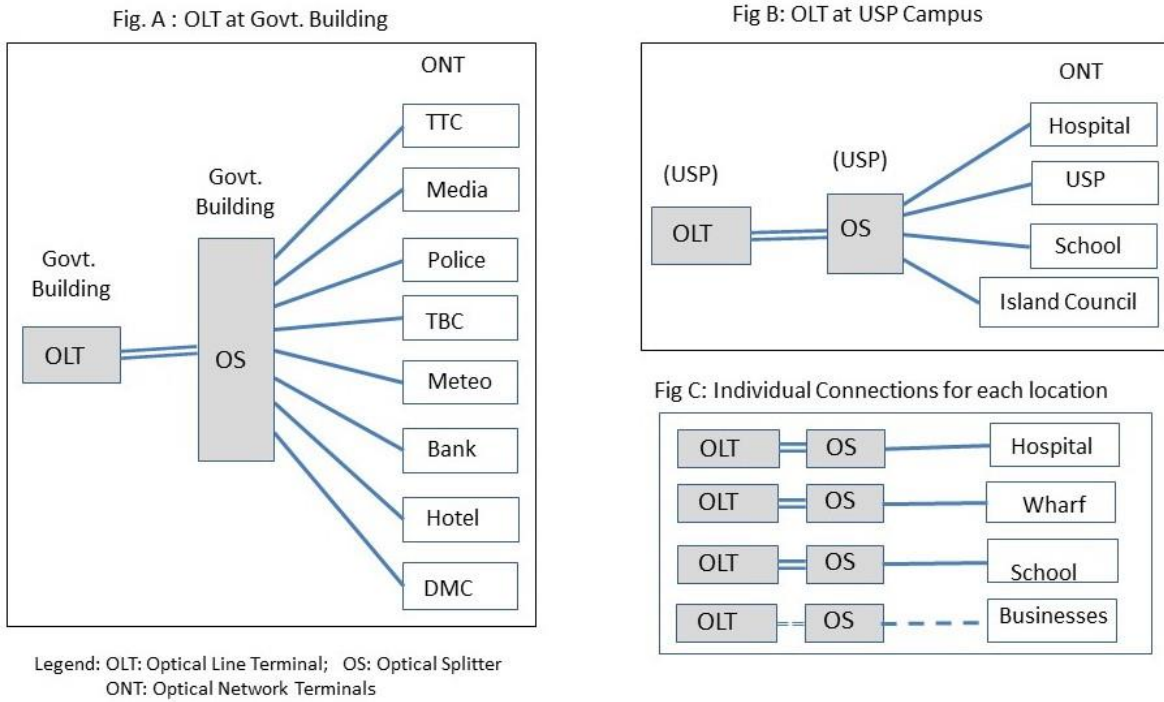Fig. 7.5 Optical fiber network for DM/DRR in Funafuti

Fig. 7.6 Terminal & network connection diagram

The total immediate need of communication when written on a diagram will be as stated in Fig. 8.7.
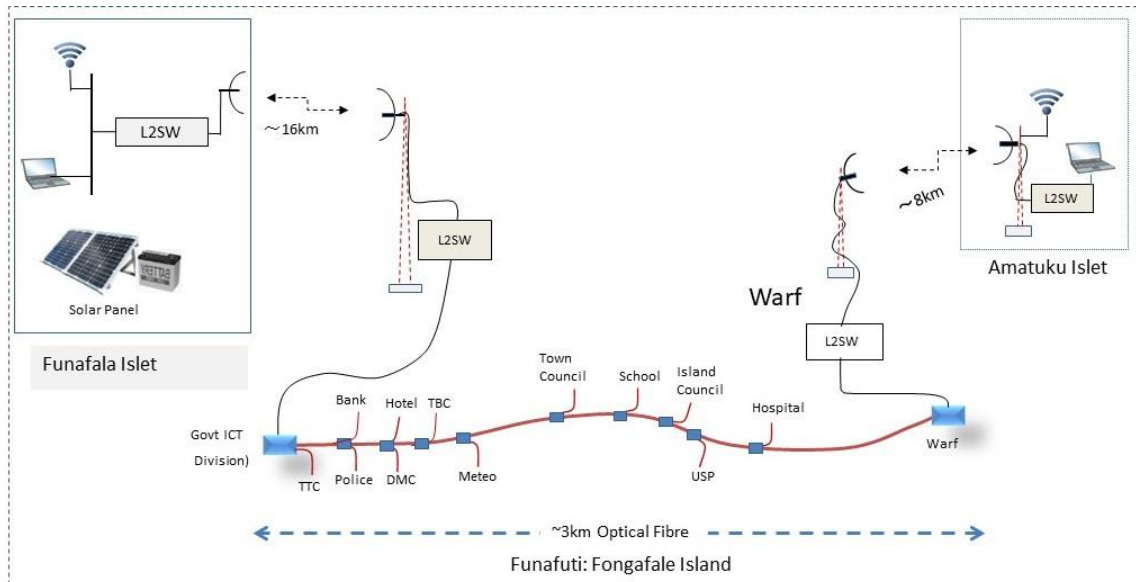

Fig. 7.7 Network outline to realize the services

Photo of the Funafala island facilities

The Funafala islet was surveyed and where a community hall (the right hand building) exists for a possible E-centre could be created. There is a guest house with furniture and amenities near the existing equipment shelter where the Chatty Beatle is installed.

The island itself is about 14 km long and 1km wide at the middle. The Tuvalu house (Govt. building) is located at 4km from to the south end, and 10km from the north end. People live only near the centre and not at the extreme ends.

By dividing the island into three sections for easy understanding, the communication system is explained and shown in Fig.8.8 (A_B_C). The availability of suitable communication service is itemized as shown in subsequent itemized diagrams.
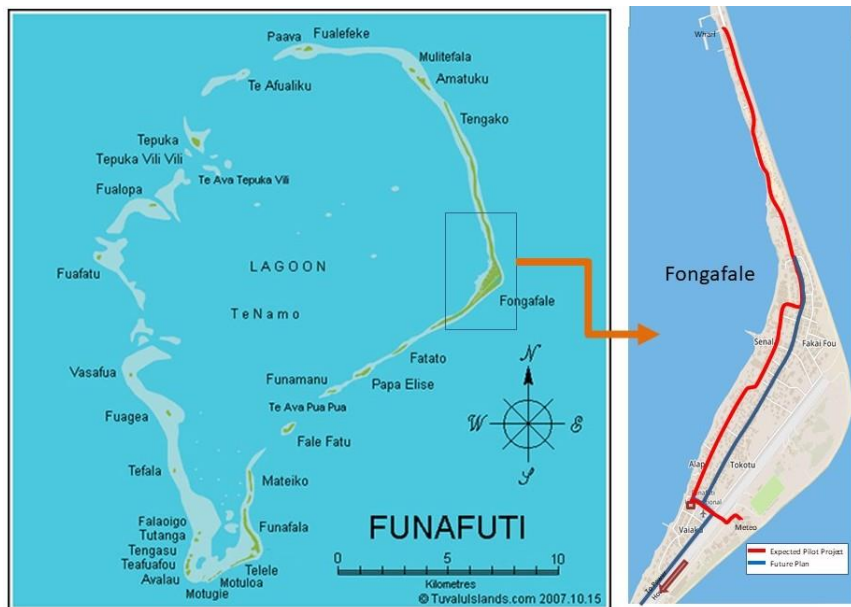
The Tuvalu House (Govt. Building) is located at the centre of the island with proximity of TTC, TBC, DMC, Tuvalu Bank, Police, hotel and the airport. The Meteo is a bit far but within about 500m across the Funafuti airport runway. This is the busiest section of Funafuti and communication is in utmost need at all times. Therefore the network hub or the centre will be located at the Govt. ICT Dept. for priding appropriate service at all situations.
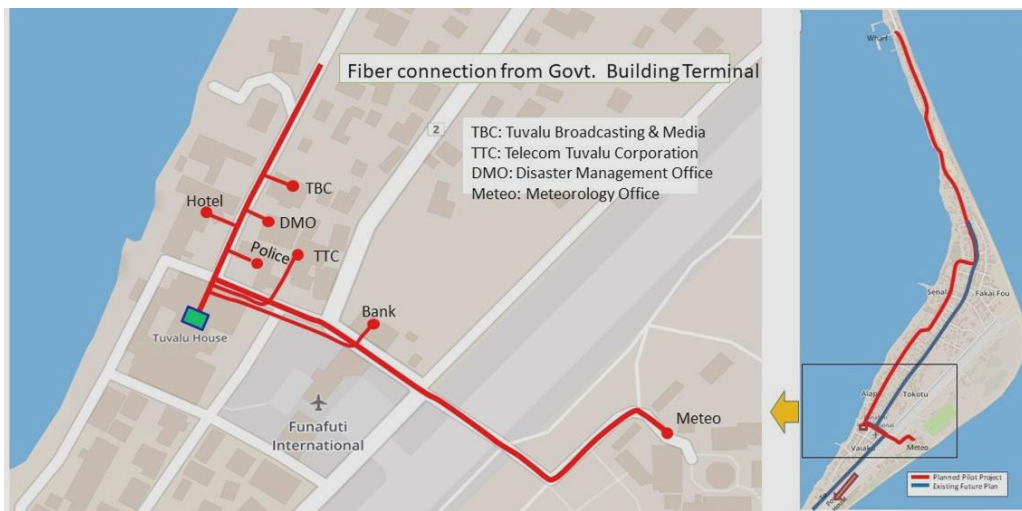

Fig. 7.8(A) Fiber connection outline in Central Fongafale

The business installations, schools, College, hospital, Island Council office and the city council offices are located a few hundred meters north of Tuvalu house. A number of residential houses as well as restaurants are also located in this area. The overall status is shown in Fig. 8.8(B) Fiber connection outline in Northern Fongafale.
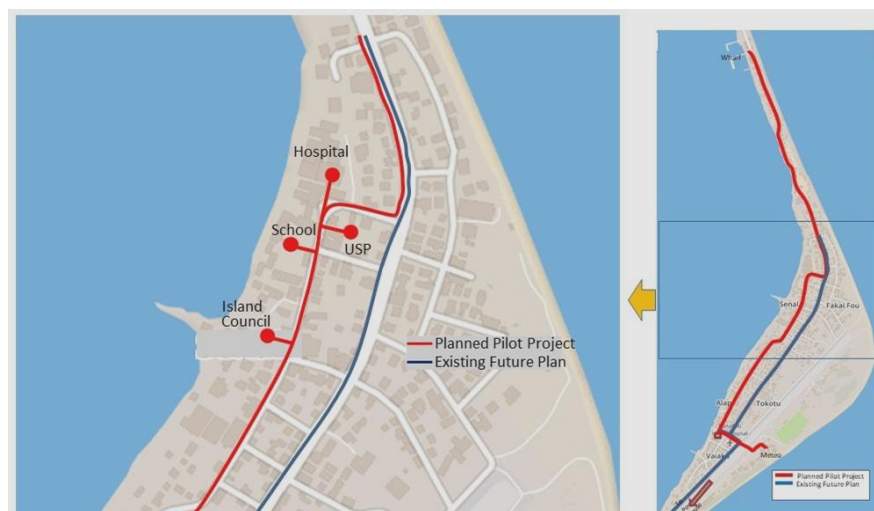

Fig. 7.8(B) Fiber connection outline in Northern Fongafale

The only ocean gateway is located at about 3km from the Tuvalu house. This area is also having a number of residential houses as well as the people working at the Wharf. Communication is very crucial for ocean going vessels as well as inter island ferry and boats. This wharf is planned to include in this fiber network considering the importance economically and socially.

Fig. 7.8 (C) Fiber connection outline in Northern Fongafale

Considering the current status of communication and its facilities, a fiber of 3km will is recommended. At the initial stage there will be 12-16 drops or cable access branching points where almost half of which could be pulled from one location, the Tuvalu house leading to minimum lead time and less investment. The details has to be worked out at the time of system planning and design.

Chapter 8

Conclusions and Recommendations

Realizing digital divide and the importance of ICT in assuring public safety in Tuvalu, it was decided to study the current status, key success factors, appropriate and sustainable models of creating disaster management "E-Community Centres" that can also gather firsthand information on related issues directly from site.

The study was carried out on the status of ICT system and services in disaster and climate change status to designate specific community vulnerable to hazards for developing E-Community Centres. The team visited Funafala, an island at the south west of Funafuti lagoon to identify ways and means to collect and disseminate Govt. decision as well as status of disaster and related information to the endangered area. The outcome is explained in chapter 7.

Survey was carried out on means and constraints with disaster risk management with environmental and immediate humanitarian issues observed in Tuvalu.

The information from the islet of Funafala is very useful and effective to understand the situation in small inhabited islets which will be very much helpful to formulate a Pilot project on broadband ICT for public safety, enhancing ICT activities on developing established culture on safety and preparedness.

The information on Tuvalu's current and future climate, meteorological service data flow was available from the Tuvalu Meteorological department when the information on message dissemination procedure on disasters was also explained.

Tuvalu Disaster Management plan prepared under the guidance of the National Disaster Committee following thorough extensive consultations with the Government, non-government organisations, civil society, and also with partner organisations at a Pacific regional level.

Actions to reduce vulnerability and increase resilience in DRR context is necessary to address climate change hazards. Therefore it is urgently required to create an environment to mainstreaming DRR and Climate Change programs in the planning context. Thereby the need of appropriate ICT network, applications and services are extremely necessary.

During the mission it revealed that Tuvalu govt. has a plan on fiber optic network running from the north tip to the south tip of Fongafale Island while another one from the Tuvalu House (Govt. Buildings) up to the Wharf realizing a loop within the island. At the start, the services for the major communities in Fongafale area of Funafuti and in two nearby islets can be considered. A pilot project could assist to materialize ICT services.

Tuvalu Telecom Corporation (TTC): key challenges are connectivity to other Islands, Service to other islands, billing system whereas the Meteorological Department (MET) key challenges lies with communication network constraints. No communication no internet available in most of the islands. PC network situation is very poor due to insufficient bandwidth and therefore introduction of Broadband is very essential. Damages caused on ICT infrastructures due to natural disasters in recent years that caused subsequent delay in recovery process.

Considering the current status of communication and its facilities, a fiber of 3km will is recommended. At the initial stage there will be 12-16 drops or cable access branching points where almost half of which could be pulled from one location, the Tuvalu house leading to minimum lead time and less investment. The details has to be worked out at the time of system planning and design.

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