Nepal Engineers' Association Japan Chapter
नेपाल ईन्जिनियर्स एशोसिएसन जापान च्याप्टर
NEWSLETTER
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NEPAL ENGINEERS' ASSOCIATION

Pulchwok, Lalitpur

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April 7, 2009

Message

I am pleased to know that Nepal Engineers' Association- Japan Center is publishing 2nd issue of Newsletter for which I and my colleagues congratulate my colleagues of NEA-JC for their continued efforts to publish this issue.

Nepal is at the verge of political & social transformation. In the new context, engineers' innovative undertakings to accelerate the development & service sector project are high. Our past and ongoing efforts have to direct towards the development and prosperity of the people for which we need to take leadership at all level. By realizing this fact, NEA is organizing 11th National Convention of Engineers with the theme "Converging Development Vision with reality: Engineers' Leadership". Through this convention, we need to prove ourselves that without engineers' leadership, any nation can't be developed. This newsletter should be institutional in proving our leadership in all sectors of the society.

Nepalese Engineers who acquired higher degrees from Japanese universities have remarkably contributed for the development of the country. I hope that this newsletter will be supportive to disseminate the information on various activities by the centre. This endeavor should also inspire other centers abroad to publicize newsletter & other publications. This should also reflect the quality of our engineers in moving forward for strengthening our professional ethics and commitments.

On behalf on Nepal Engineers' Association, Central Executive Council and myself I would like to express sincere thanks to the NEA-JC Executive Council and especially to the publication team for this initiative. All of you are cordially invited to participate in the forthcoming 11th national convention of Engineers which is going to be held on 11-13 May, 2009 in Kathmandu, Nepal.

Last but not the least, I would like to express best wishes for the prosperity, good health and continued professional success of our colleagues in Japan on the auspicious occasion of the first Happy New Year 2066 of Republican Nepal.

Er. Kishore Shakya
President

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Message from the President

Dear respected NEA-JC members, we in NEA-JC ex-com are very happy to have this chance to welcome you to the fourth issue of NEA-JC Newsletter. I want to thank friends in the Publication Committee for their dedicated effort on materializing this issue.

The tenure of this executive committee of NEA-JC is soon to be over. We continued all the activities initiated by the previous executive committees and initiated two new activities.

But we are mindful that we had promised with you to accomplish more and we wish we could do more. We are thankful to you all for your participation in different NEA-JC activities, despite the hectic schedule. We have got your valuable feedbacks on the NEA-JC activities during this tenure in the General Assembly meeting. It will help NEA-JC greatly to improve its performance in serving you in future. Similarly, we are also encouraged by your active participation in the recently concluded elections for the new executive committee of NEA-JC. Please let me thank the election committee for their hard work. I also want to congratulate and wish a successful to the incoming executive committee.

Previous three issues of NEA-JC Newsletter were introductory in content, which is natural as NEA-JC was just beginning its journey and we had to introduce it to you and all other well-wishers. Current issue has more varied content. Some of our members have shared their research and work experience through articles and research abstracts. We hope NEA-JC can collect more articles and discussions, not limited to engineering field, for future issues of its Newsletter.

Days are bright and lovely, beautiful HANAMI season is just over and golden week is near. We wish you all a great holiday season.

- Er. Dr. Basanta Kumar Gautam

Inside this issue

Message from Publication Committee

We are glad to disclose this next issue of newsletter to all the NEA-JC friends and colleagues. Some insightful articles , news clips and achievements from our friends has been incorporated in this issue. Though there is remarkable volume of research already carried out or being carried out by our researchers, we are unable to include everything in this small newsletter. Also the bitter reality is we got very few enthusiastic friends who supported us with their publication and articles. We hope there will be more enthusiastic friends in the coming days and wish all the best for the next publication committee .

Ar. Roshan Bhakta Bhandari
Er. Bhoj Raj Pantha
Er. Kumar Simkhada

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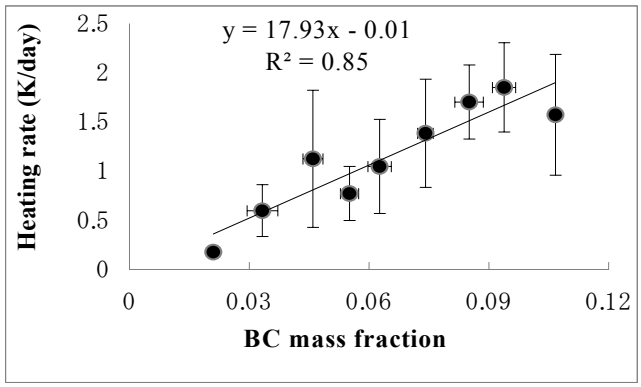
Atmospheric aerosols: Complex players in the climate change game

Dr. Pradeep Khatri
(Center for Environmental Remote Sensing, Chiba University, Chiba, Japan)

Climate change issue is the mostly debated topic in the recent years. For the past decades, we have been hearing that greenhouse gases (mainly CO2) emitted from various human activities are heating our planet. It is true that such greenhouse gases can heat our planet by absorbing heat energy in the atmosphere. The roles of such human made long-lived greenhouse gases on climate change have been fairly well understood by scientific communities. On the contrary, the roles of aerosols (solid or liquid suspended particles in the atmosphere) on climate change have still become a challenging work for the atmospheric and climate research communities. This is due to their short life time as well as spatial and temporal variations. Depending on the physical and chemical properties, aerosols present in our atmosphere can scatter light causing cooling effect as well as can absorb light causing heating effect. In addition, depending on the mixing state (internal or external), vertical profile, surface reflectively, meteorological condition etc., such aerosols can have complicated effects on radiative transfer phenomenon, causing a great difficulty to accurately predict their effects on climate change. Furthermore, aerosols can affect the regional as well as global climate indirectly by influencing the microphysical and optical properties of clouds.



A figure showing how an increase of black carbon (BC) aerosol mass fraction can increase the heating rate at the surface in an urban atmosphere of Japan. Heating rate is calculated using a radiative transfer model. Referred from Khatri et al. (2009, JMSJ).

Realizing that a clear understanding of aerosol effects on climate change is beneficial to the human society in a number of respects, much efforts have been paid in the recent years. This includes study of atmospheric aerosols from space and ground based remote sensing approaches, numerical simulation, intensive field observation etc.

Congratulatory Notes

Er. Badri Bhakta Shrestha, a doctoral student at Civil and Earth Resources Engineering lab of Kyoto University, and regular member of NEA has been awarded a prestigious JSCE Award for his outstanding research entitled " Numerical simulation of debris-flow with driftwood and its capturing due to jamming of drift-wood on a grid dam" The paper was published in Annual Journal of Hydraulic Engineering in 2009. Mr. Shrestha is granted this prestigious award under foreign researcher category.

Congratulations to all our engineer colleagues for successfully completion of their Masters and Doctoral degree in September 2008 and March 2009 from Japanese universities. We wish them all the best for their professional careers ahead.

New Generation Network and its Requirements

Ved P. Kafle
National Institute of Information and Communications Technology Tokyo, Japan

1. Introduction

Before starting the discussion on New Generation Network research, I briefly mention about the currently available three types of communication networks – telephone, broadcast, and the Internet – and their limitations.

Telephone networks, which were introduced more than 100 years ago, are based on circuit-switching technology. They provide voice services with a reasonably good quality of service by exclusively reserving network resources – timeslot or frequency band – to set up a dedicated end-to-end traffic channel. The exclusive reservation of network resources for each and every user leads to under-utilization of the resource, thus increasing the service cost. Two types of telephone networks are currently serving society, fixed and mobile, which generally require two separate subscriptions and user terminals.

Broadcast networks serve videos or television programs to a mass of users over wireless TV channels or cable networks. Broadcast networks are traditionally meant to carry only one-way transmission of video signals from a single source to multiple user terminals such as TV sets.

The Internet, introduced about 40 years ago, has its foundation on Internet Protocol (IP) which runs over the packet-switching technology. Since the Internet is a loosely-connected global network of several autonomous small networks, there are no central controlling entities or functions, no dedicated control channels, no end-to-end resource reservation, and no defined responsibilities of the component network operators. These open features of the Internet bestow it with both advantages and disadvantages. They allow a component network operator or user to easily expand the Internet by simply setting up a local network and connecting it to the Internet through a router. Users can also create and run a number of applications over the Internet by optimally utilizing the network resources. However, the openness as well as the lack of a central control makes it difficult to provide such services that require a guaranteed quality service (QoS), security and reliability in end-to-end data transport.

Although the current Internet is not suitable for interactive voice/video services, we have been experiencing wide use of the IP technology for voice and video services in recent years. Many Internet service providers (ISP) and telecom operators are providing triple-play services, i.e., telecom operators are providing triple-play services, i.e., voice, video and data services, to users under a single subscription. To facilitate this trend through standardization, the International Telecommunication Union (ITU) has been developing standards for the Next Generation Network (NGN) for last a few years.

2. Next Generation Network (NGN)

NGN has already entered into the deployment phase in some developed countries like Japan and is expected to expand into several other countries within few years. NGN is an operator-centric network in which operators control and manage their state-of-the-art IP-based networks to support application-oriented QoS control, fixed mobile convergence (FMC), and security. NGN is supposed to maintain safety and reliability at the level of current telephone networks, while providing the quadruple-play services – voice (Voice over IP, or VoIP), video (Internet Protocol Television, or IPTV), data, and FMC. The FMC service enables an NGN subscriber to seamlessly handover voice, video and data services from a fixed network to a mobile network, and vice versa.

Limitations of Next Generation Network: It is noteworthy that NGN does not focus on user-oriented services that can be locally generated and freely distributed to optimally fulfill local community needs. In the future ubiquitous society, not only operators' networks, such as NGN, but also locally established and managed wireless sensor networks, mesh networks, personal area networks, and home networks will play a vital role in creating new user-centric communication services in which users disseminate information that they freely created, collected or processed. Therefore, taking the future ubiquitous network-oriented societal requirements into consideration, we have been pursuing research and development of the dynamic access system of the New Generation Network (NWGN) that will go into deployment around 2020.

New Generation Network (NWGN) and it's Requirements

NWGN is the future Internet that could be based on radically different networking concepts to be free from all constraints of the current networks. The National Institute of Information and Communications Technology (NICT), Japan has set up the AKARI Architecture Design Project to research and develop the basic architecture of NWGN that will go into the deployment phase around 2020. The AKARI project, established in 2006, includes several Japanese university professors and NICT researchers. The project organizes two workshops every year by inviting experts from academia as well as industries to promote and share NWGN research activities leading to the creation of the NWGN architecture. The project has produced the AKARI Architecture Conceptual Design white papers that outline the basic design principles and candidate technologies for the NWGN architecture. The white papers can be freely downloaded from the project website [http://akari-project.nict.go.jp/].

Figure 1 shows the conceptual positioning of NWGN, along with the Next Generation Network and the current as well as past networks. The AKARI project has been pursuing the clean-slate approach that allows us to introduce completely new technologies for NWGN without being hindered by the existing networks' constraints. The clean-slate approach is necessary to overcome the concerns that if research and development is performed based on current technologies, the direction taken by the development process for the future network-oriented society will reflect corporate interests or be reduced to local optimizations. Therefore, the NWGN goals are first to design and develop NWGN in a new paradigm and then to modify the Next Generation Network to migrate from it to NWGN. NWGN is expected to satisfy the design requirements shown in Table 1. The table also shows the corresponding societal requirements of the future society that NWGN will satisfy. Each of the design requirements is briefly mentioned about below.

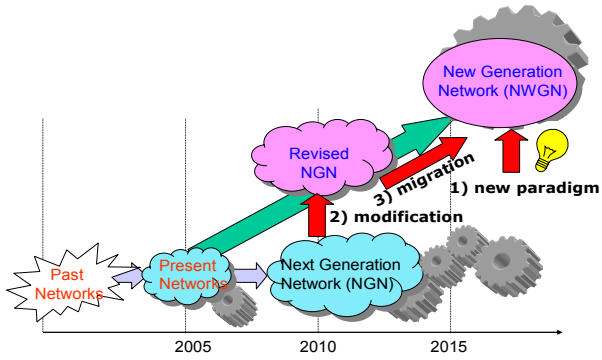


Fig. 1 Conceptual positioning of New Generation Network

Design Requirement 1: Large Capacity

If we assume that the societal requirement for capacity is estimated to be approximately 1000 times larger than the current capacity in 10 years, then a Peta-bits per second (Peta-bps) backbone and 10 Giga-bps Fiber-To-The-Hope (FTTH) will be required.

Design Requirement 2: Scalability

The devices that are connected to the network will be extremely diverse, ranging from high-performance servers to single-function sensors. Although little traffic is generated by a small device, their number will be enormous, and this will affect the number of addresses and states in the network. Consider the following design example. If the global population is five billion people and there are approximately 20 connected devices per person, 100 billion devices must be able to be connected. In addition, besides communication between people, machine-to-machine communication between robots or computers is also expected to increase.

Design Requirement 3: Openness

Appropriate principles of competition promote autonomous growth of both society and the network. The degree of competition in a network is affected by the network architecture. A balance between network providers and network users is important, and a high degree of control by users as well as user-oriented diversity is also required. Therefore, the network must be open and must be able to support appropriate principles of competition.

Design Requirement 4: Robustness

To be able to rely on networks as part of our societal infrastructure, we must be able to use them for medical care, traffic light control and other vehicle services, or bulletins during emergencies. We must be able to entrust important services to networks just like we entrust our lives and well-being to doctors. The existing telephone network provides us with a benchmark of 99.99% availability. NWGN must provide an even higher availability even during a disaster.

SN	Design requirements	Societal requirements
1	Large capacity	Have 10^{15} bits per second (Peta-bps) speed backbone, 10^{10} bits per second (10 Giga-bps Fiber-To-The-Home (FTTH) links
2	Scalability	Include 100 billion communication devices, 1 million broadcasting stations
3	Openness	Enable open competition and user oriented
4	Robustness	Support essential services such as medical care, emergency rescue and transportation; provide 99.99% reliability
5	Safety	Provide safe and dependable services for monetary and financial, food supply acceability, disaster prevention
6	Diversity	Provide equally good services to affluent society, disabled person, aged society
7	Ubiquity	Facilitate monitoring global environment and human society
8	Integration and simplification	Integrate communication and broadcasting
9	Network model	Incorporate model for economic incentives (business cost model)
10	Electric power conservation	Promote energy conservation for ecology and sustainable society
11	Extendibility	Accommodate space for human potential, universal communication

Design Requirement 5: Safety

Network privacy is not just the hiding of information, but the ability of the entity that owns information to control that information. On the other hand, the tracking of food or other commodities means that the recipient traces back along the information path of that commodity. Safety that enables the flow of information to be controlled or information to be traced in the reverse direction is an important network function. To enable safety to be used with monetary and credit services, certification of individuals is required as well as mutual certification, which also enables the individual to certify the communication destination such as a bank.

Design Requirement 6: Diversity

Current network design practices have pursued volume or efficiency objectives and have mainly targeted large numbers of users. In the future, an information network-oriented society that also targets fewer users such as kids, disable persons and aged society should be constructed.

Design Requirement 7: Ubiquity

An information network for comprehensively monitoring the global environment from various viewpoints is indispensable. However, monitoring the natural environment alone is not enough. Human activities also must be monitored. But privacy must be taken into consideration where human monitoring is concerned. When designing a network, there is a tradeoff between transparency and privacy protection, and a means must be provided for controlling the balance between them.

Design Requirement 8: Integration and Simplification

Information networks are shared by all applications. In addition, not only broadcasting stations, but also individuals are sending information to widely scattered recipients, and a large number of data sources, including such devices as sensors, are pouring information into the network. Network design must be simplified by integrating selected common parts, not by simply packing together an assortment of various functions.

Design Requirement 9: Network Model

To enable the information network to continue to be a foundation of society, it should be developed in a sustainable manner. To accomplish this, appropriate economic incentives must be offered to service providers and businesses in the communications industry.

Design Requirement 10: Electric Power Conservation

As network performance increases, its power consumption continues to grow. For example, network power consumption in 2004 reached approx.

5.5% of total power consumption. In addition, the network traffic volume is expected to increase, and if we assume that traffic volume increases at an annual rate of 40% and that there is no change in electronic technology, then by 2020, network power consumption is estimated to reach 48.7% of total power consumption. The information network-oriented society of the future must be more Earth friendly.

Design Requirement 11: Extendibility

The network must have enough flexibility to be extended as society develops. The network will support universal communication that will overcome the obstacles of language, culture, distance, or physical ability and contribute to the creation of human "wisdom".

Conclusion

This article presented an overview of the existing networks and their limitations on fulfilling the future societal requirements on communication networks. To overcome these limitations, the New Generation Network (NWGN) research has been initiated in Japan. Similar research activities have also been started in the USA, Europe and elsewhere. In the USA, the future Internet projects are called Future Internet Design (FIND) projects, while in Europe these are called Future Internet Research and Experiments (FIRE). One of the objectives of these projects is to make the future networks friendlier to the developing regions than the current Internet.

Clean Energy Farming

- Govinda Rizal, Kyoto University

Perspective

Like any other developing countries, Nepal is under pressure to keep up with increasing industrial activity and productivity, but at the same time, to reduce emissions of harmful gasses during energy production. With a small incentive of assurance to peace and stability, Nepal's industrial development will shift to a rapid development phase, any time from now. The dependence on the imported fossil fuels will increase adversely affecting the energy reliance of the rest of the population. The majority of this 'rest of the population' lives in rural farms. Moreover, the consequences are especially serious to those on the lowest income rung. All countries want to move away from the increasing dependence on the imported fossil fuels. They want to produce their own energy - and generate biofuels. What options are available to Nepal for environmentally friendly sources of energy enduring socio-economic development? There are many. Going back to the farms is one of those.

To meet the ever-increasing demand of the energy, there is no better option than developing hydro-electricity utilizing all the available niches and harnessing them properly on a sustainable basis. A lot of energy is going into drains, waste fills, and the focus, for the relief, is on the import. The rescue and reuse of this overlooked power, will help meet the basic energy needs.

Success stories

As an alternative, bio-fuels are emerging sources of energy; and to capitalize their potential, investment on research and following the footsteps of successful countries is the short cut to the goal. China's clean-tech market is on a steady climb. That's because China's economy and its 1,321,851,888 lives do not have the luxury of choice anymore. They must do away with the pollution. It is truly a matter of "go green or perish." By 2012, China's solar power capacity is set to increase by 255%, with year-to-year average growth of 37.3%. Moreover, the country's crown jewel is a 100-megawatt solar power station planned for 2011; the world's largest by far. Brazil is successfully leading in the world with pro-alcohol biofuel promotion program and is now going ahead with sugarcane ethanol. In 1970s, when Brazil was shocked with skyrocketing prices and total dependence on foreign supply, the military government decided to develop alternative domestic fuels. A generation of dithering in "developed" countries has made Brazil, now a thriving democracy as the world's 10th largest national economy, the envy of economic pacesetters like the U.S. and Japan. Nepal cannot fail when India succeeds in extracting fuel from Jatropha. Although, the tradeoff between using land to grow food and using land to grow fuel is a controversial concern; the Jatropha plant- a source of biofuel, a native to himalayan foothils, grow well on marginal land, that are unable to support major food crops. This plant requires minimal water inputs.

Jatropha plant grows with many promises. Able to tolerate dry climates, rapidly growing, useful for a variety of products, Jatropha can yield up to two tons of biodiesel fuel per year per hectare. Put another way, Jatropha can yield about 1,000 barrels of oil per year per square mile. In such quantities, Jatropha, like biofuels in general, cannot become a replacement for oil. But on the compensatory scale, Jatropha requires minimal inputs, stablizes or even reverses desertification, and the diesel fuel with biodiesel additives causes far less pollution.

Efficiency

Air New Zealand in the beginning of 2009, successfully took the world's first test flight of a commercial airliner running on a Jatropha-based biofuel: 50% Jatropha and 50 % standard jet fuel, for two hours over Auckland. Japan Airlines carried an hour-long successful flight test with biofuel; a mixture of biofuel 84 percent from camellia, 16 percent from Jatropha, and less than one percent from algae. Camellia is a relative of tea plant, which thrives in the Nepal's climate.

Opportunities

Farm waste are fuels too. The waste fruits that come out of orchard after harvest better serve as source of fuels than of compost. They can be distilled into clean burning, high-octane fuel. By clean energy farming, farmers can improve efficiency while saving money, implement-farming practices that both save energy and protect natural resources. The first target is the energy self-sufficiency of individual farmer, which on an extended basis leads to the energy independence of the majority of the population. Biomass crops, converted vegetable oil and animal manure are cost effective ways to grow energy at farmers' lands. These are useable on farms and sale-able in biofuel markets. Converting farm waste into energy helps reduce waste going into landfills, lessen the release of gas into the atmosphere, and save energy. Moreover, it has a positive energy and carbon balance- more energy comes from the wastes than required to convert them into decomposable forms, and generates no net CO2.

Fuel made from plant waste is prepared primarily from either waste vegetable oil (WVO) or WVO converted into bio-diesel, a diesel fuel made partially or wholly from biological materials. Fuel from waste or converted vegetable oil has pros and cons, precautions to take- methanol are inflammable, but both confer many environmental and economic benefits. Used oil contains nearly twice the energy value of coal and more energy than No. 2 fuel oil. Compared to petroleum and diesel, bio-diesel produces fewer volatile organic compounds, less particulates, CO2, sulfur di oxide, carbon mono oxide and mercury.

Strategies

Fifteen to twenty percent of agricultural productions are energy related and as energy and prices increase, the inputs claim higher farm budget. The short cut to lower the cost and to use non-renewable energy is through improving energy efficiency. Various studies estimate seven to ten units of fossil fuel energy needed to produce one unit of food energy. Significant portion of the energy used in agriculture come from fertilizer, pesticides, etc. Raising livestock on pasture helps reduce dependence on energy intensive annual feed crops and transportation. Grazing system improves animal well being, water quality, plant and soil health, while also providing habitat for wild life.

Sources

Sources for ethanol are plenty- corn is widely used. The cellulosic biomass, fibrous, woody and generally inedible portions of plant matter is used. Corn Stover, wheat straw, grasses, poplar trees, alfalfa, hull less barley, algae, switch grass are few of the hundreds of species explored for the purpose. Trapping solar and wind energy helps to increase energy independence. Green houses trap solar energy and extend the period of growing seasons. From energy saving bulbs: replacing incandescent bulbs with fluorescents; solar panels and fuel grown and processed on farms can help individual as well as the nation from fuel price crunches. It curbs global warming pollutions and offers economic solutions to fuel worries.

Conclusion

Nepal's fuel demand soared up, cost of fuel purchased skyrocketed and insufficient supply created problems, only after the country started depending on imported fossil fuels and automobiles. Before the advent of fossil fuels and even today at places where its supply is scanty, there are biofuels and alternative energies at use. For a short-term strategy, dependence on the imported fossil fuel is indispensable. This period of expensive dependence must be capitalized on to develop and improve the alternative energy supply on a sustainable basis and to reduce this period itself. The energy from the water, the sun, the wind, and glaciers are under used natural gifts and so is the energy from plants and farms. The strategies and methods to harvest and supply energy from water, wind and the sun are well established, but the use of biofuels which trickled down through generations and are age old practices await large-scale financial investment for their restoration, promotion and success. Biofuel is not the panacea to the energy challenges in Nepal for the present, but it is part of the solution and way to the sustainable solution. The sources of biofuels stretch finite supplies of conventional fuel, restore the land they grow on, do not displace more viable agricultural land, and demand minimal inputs.

Fighting against the darkness

-Deependra Kumar Jha
(Doctoral student Hiroshima University, Japan)

Nepal ko paani, pragati ko khani" (which means, the key to Nepal's development lies in the extensive harnessing of its water resources) is a popular catchword in Nepal, but 'paani' (water) never got a strategic place on the developmental agenda, till the nation was left with no other choice but to impose a load shedding of 16 hours a day. The government's policies & programmes passed by the present constituent assembly focus its curricula in the hydropower development. It acknowledges the fact that economic revolution in Nepal is not possible without the development of its water resources. However, sincerity in the efforts made by the government to achieve its ambitious target of producing 10000MW of electricity in the coming decade continues to be under scanner.

Nepal has more than 6,000 rivers and rivulets from which an overall average annual run of 225 billion cubic meters of water flows towards south (India). The gradient of Nepal, which rises all the way up to 8,848m in the north, enriches it with the tremendous hydropower potential. However, these facts are good only for the academic purpose unless we seek a vision to tap this huge hydro-potential for electricity generation. We have been talking tirelessly about the possibility of exporting electricity to India but the truth is that we are on the threshold of moving to the darker days. The electricity supply is not enough to meet even the existing demand and the annual demand is increasing with a rate of over 10%. It is clear that we are in desperate need of electricity not only to meet the current demand but also to boost up the developmental plans. The possibility of establishing the heavy industries like cement, steel etc. and launching the advanced means of transportation systems like trolley bus, rail network and cable cars, can not be ruled out if the nation is to transform itself into a developed state. This will further increase the demand of electricity.

!!!Congratulations!!!

We heartily congratulate the newly Elected members of the Fourth Executive Committee of Nepal Engineers Association-Japan Center (NEA-JC).

-Third Executive Committee
NEA-JC, 2008

There can not be any alternate to the need to develop hydropower on a greater scale in order to gear up for a dream sustained economic growth in Nepal. And, the fact that we have a power hungry giant neighbor, India, provides more than enough reason to give a second thought to the speed and volume of electricity that we should plan to produce. India's total electricity installed capacity is around 135,000 MW with a peak demand of around 105,000 MW. However, the peak availability of only about 86,000 MW indicates the huge gap between demand & supply. Furthermore, the annual demand growth of about 8-9% is widening this gap every year. Nepal can thus take advantage of the prevailing power situation in India.

We discussed the need to tap our hydro resources for electricity generation both to meet our domestic energy requirements, as well as to speed up our economy through the sale of 'excess' energy to India. However, it's easier said than done. Where are we going to get the investments from? We need to seek the answers to this question. There is a significant capital in the domestic market which remains under-utilized due to the lack of proper infrastructure required for facilitation of the economic activities. This money can be attracted for the investment in some small to medium type projects. However, to realize the dream of generating 10000 MW in next 10 years, we need big investors (possibly foreign players). At this point, we can't neglect the role India can play. We may obtain investments from or outside India but, we will have to bargain with India when it comes to selling the generated electricity.

Despite several water-sharing agreements (such as the 1954 Koshi treaty and the 1996 Mahakali treaty), lack of mutual trust between India and Nepal prevented effective utilization of Nepal's huge hydro resources. As far as water is concerned, India constantly cites the Bhutan example and wonders why Nepal can't follow the Bhutanese footsteps. It is important to mention here that Bhutan has allowed India to build several dams over its rivers that produce electricity. And, the surplus electricity is sold to India. As a result, Bhutan's per capita income has become only second to Sri Lanka in the South Asian region. However, the Bhutan comparison is, probably, a bad diplomacy by India simply because it annoys Nepal each time India makes it. It's worth mentioning that there exists an anti-Indian sentiment in Nepal, thanks to the various border disputes and other existing geo-political scenarios. The negative opinion of India blazes up every now and then in India's relationship with Nepal.

The feelings apart, we have to live with the reality that Nepal is and will remain surrounded by India (particularly, in the south) and, India is the ultimate buyer of our produced power. Does it mean that we have to sacrifice our self interest and honor while dealing with India on the energy front? The answer is: no! Nepal can tactically play its cards before arriving on any sort of agreement. India may be a big player in the region, owing to its huge economy and territory; but, at the same time, it has got some problems that can only be solved through Nepal's co-operation. For example, the Koshi flood problem (the recent Koshi floods created more havoc in India than in Nepal). Any future agreement should be based on give & take principle: a win-win case for both sides.

Few months back, the government came up with a vision on hydropower development and I hope that it's not a mere 'slogan'. If Nepal could fast-track its hydro resources to produce 10,000MW in next 10 years, of which it exported the surplus power to India, it could earn billions of money every year. The policy makers are required to deal tactfully with India on the energy front and act in the country's highest interest. If we really strive to fight against the prevailing 'darkness', we need to have an honest vision and the firm commitment. It's been said that "with a hammer in hand, everything looks like a nail".

[Author is currently pursuing PhD in power system engineering at Hiroshima University, Japan]

Status of optical communication in context of Nepal

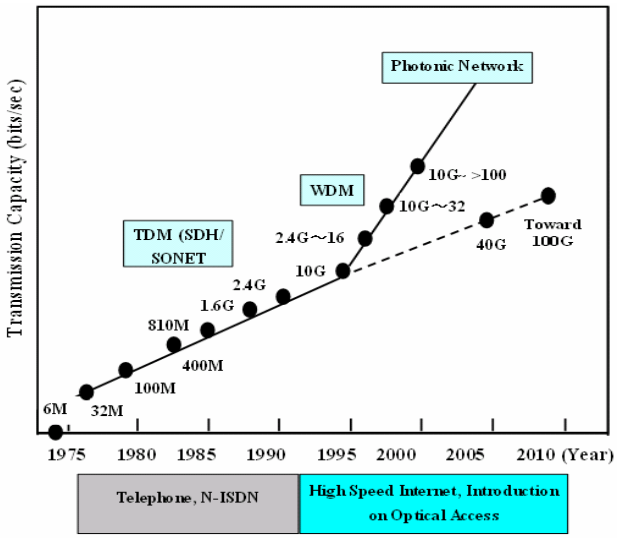
- Madhu Sudan Kayastha, Chubu University

Introduction

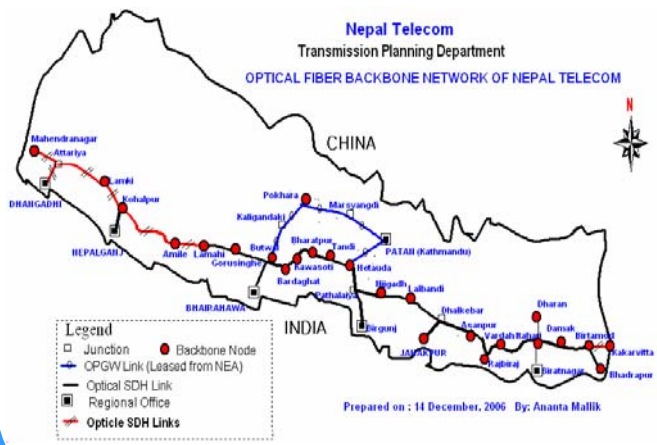
Now we are in the 21st century, the era of 'Information technology'. There is no doubt that information technology has had an exponential growth through the Modern telecommunication systems. Particularly, optical fiber communication plays a vital role in the development of high quality and high-speed telecommunication systems. Today, optical fibers are not only used in telecommunication links but also used in the Internet and local area networks (LAN) to achieve high bandwidth. In this article, I will describe short history of optical fiber communication. I will also give short introduction in contest of Japan as well as in Nepal.

Historical perspective of optical Communication

The use of light for transmitting information from one place to another place is a very old technique. In 800 B.C., the Greeks used fire and smoke signals for sending information like victory in a war, alerting against enemy, calling for help, etc. Mostly only one type of signal was conveyed. During the second century B.C. optical signals were encoded using signaling lamps so that any message could be sent. There was no development in optical communication till the end of the 18th century. The speed of the optical communication link was limited due to the requirement of line of sight transmission paths, the human eye as the receiver and unreliable nature of transmission paths affected by atmospheric effects such as fog and rain. In 1791, Chappe from France developed the semaphore for telecommunication on land. But that was also with limited information transfer. In 1835, Samuel Morse invented the telegraph and the era of electrical communications started throughout the world. The use of wire cables for the transmission of Morse coded signals was implemented in 1844. In 1872, Alexander Graham Bell proposed the photo phone with a diaphragm giving speech transmission over a distance of 200 m. But within four years, Graham Bell had changed the photo phone into telephone using electrical current for transmission of speech signals. In 1878, the first telephone exchange was installed at New Haven. Meanwhile, Hertz discovered radio waves in 1887. Marconi demonstrated radio communication without using wires in 1895. Using modulation techniques, the signals were transmitted over a long distance using radio waves and microwaves as the carrier. During the middle of the twentieth century, it was realized that an increase of several orders of magnitude of bit rate-distance product would be possible if optical waves were used as the carrier. In the old optical communication system, the bit rate distance product is only about 1 (bit/s)-km due to enormous transmission loss (105 to 107 dB/km). The information carrying capacity of telegraphy is about hundred times lesser than telephony. Even though the high-speed coaxial systems were evaluated during 1975, they had smaller repeater spacing. Microwaves are used in modern communication systems with the increased bit rate-distance product. However, a coherent optical carrier like laser will have more information carrying capacity. So the communication engineers were interested in optical communication using lasers in an effective manner from 1960 onwards. A new era in optical communication started after the invention of laser in 1960 by Maiman. The light waves from the laser, a coherent source of light waves having high intensity, high mono chromaticity and high directionality with less divergence, are used as carrier waves capable of carrying large amount of information compared with radio waves and microwaves. The optical communication systems played an important role in the research between 1960 and 1970. This experimental success opened the door to new age in science and technology research. Kao and Hockham proposed the application of a glass fiber with a cladding in 1966. However, the fibers produced an enormous loss of 1000dB/km. Immediately Kao and his fellow workers realized that these high losses were a result of impurities in fiber material. Using a pure silica fiber, these losses were reduced to 20dB/km in 1979 by Kapron, Keck and Maurer. The systems can transmit data at data rates in excess of 400 million bits per second (Mbps) over distances in excess of 100km without repeaters or amplifiers. Thus, the optical fiber communication system became an engineering reality. The optical communications industry started in the 1970s with the use of graded-index multimode fibers.



As the industry gained experience in installation and operation and as single mode fiber and components for single mode communications systems evolved, the lower attenuation and higher-bandwidth capability of single mode-fiber systems far outstripped the benefits of multimode-fiber systems. By the middle of 1980s, single mode fibers operating at 1.3μm became the dominant fiber used in long-distance networks. While short-distance applications for campus networks and local area networks (LANs) continued to use multi-mode fibers. The improvement of the capacity of the optical fiber communications systems in contest of developed country like Japan is shown in above figure. We can see that transmission speed is toward 100 Gbits/sec.



Since 1995, implementation of Optical Fiber network started in NTC. The initial implementation included the inter-exchange link. The government, through Nepal Telecom (NT), has completed the first phase of the East-West Highway Optical Fiber Project that will build the optical fiber backbone for telecom services. This has substantially upgraded the reliability and quality of long-distance calls within Nepal and between Nepal and India. Phase I of the Project covers a distance of 850 km from Bhadrapur to Lamahi and from Kholapur to Nepalgunj. The project period was 20 months which started from 18th Dec 2002 and completed on 17th Aug 2004. Phase II covers 900 km from Birtamod to Kakarvitta and from Lamahi to Mahendranagar. The completion of this project connects Nepal and India through fiber links via different connecting points, and the country has an optical fiber backbone from east to west. Nepal also becomes the Asian Information Superhighway, a cheaper and more reliable alternative to existing satellite communications. It was mostly funded from the Indian government. But Nepal Telecom has also received grant assistance from the Chinese government for the optical fiber project along the 115 km long Arniko Highway linking Kathmandu to Khasa, which borders China. This project was completed by 2007 AD. After completion of the Arniko Highway project, Nepal is connected to the information superhighway between Nepal and China. Since Beijing is already connected to Hong Kong via cable, then Nepal is also connected to Hong Kong, one of Asia's communication gateways to the rest of the world. Thus, this gives Nepal an alternative route for international communication links, besides the existing satellite. Maximum bandwidth of used in the optical fiber communication is 10Gbits/sec. However, the rate of information that could be transmitted over a single optical fiber (several Tbit/s) is still far beyond what today's available transmitter and receiver components are capable to provide. Researchers are engage for the continuous development on these components in order to make them faster and more efficient.

Climate Change: Is it Antropogenic or Natural?

-Netra Gyanwali, Kyoto University

Fossil fuel shares almost 85% area in world's primary energy consumption pie-chart, with releasing pollutants and CO2 as a consequence. Although the adverse effect of NOx, SOx and suspended particles in environment require no further explanation, the effect of CO2 (also known as GHG) in climate change is, however, not so obvious. There are two schools of thoughts, arguing the climate change with (a) increased concentration of CO2 in atmosphere which, in great extent, caused by human activities, termed as *anthropogenic* (b) natural events like, atmosphere and sea interaction, solar output, change in the optical depth of atmosphere due to volcanic eruption and so on.

The basic observed fact is that there is rise in earth average temperature from 1900 to 2005 by 0.7 degree Celcius, and it is more apparent when observing the pattern from 1950s (when the fossil fuel use started to accelerate). Many environmental models claim that between 2030-2060, the temperature will rise by 2-5 degree and if the energy consumption pattern is not altered, there will be rise of 3-10 degree by 2100, threatening the basic life elements. i.e, access to water, food, health, use of land and shelter as a consequence. As the most adverse aspect, it will cause 3-5 meters rise in sea level enough to engulf the Maldives like settlements. Although the modeling of climate change is very complex, with either some parameter or their proper weight is unknown, the anthropogenic effect is more convincing and realistic. Putting the human activities as the main cause of the global warming, the intergovernmental Panel for Climate Change (IPCC) was formed involving the scientists from 169 countries. More surprising and yet annoying facet of this story is that the activities 10% of the population of developed countries making victim to the rest of the population in the world. Let's see the some fact of the *heavy weight countries* which did not sign the Kyoto protocol.

USA has increased the release of CO2 by 20% since that of 1990s, while the target of Kyoto protocol was to cut by 7%. China will surpass USA in its CO2 release by 2025 if alternative actions are not taken. India has accelerated the CO2 release since past two decades. If the human activities are cause of global warming, their action should be checked. It includes: Go for renewable and alternative energy generation. Reduce the petroleum product in transportation. Use of carbodioxide capture and store (CCS) techniques (*a process consisting of the separation of CO2 from industrial and energy-related sources, transport to a storage location and long-term isolation from the atmosphere. This report considers CCS as an option in the portfolio of mitigation actions for stabilization of atmospheric green house gas concentrations).*

The good news is that the EU has taken the initiation to reduce the GHG release by 60% of the present amount by introducing. It has planned to generate 50% of total generate electricity from renewable type by year by 2050. For the second option, it needs the high awareness among the users and technological innovation for hybrid vehicles. For the last option, research are being made and it is likely to take more years for convincing results.

The solution of the global warming is, mainly, in the hand of the *heavy weight countries* who are cause of it. Let's hope their proactive response in this regard.

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Detecting early stage breast cancer using Ultra wide band microwave imaging

- Saroj Raj Tripathi, Shizuoka University

Breast cancer is one of the leading causes of death among women in the world. It is believed to be the second most common cancer among Nepalese women after cervical cancer. In Japan only, more than 10,000 deaths per year are reported whereas the death toll rises up to 40,000 persons per year in USA. Early detection and timely medical treatment are the key factors affecting long-term survival and the quality of life of breast cancer patients. X-ray mammography is currently the most preferred method for the detection of nonpalpable early stage breast cancer. However, this method suffers from various limitations like high missed and false detection rates, uncomfortable compression of breast and exposure of ionized radiation. Therefore, to avoid these limitations, an alternative imaging technique is required. One of the potential candidates is Ultra Wide Band (UWB) microwave imaging. This technique promises to address the above issues and has the various merits like use of non-ionizing low power microwave and high detection rate. Moreover, this method avoids the breast compression. The physical basis for breast cancer detection using microwave is the significant contrast in the dielectric properties of normal and malignant breast tissues. Since tumors have a higher water content compared to normal tissue, they will back-scatter the microwaves and produce an echo, which is processed further to obtain the knowledge of position and size of the breast tumor.

Imaging of the breast cancer using microwave is a RADAR based technology which involves the transmission of ultra wide band pulse into the breast and reception of the backscattered signal from the breast tumor. In the actual breast examination, the patient lies in the supine position and the arrays of monostatic antennas A1, A2,..... AN are placed above the naturally flattened breast of the patient as shown in the figure 1. The use of appropriate coupling medium in between antenna array and skin minimizes the distortion in received signal and allows to couple microwave energy into the breast more efficiently. Each antenna in an array sequentially transmits an

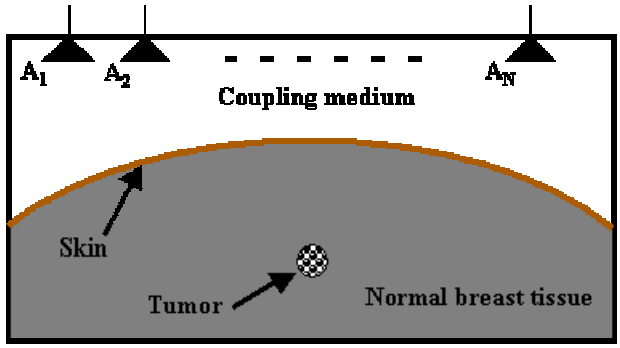

Fig1. Geometrical configuration of breast structure for supine position

ultra wide band modulated Gaussian pulse having the center frequency of 6 GHz and receives the backscattered signal in the same antenna resulting into the backscattered signals that contain the reflections from the skin, clutter and the response due to malignant tumor. The skin reflected signal has much greater amplitude than the tumor response. Therefore, removal of skin-breast artifact prior to further signal processing is mandatory. These reflections are removed either by linear filtering methods or by averaging method. In averaging method, a reference waveform is created by averaging all received waveforms. The reference waveform is then subtracted from the actual responses recorded at each antenna to obtain signals which contain only tumor response. Exemplary received signal before and after removing the reflections from the skin is shown in figure 2. The early time content, which contain the reflections from the skin, as in the left panel is completely eliminated as shown in the red curves whereas the late time content which contains the tumor response is preserved in each channel. The relative arrival times and amplitude of the backscattered signal received in each antenna provide the information that is used to determine the scatterer location using beamfomation techniques. The beamformer is a signal processor used in conjunction with arrays of antennas that controls the directionality of a radiations pattern. The typical beamformer is the delay and sum beamformer

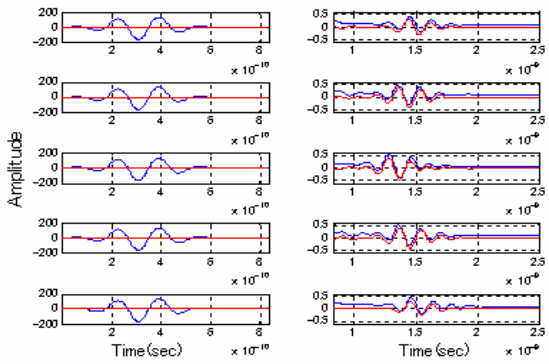

Fig.2: Signal before (blue curve) and after (red curve) removing the reflections from the skin.

which as the name implies time delays and sums the received backscattered signal to create a synthetically focused signal. The delay and sum beamformer however, does not allow for compensation of frequency-dependent propagation effects, such as dispersion and offer limited capability for discriminating against artifact and noise. Dispersion is important since it can introduce considerable broadening of the transmitted-pulse duration, thereby reducing resolution. To compensate for these frequency-dependent propagation effects, a broadband beamformer known as microwave imaging space time (MIST) beamformer is used. A rectangular window is applied to obtain the pixel energy of the scanned location to the output of the beamformer. Finally, images of backscattered energy as a function of scan location are generated for a whole scan area. The figure 3 shows the image of the breast cancer obtained using the method discussed here. The image of the tumor lying 3cm below the skin is clearly evident.

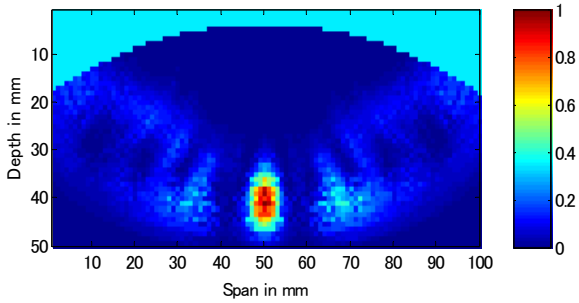

Fig. 3: Image of the breast tumor lying 3cm below the skin.

This article briefly introduces the fundamental of early stage breast cancer detection system using RADAR based UWB microwave imaging system. This system shows the promising results in detecting millimeter sized breast cancer using a very low power which is less than a cellular mobile phone. It is to be noted that when cancers are detected less than a centimeter in size, there is a more than 90% percent survival rate. But at 2-3 centimeters, the cancer often moves into lymph nodes and survival rates begin to decline. Therefore, the early detection and timely medical treatment is extremely important. It is expected that the use of UWB microwave imaging can assist to reduce the woman mortality rate by detecting the breast abnormalities in the early stage.

The PDF version of this issue is also available at www.neajc.org

We would like to thank the authors for providing their valuable articles for this issue of NEA-JC newsletter.

If you have any comments or suggestions on any article published in this issue, please send them directly to the concerned authors.

- Publication Committee

Photovoltaic Energy Potential in Nepal Himalaya

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Solar energy has been proved a very important alternative source of energy to fulfill the most basic electricity needs to the people in Nepal Himalayas. At present, only about 4% of the rural population of Nepal has access to electricity. Photovoltaic (PV) technology converts solar energy directly into electricity. However, apart from efficiency of the technology itself, knowledge on seasonal (or monthly) and spatial distribution of solar energy (irradiance) is important prior to any PV installation for proper energy planning, and to achieve optimum efficiency from the overall PV system. The purpose of this paper is to report seasonal/monthly and spatial variation of solar irradiance, and to illustrate consequent PV energy potential in Nepal the Himalayas.

Solar irradiance data from high altitude meteorological stations in Nepal Himalayas were analyzed in this study. Seasonal mean solar irradiance was derived from monthly mean values that fall under each respective season. The data availability in this study (Kanjiroba, Annapurna, Langtang and Khumbu and Makalu) varies from station to station, because of the discontinuity and loss of data owing to remoteness causing delay in maintenance, repair and replacement of malfunctioning instruments. Absolute extreme solar irradiance data from all the meteorological stations also observed in specific day of each month was utilized in this study.

Fig.1 shows mean seasonal variation of solar irradiance and consequent PV output (solar cell efficiency of 20%) for all the stations. It is clear in the figure that absolute values and characteristics of seasonal variation of solar irradiance in Langtang and Khumbu are very similar. Both Langtang and Khumbu receive almost equal amount of seasonal maximum solar irradiance in spring and summer, while winter receives the least amount. In Annapurna and Makalu amplitudes of the seasonal mean solar irradiance are much smaller than those of Langtang and Khumbu. Seasonal amplitude of Kanjiroba is moderate, but still lower than that of

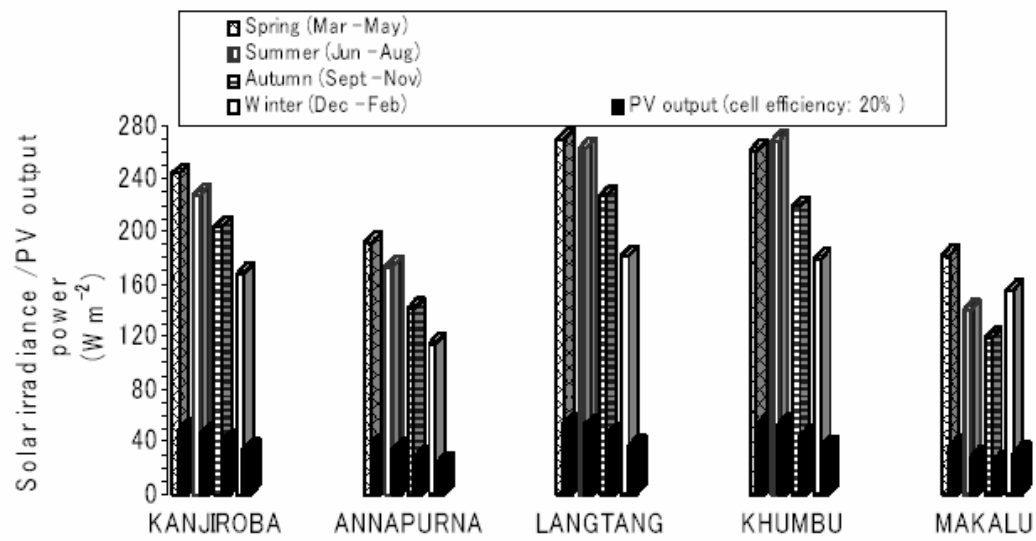

Fig. 1 Mean seasonal variation of solar irradiance in Kangiroba, Annapurna, Langtang, Khumbu and Makalu. The attached black bars corresponding to each season and represent consequent PV output power (solar cell efficiency: 20%).

Langtang and Khumbu. There is a gradual decrease of solar irradiance from spring to winter in all the stations except Makalu. In Makalu solar irradiance in winter is higher than in autumn (it is even slightly higher than in summer), which is unusual.

Fig. 2 shows absolute extreme values of solar irradiance observed in each station during fine weather conditions as an example. It indicates that intensity of solar radiation is quite high in Nepal Himalayas during fine weather conditions, and hence high potential to generate solar electricity. PV technology and knowledge on solar energy (irradiance) distribution in space and time are important to achieve optimum efficiency to generate electricity from overall PV system. In this study I analyzed available data of solar irradiance from different locations of Nepal Himalayas. Because of the high mountains and rugged terrain of the Himalayan region long term and continuous solar irradiance data is limited. However, the results based on the available data set show significant similarities and differences on solar energy input and consequent PV energy potential with respect to seasons and locations in Nepal Himalayas.

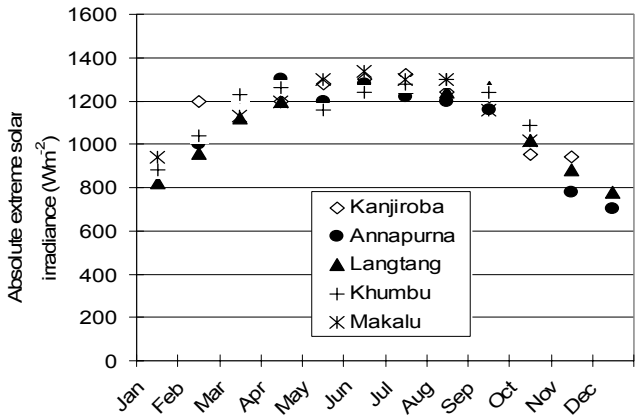

Fig. 2 Absolute extreme values of solar irradiance observed in each station during fine weather conditions

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NEA-JC successfully organized a one day on "Present and Future Technologies" on 12 October 2008. Workshop was held in the JICA Plaza Hall located in the downtown Tokyo.

More than 25 engineers affiliated with such different organizations as government research institutions, universities, and private companies in Japan had participated actively in the workshop.

The detail reports of the workshop, presentation papers/slides and photographs are available at
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