Present trends in worldwide in ensuring Energy Efficient Telecom Equipments

Abstract:

In telecom networks “Green” refer to minimizing consumption of energy through use of energy efficient telecom technologies and renewable energy resources.

Greening of telecom reflects in green telecom equipment, green manufacturing, environmental friendly design of telecom building, telecom mobile towers and safe telecom waste disposal.

Carbon footprint can be reduced by introducing energy efficient telecom products by telecom manufactures and suppliers in the present market.

This study paper is an attempt to have a feel of vast evolving energy efficient technologies trends worldwide in telecom field.
INDEX

Chapters
PAGE
1. Introduction 1
2. Importance of green and energy efficient telecom 2
3. Global initiatives in energy efficient technologies 2
4. Government Support- Subsidies, Taxes and Levies 8
5. Energy saving certificate practices worldwide 9
6. Various international energy efficiency testing Standards for telecom equipments 10
7. Conclusion 11
8. References 12
Introduction:

Global Scenario – Energy consumptions in ICT

The information and communications technology (ICT) industry alone accounts for about 2% or 860 million tons of the world’s greenhouse gas emissions. The main contributing sectors within the ICT industry include the energy requirements of PCs and monitors (40%), data centers about 23% and fixed and mobile telecommunications contribute about 24% of the total emissions.

Many countries have initiated steps to reduce energy consumption and emissions in line with the Kyoto Protocol of 1997, which was signed by over 160 countries, including India, to reduce their emissions of greenhouse gases by 5%, from the 1990 level, by the year 2012. The importance of Green and energy efficient telecom equipments have risen phenomenally in recent years and is being talked about by most of the manufacturers in the world due to following reasons:-

Importance of Green and Energy efficient telecom equipments:
In present scenario it is very much essential to have energy saving Telecom equipments and networks.

- To reduce power consumption which is largest operating expenses for telecom network operators?
- To reduces Green house gas effects contributions from energy consumption by telecom networks.

The new energy saving technologies are important to develop and evolve to make equipments energy efficient. Equipments should be used in efficient manner to reduce energy consumption and increase throughput /power consumption level.

Technologies at their relevant level play important role for energy saving

- **Device level:** - Technologies applicable for electronic Device of LSI (Large Scale integration) and Memory.
- **Equipment level:** - Technologies applicable for a set of Device/ One equipment e.g. router/switches/GEPOP etc.
- **Network level:** - Technologies applied in network, protocols applied for routing etc.

**Global initiatives in energy efficient technologies:**

Technologies help in Energy- saving /reducing Power Consumption

Technologies application for different levels:

Device level: The following technologies are important at this level.

a) LSI micro fabrication
b) Multi core central Processing Unit (CPU)
c) Clock gating
d) Power aware Virtual memory
e) Advanced Power amplifies

a) With Smaller the Size of LSI Macro fabrication reduces driving Voltage which is linked with reducing power consumption (linked with Driving Voltage square). But leakage current essentially to check with smaller the size of LSI macro fabrication.
b) In order to execute any work, multi low specs CPUs can save energy Over Using Single high Specs CPU. Energy Consumption is linked with (Clock frequency) cube. The performance which can be handled by multi- CPU directly help in energy saving.

Multi- core CPU runs with Control Technologies like Clock gating and sleep mode Control. They help multi core CPUs to control power supply and clock rate which help to configure minimum required CPUs to operate at the minimum Clock rate.

In order to reduce the energy Consumption the number of active CPUs and their clock rate should be controlled as per the load.

(c) Clock Gating: Depending upon the task, LSI and circuit are being supplied the clock. Even no supply of clock when there is no required task, which help in saving energy. Factor that optimal transition between ON and OFF states should be there, otherwise less energy would saved as more energy is required for transition.

d) Power aware virtual memory: Depending upon demand and use of memory energy consumption occurs. For energy saving, technology helps to introduce to buffer memory and cache memory.

e) Advanced power amplifier: Power amplifier consume high percentage of total power consumption of wireless network base station. Higher efficient power amplifier help in reducing power consumption. With the help of digital pre distortion (DPD) technology energy saved as DPD help to cancel the distortion in opposite direction when ever distortion occurred in power amplifier.

Technologies applied at equipment level:-
1) Sleep mode: Technology help to reduce energy consumption when equipment and functions put on sleep mode/not in use. It applied at equipment level as well as network. Equipment without sleep mode consumes constant energy depending upon the maximum traffic to be adopted. Sleep mode helps in saving power when less traffic implies. If traffic in parallel path is less then maximum, some traffic can be diverted/aggregated into one path, the unconcerned equipment to the path can put on sleep mode to save energy.

Constraints: When selecting control traffic is issue due to important control traffic to be forwarded / delivered such as routing information other is when small wired network.

Technology solution like:

(a) Maintaining proxy: Which serve when network is in sleep mode and responds to routine network traffic?

(b) Energy efficient Ethernet protocol developed by the energy efficient task force (IEEE 802.3az)

(c) L2 Power saving mode combined with ADSL 2 and ADSL plus technology.

(d) in wireless network: Sleep mode control software and operation are provisioned in mobile base station and devices.

Sleep mode control software shutdown low traffic band for the cell /whole base station.
Mobile devices during sleep mode operation change state from sleep and listening to reduce power consumption of the battery.
Adaptive link rate (ALR) and dynamic voltage scaling (DVS)
This energy saving provision mode for network equipment
ALR: interface link speed (Bit Rate) is controlled by amount of traffic to be handled.
DVS: Driving voltage of the CPU, network interface card and hard disc controlled according to traffic to handle.
CACHE SERVER: If single user use contents multiple time or multi user use the same content repeatedly, the avoidable traffic can be reduced when contents are cached. It further reduces the band width.
Filtering: Blocking invalid or unimportant data by blocking keep alive messages or repeated user’s messages. Denial of services if detected attacks by the intrusion prevention function.
Sorry Server: It returns response for unavailability of the service due to temporary traffic congestion (an excuse”). Due to which some user may leave their demand resulting in reducing traffic.

Shaping: The output rate of packets lower than the potential link rate of control which save energy of the other subsequent nodes which are nearly operating to the maximum data rate. (But in increase of delay due to queuing to be checked).

**Smart Antenna Technologies:** such technologies e.g MIMO use smart processing algorithms with multiple arrays at both the transmitter and receiver. It can control the directionality of reception/transmission signal which reduces interference with other signals resulting in higher data rates transfer as compared to single input single output (SISO) under same power budget and bit error rate performance.

Compact base transceiver stations (BTSs): These types of base stations are without ground shelters and cooling equipments which reduce energy consumption. These BTSs support feature like multiple antenna per sector with multiple input, multi-output (MIMO) and beam forming.

Optical network node: the energy efficient technology for transmission interface and switching fabrics to a network node. Optical network node can handle speed of Tbps or more. This help in network energy efficiency by large amount of traffic aggregation along with node. Optical packet switching help in improving network energy efficiency as optical to electrical and electrical to optical translation is avoided which consume large energy.

Relay station: it helps to deliver data at destination node with multiple wireless links. As each link has independent fading channels, diversity gains which improve spectral efficiency. It also helps to reduce time to transmit a fixed amount of data which further reduce energy consumption.

**Network level Technologies**

Circuit switching: As compared to packet switching which is having energy consuming memory devices like SRAM and CAM for routing information, the circuit switching use less energy. Circuit switching is more useful and efficient for streaming traffic (video streaming, which is likely to increase in coming years). main draws back: a) every connection occupies line, even there is less
traffic, traffic cannot be that easily routed through remaining lines (resources) .b) the packet level statistical multiplexing function for link utilization cannot handle by circuit switching which result in reduction of network energy efficiency.

Burst switching: in order to save energy at core routers, packets are prepared for data burst at edge routers. With bursts the operation at core routers decreases. In similar nature optical burst switching take place in optical network for better network utilization. by control packet, some bandwidth is used for the bursts in advance of transmission .with efficient utilization of bandwidth, the set-up is fast as compared to optical circuit switching. Further processing operation reduces and energy saving in core network.

Transmission scheduling: traffic/packets buffer to be reduced at the network nodes with the timing of packet transmission and to further minimize the waiting time at each node. Designed buffer capacity is important aspects to check packet loss. Optimum condition is required for saving energy. To regulate the network, timing of packet transmission for each node in multiple nodes environment to be seen.

Energy consumption based routing and traffic engineering:

Optimum use of traffic route to reduce energy consumption network wise. important process related to it are traffic aggregation, multiple path routing and network coding.

. With sleep mode concept, traffic aggregation to limited set of routes and remaining (unused nodes) to operate in sleep mode to save energy.

.with ALR/DVS, multiple routes are used to handle minimum traffic, optimize the link rate or voltage to save energy.

Light weight protocol: save energy by reducing unnecessary functions of the networks nodes .it take care of protocols functionality along with protocols available in other layers (MPLS performed in IP network) traffic can be transferred by using lower-level simpler layers, it tries to simplify functionality of protocol e.g. extending IP capability from access network to backhaul to provide full IP network common platform..

Content delivery networks: in order to deliver content energy efficiently, access server nearer than the (distant) main server is use to save bandwidth ,energy and resources related to distance.

Traffic peak shifting: maximum traffic transmission during off-peak hours which internally reduce maximum traffic accommodation in general.
Small cell design: macro cell is replaced by micro cell, pico cell and femto cell. The small cell utilizes less energy. It can save energy for transmitting a radio signal. As power loss over a wireless channel is related to distance* where* is path loss exponent e.g. due to short distance, femto cell can provide better indoor voice and data coverage with lower transmit power. It has better signal to interference noise ratio.

Energy consumption aware network planning: network level design and planning for better energy efficient networks with the help of energy consumption report and network outage reports. Static part deals with physical network and routing policy to save energy. Dynamic part play in operation phase i.e. re-route the traffic low or add traffic to save energy broadly e.g. cell-zooming.

**Government Support – Subsidies, Taxes and Levies:**

(i) Incentives can be given for equipment working on the principle of energy conservation. The equipment that outperforms the threshold set may be given incentive.

(ii) Equipment that uses renewable energy sources may be given subsidy.

(iii) Equipment that is spectrum efficient and is able to provide more data rate with minimum bandwidth and equipment which is able to provide radiations of more signal strength with less power consumption can be given incentive.

(iv) The operators who utilize non-hazardous materials in telecom as per Kyoto Protocol be given incentives.

(v) There could be incentive plans for operators who implement equipment recycling program.

(vi) There could be non-financial incentives to operators/tower companies in the form of technical assistance provided by experts of bodies like GSMA, specifically for feasibility studies.

**Corporate Social Responsibility and Community Service:**

Energy consumption is one of the leading drivers of operating expenses for both fixed and mobile telecom network operators. Several Govts. have adopted corporate social responsibility (CSR) initiatives with a goal of reducing their networks’ carbon footprints, and network infrastructure vendors are striving to gain competitive advantage by reducing the power requirements of their equipment.
The CSR adopted by telecom service providers and manufacturers generally revolves around reducing energy consumption and greenhouse gas (GHG) emissions with more energy-efficient products and operations,

GENERAL ENERGY SAVING CERTIFICATE PRACTICES WORLD WIDE (WHITE AND GREEN CERTIFICATE):

Broadly it can be categorized into two types:-

a) White certificates: *When determining the extent of energy saving, the energy use is compared against a baseline, which is an estimate of the energy Use in the absence of any attempt at saving energy.* In environmental policy, **white certificates** are documents certifying that a certain reduction of energy consumption has been attained. In most applications, the white certificates are tradable and combined with an obligation to achieve a certain target of energy savings.

A white certificate, also referred to as an *Energy Savings Certificate (ESC), Energy Efficiency Credit (EEC), or white tag,* is an instrument issued by an authorized body guaranteeing that a specified amount of energy savings has been achieved. Each certificate is a unique and traceable commodity carrying a property right over a certain amount of additional energy savings and guaranteeing that the benefit of these savings has not been accounted for elsewhere.

b) Green certificate:-

A **Green Certificate** is a terminology used in Europe -also known as **Renewable Energy Certificates (RECs)** in the USA, are tradable commodity proving that certain electricity is generated using renewable energy sources. Typically one certificate represents generation of 1 Megawatt hour of electricity. What is defined as “renewable” varies from certificate trading scheme to trading scheme. Usually, at least the following sources are considered as renewable:- Wind (often further divided into onshore and offshore); Solar (often further divided into photovoltaic and thermal); Wave (often further divided into onshore and offshore); Tidal (often further divided into onshore and offshore); Geothermal, Hydro (often further divided into small - micro hydro and large), Biomass (mainly bio-fuels, often further divided by actual fuel
Green certificates represent the environmental value of renewable energy generated.

**Various international energy efficiency testing standards for telecom equipments:**

- **TS102533** Energy consumption in broad band telecommunication network equipment This is a Technical Specification, It defines the test methods and power targets for Broadband Access equipment (at the network side) ETSI.
- **TS102706** Energy efficiency of wireless access network equipment. This is a Technical Specification which defines the criteria for the assessment of power consumption in Wireless Access Networks.
- Environmental Engineering Work Program DES/EE-00015 Measurement method and limits for energy consumption in broadband telecommunications equipment, This is an ETSI Standard done for the TS102533 and to add further new Access technologies (e.g. GPON) that are part of the latest version of the European Code of Conduct.
  - The methodology and the tests conditions to measure the power consumption of end user broadband equipment in the following conditions:
    - Off mode
    - Standby
    - Networked Standby
    - Low Power states On mode

- Draft available at Working Group level DTS/EE-00022 Energy Efficiency of Wireless Access Network Equipment, this is the revision of the present TS 102 706 to define efficiency parameters taking into account traffic load.
- Draft available at Working Group level DTS/EE-00023 Measurement Methods for Power Consumption in Transport Telecommunication Networks Equipment will be a Technical Specification, will define the measurement methods for power consumption, and efficiency indicators for transport equipment.

- CENELEC Liaison will be established with CENELEC JWG on the mandate M/439 on the standardization in the field of standby and off-mode power consumption measurement for energy using products.
- ETSI ES 203 136 V1.0.0 (2013-03) Environmental Engineering (EE); Measurement methods for energy efficiency of router and switch equipment.
- ITU recommendation: L.1310 Energy efficiency metrics and measurement for Telecommunication equipment.
Conclusion:

With the growing telecom infrastructure and telecom networks, the need for energy efficient technologies for telecom sector is the necessity. The energy efficient technologies bring change for betterment of telecom component, equipment and network level development.

Energy efficient technology helps in reducing Green house Gas emission effects which is now a corporate social responsibility for telecom manufacturing industry and telecom operators.

The R&D facilities for development and lab for testing energy efficient technologies is must for our country. TEC can play important role by bringing test methodology and concept lab for testing energy efficiency in telecom field.

It would further help DoT to formulate the policy for Indian telecom sector in respect of procurement of energy efficient equipment in telecom networks.
References:

1. ITU standards,
2. TRAI paper on green telecom