CSC 402 – Internet Technology

Recap

- General Application: Email, WWW, Gopher, Online Systems
- Multimedia and Digital Video/Audio Conferencing

Internet Relay Chat (IRC)

- IRC – Internet Relay Chat. Application layer protocol providing a text based multi-user chat system.
- Designed for group (many-to-many) communication in discussion forums called channels.
  - Allows one-to-one communication via private messages.
- Created in 1988, evolved over the years.
  - Author: Jarkko Oikarinen (IRC is ‘made in Finland’).
  - RFC1459 (1993) and RFCs 2810-2813 (2000).
  - Relative unknown at first but became the only reliable source of sending information out of war zones during early phase of Gulf War and during the 1993 attempted coup against Boris Yeltsin in Russia when wire services were destroyed.
- Developed for systems using the TCP/IP protocol stack.

IRC

- IRC itself is a teleconferencing system running on many machines in a distributed fashion.
- Operates in the client-server model.
- A single process (the server) forms a central point for clients (or other servers).
- The server performs the required message delivery/multiplexing and other functions.
- IRC is a plaintext protocol.
  - Possible to use IRC via a basic byte-stream client such as Telnet.
  - It uses a modified version of ASCII, and does not provide support for non-ASCII characters in text.
    - This results in many different, incompatible character encodings used.

IRC

- Main characteristics of IRC architecture.
  - IRC is an open protocol using TCP and optionally SSL.
  - An IRC server can connect to other IRC servers to expand the IRC network.
  - Users access IRC network by connecting to a server.
  - Most IRC servers do not require users to log in, but a user will have to set up a nickname before being connected.
- IRC network – a network of servers.
- Famous IRC networks:
- IRCnet, DalNET, Undernet and QuakeNET.

IRC

- Servers and clients send each other messages which may or may not generate a reply.
- Client to server and server to server communication is asynchronous in nature.
- Each IRC message may consist of up to three main parts.
  - Optional prefix.
  - The command.
  - Up to 15 command parameters.
- The prefix, command, and all parameters are separated by one ASCII space character (0x20) each.
- Each IRC message is seen next to the senders name at the receiver's device.

Broadband Communication and Policy

- 5 types of LAN components :
  - **Stations**: Desktops, laptops, printers, file servers.
  - **LAN protocol stack**: This usually takes the form of a hardware card inside the station, containing a microprocessor and embedded software.
  - **Physical transmission medium**: Coaxial cable, twisted pair, optical fiber, radio waves.
  - **Physical interface units**: The exact form of the PIU is highly dependent on the LAN physical medium (e.g., cable connectors for twisted-pair interfaces)
  - **Interconnecting devices**: Repeaters and hubs at Layer 1, bridges and switches at Layer 2, routers at Layers 3 of the OSI reference model.

Broadband Communication and Policy

- LANs can be grouped according to 4 key characteristics:
- Topology (physical or logical) of the network
  - Bus
  - Ring
  - Star
- Transmission technique they use to transmit data over the network
  - Baseband
  - **Broadband**
- Transmission media over which they can operate
  - Wired (coaxial cable, twisted pair, optical fiber)
  - Wireless (radio frequency band)
- Media Access Control (MAC) method
  - Contention-free
  - Contention-oriented

Broadband Communication and Policy

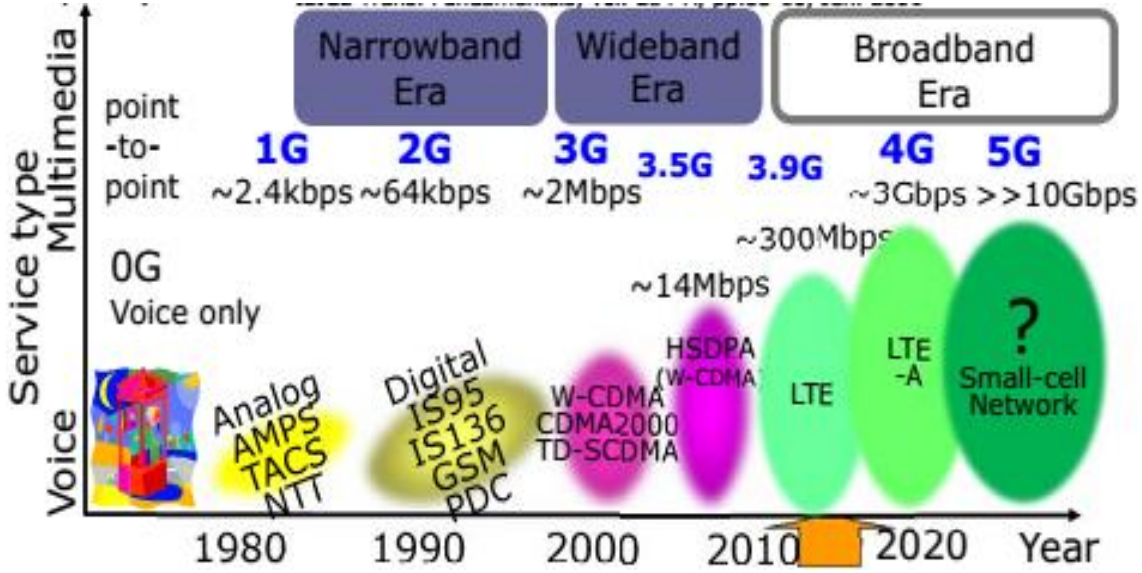
- The purpose of transmission techniques (also referred to as signaling and line encoding) is 2-fold:
  - To match signals to propagation properties of the transmission medium.
  - To provide a signal formatting language (i.e., signals transmitted across the transmission medium will have some actual meaning and can be interpreted logically).
- Line encoding often involves adding timing content to the signal.
- 2 types of transmission techniques :
  - Baseband
  - Broadband
- Do not confuse with ”broadband” in terms of ”high-speed”; in the given context, ”broadband” means a broad range of frequency bands.

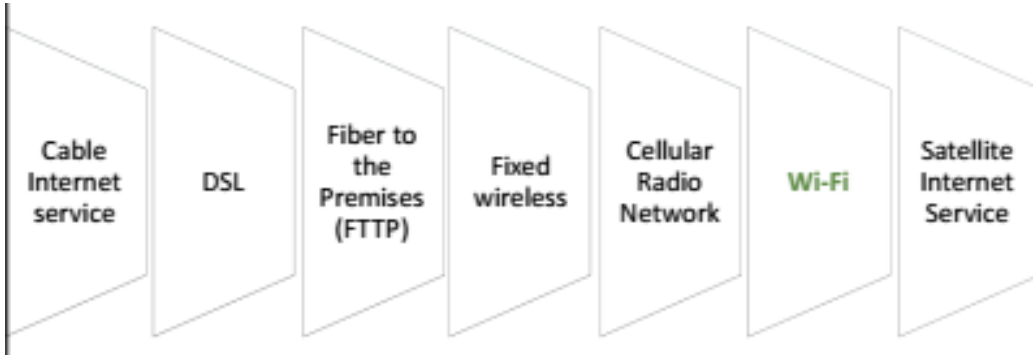
Broadband Communication and Policy

- Baseband LANs :
  - Baseband LANs are single-channel, supporting a single communication at a time.
    - Analogy: Nepalese people talking to each other.
  - They are digital in nature, varying the bit state through voltage ON/OFF or light pulse ON/OFF.
  - Digital signal from a transmitting device is directly introduced into the transmission medium (typically, after encoding).
  - E.g., 10Base5: 10 Mbit/s, baseband, 500 m. Ethernet uses baseband signaling.
- Broadband LANs :
  - Broadband LANs are multichannel and analog in nature.
    - Analogy: Meetings of foreigners from different country speaking different language.
  - The different channels can be used to transfer different types of information or multiple simultaneous transmissions.
  - Modem is used to transform the digital signal from a transmitting device into a high frequency analog signal.
  - The channel is subdivided by frequency into many sub-channels.
  - E.g., 10Broad36: 10 Mbit/s, broadband, 3600 m. Cable TV uses broadband signaling.
- Baseband LANs are the most prevalent.

Broadband Communication and Policy

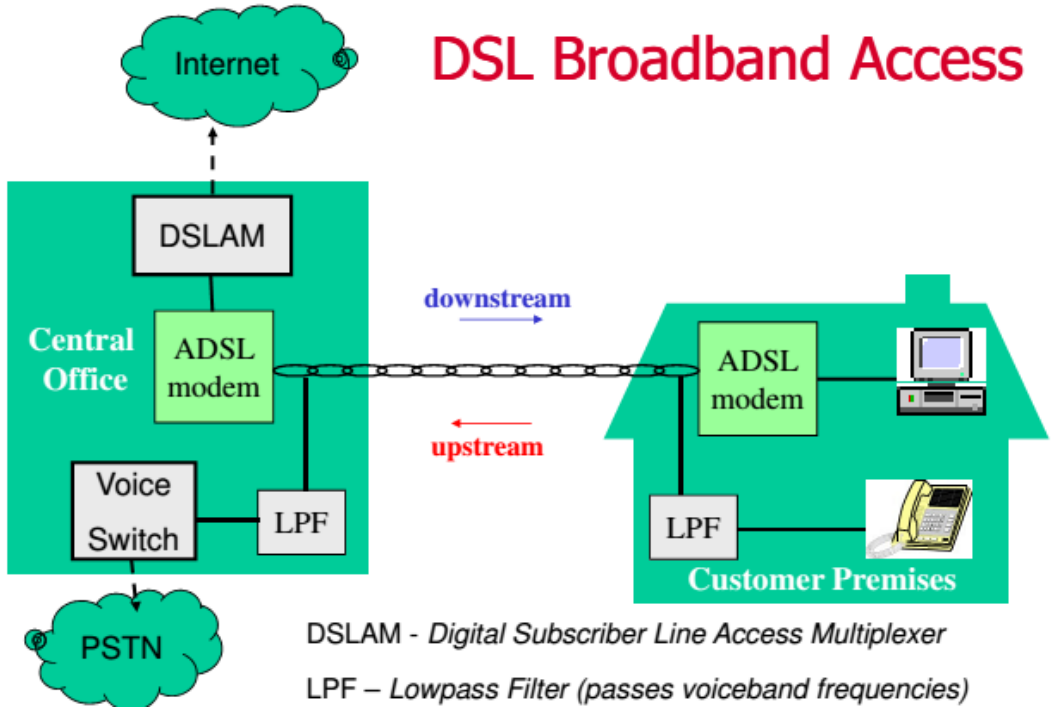
- The “Broadband” we’ll be talking about is “high-speed” internet access technology.
  - E.g. Cellular network that started with 1G and currently, 4G.
- In early 1980’s, communications systems changed from fixed “point-to-point” to wireless “anytime, anywhere” communication.
- Every 10 years, new generation appeared
- Wireless networks have evolved from narrowband networks of a few 10kbps to wideband networks of a few 100Mbps (LTE).
- Now on the way to broadband networks of a few Gbps (LTE-A and beyond).





Broadband Communication and Policy

- High speed internet connection
  - Greater than 128Kbps.
  - Always on!
  - Simultaneous up-Link and down-link communication.
  - Overcomes Internet frustrations.
  - Made possible by digital modems.
- Leading broadband access technologies.
  - xDSL, cable, satellite, ISDN digital modems.



Broadband Communication and Policy

- xDSL is the term for the Broadband Access technologies based on Digital Subscriber Line (DSL) technology.
  - “x” signifies that there are various flavors of DSL
- Provides always-on, high-speed data services over existing copper wires to residences & businesses.
  - POTS service and DSL coexist on same copper line.
- Lower rate xDSL (up to 1.5 Mbps) is gaining popularity in the residential market; will get faster and cheaper.
- High performance xDSL (up to 52 Mbps) targets business and high-end users.

Broadband Communication and Policy

- Benefits:
- High-speed data service.
  - DSL typically >10x faster than 56-kbps analog modem.
- Always on connection
  - No need to “dial-up”
- Uses existing copper wires.
  - Co-exists w/ POTS service.
- Reasonably priced today and getting cheaper.

- Applications:
- High speed Internet access.
- SOHO.
- Multimedia, Long distance learning, gaming.
- Video on Demand.
- VPN.
- VoDSL.

Broadband Communication and Policy

- ‘DSL’ stands for ‘digital subscriber line’.
- The term is a general term applied to a variety of different technologies used to achieve ‘broadband’ or high speed digital transmission over 2-wire or 4-wire ‘standard copper’ public telephone network access lines.
- Mainly 2-types:
  - SDSL (symmetric digital subscriber line).
  - ADSL (asymmetric digital subscriber line).
- SDSL the transmission rate in downstream and upstream directions is the same (i.e. symmetric). In ADSL, the downstream rate of transmission is greater than the upstream bitrate (i.e. asymmetric).
- The commonest form of DSL is ADSL.

Broadband Communication and Policy

- Other types of DSL:
  - **HDSL** (high speed digital subscriber line) is a particular type of SDSL – usually providing 2 Mbit/s transmission in both downstream and upstream directions.
  - **VDSL** (very high speed digital subscriber line) is able to operate at very high speed (e.g. up to 50 Mbit/s) over copper cable – but only over short distances.
    - Typically VDSL is used in 'hybrid' networks, comprising short copper cable connections from VDSL customer premises to locally placed street cabinets and then by means of glass fibre to the network operator's exchange building site (this type of hybrid network is sometimes referred to as 'fibre-to-the-curb' (FTTC)).
  - **XDSL** is sometimes used as a generic term to mean 'any type of DSL'. The 'X' stands in place of a letter making up a recognised DSL abbreviation.
    - Thus XDSL may be used as a short form to mean 'any of: ADSL, HDSL, SDSL, VDSL etc.)

Broadband Communication and Policy

- What are ADSL2 and ADSL 2+?
  - ADSL2 and ADSL2+ are further developments of the ADSL standard (defined in ITU-T recommendations G.992.1 and G.992.2).
  - In particular, the developments increase the bitrates and line lengths possible with ADSL.
  - The higher bitrates are intended to allow new applications over DSL, such as HDTV (high definition television).
  - The maximum bitrate of an ADSL2 line (defined by ITU-T recommendation G.992.3) is 12 Mbit/s.
  - The maximum bitrate of ADSL2+ (defined in ITU-T recommendation G.992.5) is 25 Mbit/s. In addition, there is a variation of ADSL2/2+ which allows an upstream bitrate of up to 3.5 Mbit/s.
  - The maximum bitrate of a standard ADSL line is 8 Mbit/s.

Broadband Communication and Policy

- Limitations of ADSL:
  - The prime limitation is that ADSL is not available to everyone – not all exchange areas are equipped for ADSL.
  - In addition, for very heavy users or for bandwidth-hungry applications (such as live video or TV-streaming, large scale software downloading, video-on-demand, high speed 3D gaming etc.) the downstream bitrate may be a limitation.
  - The upstream limitation of 1 Mbit/s may also be a limitation for users requiring to send a lot of data (‘peering’ applications, large file transfer, back-up applications, web server connection at the site etc.).
  - In this case, ADSL2, ADSL2+ or SDSL may be better suited.
- Limitations of ADSL 2/2+:
  - As with ADSL, not all telephone exchange areas are equipped for ADSL2 and ADSL2+. In addition, the upstream limitation of 3.5 Mbit/s may also be a limitation for users requiring to send a lot of data (‘peering’ applications, large file transfer, back-up applications, web server connection at the site etc.).
  - In this case, SDSL may be better suited.

Broadband Communication and Policy

- Limitations of SDSL:
  - As with ADSL, not all telephone exchange areas are equipped for SDSL. Where the data rate of 6 Mbit/s is not sufficient then you may need to request a high speed leaseline (e.g. ethernet, 34 Mbit/s, 155 Mbit/s or Gigabit Ethernet – 1000 Mbit/s) as your means of connection to the Internet.

Broadband Communication and Policy

- Why can I not get the bitrate and/or DSL service that I want?
  - Since the modulation technique used to carry the high bitrate ADSL signal over your “local loop” telephone line makes heavy use of high frequency signals, the line has to be of a given minimum quality before ADSL can be expected to work properly.
- The length of your telephone line from your house to the nearest telephone exchange. The length must typically be <5.5 km. If not:
  - Signal loss across your telephone line should typically be less than 45 dB.
  - The noise level on your telephone line (poor connections (“fried egg noise”) or crosstalk (humming or overhead conversation or other signals) disturb the ADSL signal. Line noise must typically be less than 55 dB.
  - Line capacitance of your telephone line acts as a filter for the higher frequencies. The value must be less than 180 nF.
  - The cable gauge (i.e. the diameter of the copper core) of your telephone line – narrower gauge wires cause higher signal attenuation (loss of signal strength) but may have lower capacitance.

Broadband Communication and Policy

- Reference:
  - National Broadband Policy, 2071 by Ministry of Information and Communication, Government of Nepal.
  - Wireless broadband masterplan for the Federal Democratic Republic of Nepal, International Telecommunication Union (ITU) supported by Korean Communications Commission (KCC).
- Recent advances in telecommunications/ ICTs (Information and Communications Technologies) offer strong potential for generating far reaching development outcomes in a country like Nepal.
- Telecommunication infrastructure capable of carrying not only voice but also data and enabling multiple channels of service and information delivery continues to be at the core of this process of transformation.
- Growing consumer demand (incl. enterprise and corporate houses)
- Consumers wants to enjoy the economic and social benefits of broadband connectivity.
- Telecommunications sector in Nepal has registered impressive growth over the recent years thanks largely to the policy of sector liberalization adopted by the Government.
- Competitive intensity of the sector has increased and as a result, telecom penetration is significantly on the rise throughout the country.
- Mobile sector in particular has registered impressive uptake as evidenced by its sustained growth trajectory over the past few years.

Broadband Communication and Policy

- Broadband connectivity is a means of accessing and providing data in as fast a manner as possible, its role has been identified as of high enough importance to warrant the characterization of a ‘human right’.
- A World Bank study emphasized the importance of broadband penetration for developing economies having concluded that every 10 per cent increase in broadband penetration provides a 1.38 per cent increase in GDP.
- Broadband networks are able to deliver a host of applications and services that other mediums are simply not capable of providing. These services include:
  - e-commerce, e-banking, e-government, e-education, improved education/training and telemedicine/e-health.

Broadband Communication and Policy

- ITU adopted a set of four broadband targets to be achieved by 2015:
  - All countries should have a national broadband plan / strategy or include broadband in their universal access / service definitions.
  - Entry level broadband services should be made affordable in developing countries through adequate regulation and market forces (for example, amounting to less than 5 per cent of average monthly income).
  - 40% of households in developing countries should have Internet access.
  - Internet user penetration should reach 60 per cent worldwide, 50 per cent in developing countries and 15 per cent in least developed countries.
- It should be noted that ITU is optimistic that all of these targets will be either met or exceeded by 2015.
- In order to reap the benefits of wireless broadband, Nepal must strive to meet and exceed these country household broadband targets.
- The ICT Development Index (IDI) is intended to provide insight into the level and evolution over time of national ICT development, progress in ICT development, the digital divide and development potential of ICT.
- It represents an amalgamation of data measuring ICT access, usage and skills.

Broadband Communication and Policy

- Nepal, alongside other SAARC19 Members (Afghanistan, Bangladesh, Bhutan, India, Maldives, Pakistan and Sri Lanka), is committed to a regional ICT policy aimed at increasing penetration, quality and harmonization of ICT services.
- A 'Plan of Action' for telecommunications services has evolved over three SAARC conferences in 1998, 2004 and 2008. The following aspirational goals and objectives were formulated:
  - 'To promote cooperation in the enhancement of telecommunication links and utilization of information technologies within the SAARC region;
  - To minimize disparities within and among Member States in the telecommunications field;
  - To harness telecommunication technology for the social and economic up-liftment of the region through infrastructure development by optimal sharing of available resources and enhanced cooperation in technology transfer, standardization and human resource development;
  - To evolve a coordinated approach on issues of common concern in international telecommunications for a (opportunities).

Broadband Communication and Policy

- As of 2012 Ncell, operator of the nation's largest GSM network now provides 3G services using the 2100 MHz band to all main urban areas in Nepal.
- Ncell has 7 million GSM subscribers, followed by Nepal Telecom with acustomer base of 5.74 million in January 2012, up from 5.65 million a month earlier.
- The customer base of Ncell is therefore 1.26 million higher than its competitor Nepal Telecom. In addition to the main two operators, three operators currently provide telephony in rural areas:
  - Gramintel (STM): licensed to provide Rural Telecom Services (RTS) in rural areas of the Eastern Development Region. It provides fixed and pay phones;
  - United Telecom Limited (UTL): the first private operator to be granted a nation-wide licence.
  - Nepal Satellite Telecom Pty Ltd (NSTPL): licensed to provide Basic Telecom Services (BTS) throughout the country;
  - Smart Telecom (STPL): licensed to provide RTS in rural areas of all development regions excluding the Eastern Development Region using VSAT technology.

Broadband Communication and Policy

Ambit of operation	Laws / Regulations / Instruments
Licensing	• Telecommunications Act 1997, as amended by the Amendment Act 2007 and the Telecommunications Amendment Act 2008 • Telecommunications Regulations 1998 • Rules on Licensing Telecommunication Services • Quality of Service Parameters for Basic Service (26 June 2007): • Quality of Service Parameters for Internet (26 June 2007
Spectrum management and allocation	• Radio Act 1957 • Radio Communications (License) Regulation 1992 • Telecommunication Service Radio Frequency (Distribution and Pricing Related) By-law 2066
Access and interconnection	Telecommunication Act 1997
Retail and tariff regulation	Telecommunication Act 1997
Competition	Telecommunication Act 1997* (NTA implicitly has power to regulate for competition via licensing and other mechanisms.)
Universal service obligation	Telecommunication Act 1997

Broadband Communication and Policy

Licensee	CDMA 800	GSM 900	GSM 1800	CDMA 1900	IMT 2000 (3G)	Total (MHz)
Nepal Telecom	2 x 8MHz	2 x 7.2 MHz, 2 x 2.4 MHz	2 x 9 MHz, 2 x 6 MHz	-	2 x10 MHz	52.6
STSPL	-	2 x 2.4 MHz, 2 x 0.6 MHz	-	-	-	3
UTL	2 x 3 MHz, 2 x 1.5 MHz	-	-	2 x 1.25 MHz	-	5.5
NSTPL	-	2 x 4.4 MHz	2 x 9 MHz	-	-	13.4
STM	-	2 x 2.4 MHz	-	-	-	2. 4
Ncell	-	2 x 6 MHz 2 x 2 MHz	2 x 9 MHz, 2 x 2 MHz	-	2 x 10 MHz	29

Broadband Communication and Policy

- Radio frequency laws and regulations are governed by the Radio Act 1957.
  - This Act simply empowers the government to make rules with respect to radio machines (Act Section 10) and stipulates that subject to express exceptions, a license is required to hold, use and manufacture radio machines (Act Section 3).
- Key issues and challenges:
  - Competition to create conditions for large scale rollout of broadband infrastructure and expanding access to broadband services to the majority of the population in Nepal.
  - Ensuring timely availability and re-farming of radio spectrum for IMT and IMT Advanced services has been a challenge in Nepal i.e. Spectrum allocation.
  - Difficult terrain and disruptions in power supply pose yet another set of challenges warranting appropriate policy responses.
  - Affordability.
  - Policy and regulatory barriers
    - Complex licensing scheme that acts to discourage enterprises from entering the domestic market and hence providing additional competition;
    - non-transparent spectrum allocation regime and inefficient allocation of key spectrum bands;
    - The lack of an effective interconnection regime; and
    - Inefficient taxes that add to the expense of purchasing new technology / equipment.

Broadband Communication and Policy

- Government of Nepal believes that broadband is a ‘general purpose technology’ that will transform economic relations, enhance productivity and create new services.
- At the level of access network and technologies, several broadband technologies like cable modem, xDSL, Fiber, 3G and WiFi, Ethernet, and VSAT are commonly in use in Nepal.

Broadband Communication and Policy

- Key objectives and targets of National Broadband Policy:
  - To provide secure, meaningful, affordable and reliable broadband services on demand in urban areas and universal access to broadband services in rural, unserved and underserved areas of Nepal.
  - To promote broadband take-up by early and influential users including government and business users, socially important users such as the education and health sectors as well as to stimulate demand and content creation and build user capacity.

Broadband Communication and Policy

- To meet these objectives following policy will be adopted:
  - Radio frequency spectrum to expand broadband access by means of both mobile and fixed wireless technologies consistent with international standards and best practices will be released.
  - Fixed-mobile convergence will be promoted for optimized delivery of services to the consumers irrespective of their devices and locations.
  - Roadmap for availability of additional spectrum for every 5 years will be prepared beginning the year 2014.
  - Infrastructure sharing will be promoted through legal and regulatory instruments.
  - Measures taken to secure unbundling of the local loop under favorable terms and conditions.
  - Comprehensive measures will be taken to lower infrastructure rollout costs.
  - And few others.

Broadband Communication and Policy

- Institutional arrangement: A National Broadband Policy Implementation Steering Committee will be formed at the Ministry of Information and Communication with the following structure:
  - Hon. Minister, Ministry of Information and Communication; Chairperson
  - Member, National Planning Commission; Member
  - Secretary, Ministry of Education; Member
  - Secretary, Ministry of Health; Member
  - Secretary, Ministry of Agriculture; Member
  - Secretary, Ministry of Finance; Member
  - Secretary, Ministry of Local Development; Member
  - Secretary, Ministry of Information and Communication; Member
  - Chairman, Nepal Telecommunications Authority; Member
  - Joint-Secretary (Policy and Programme), Ministry of Information and Communication; Member-Secretary

Broadband Communication and Policy

- Assumptions:
  - Broadband as development agenda will enjoy high level of stakeholder support and buying the days ahead.
  - There will be intensified demand for broadband services thereby creating conditions for more private sector investment in the sector.
  - Necessary regulatory reforms in the area of licensing and spectrum governance will be taken in an urgent basis to promote investment in the sector.
- Risks:
  - Overall investment climate might be compromised on account of delays in much needed regulatory reforms.
  - The continuing challenges associated chronic power shortages could dampen the overall demand for broadband and create disincentive for investment.
  - Potential error in judgment in relation to the selection of future proof technology choices in rolling out broadband.
  - Lack of oversight giving rise to in skewed, purely market driven expansion of broadband resulting in exclusion of the communities outside urban areas.