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टी ई सी संचारिका NEWSLETTER

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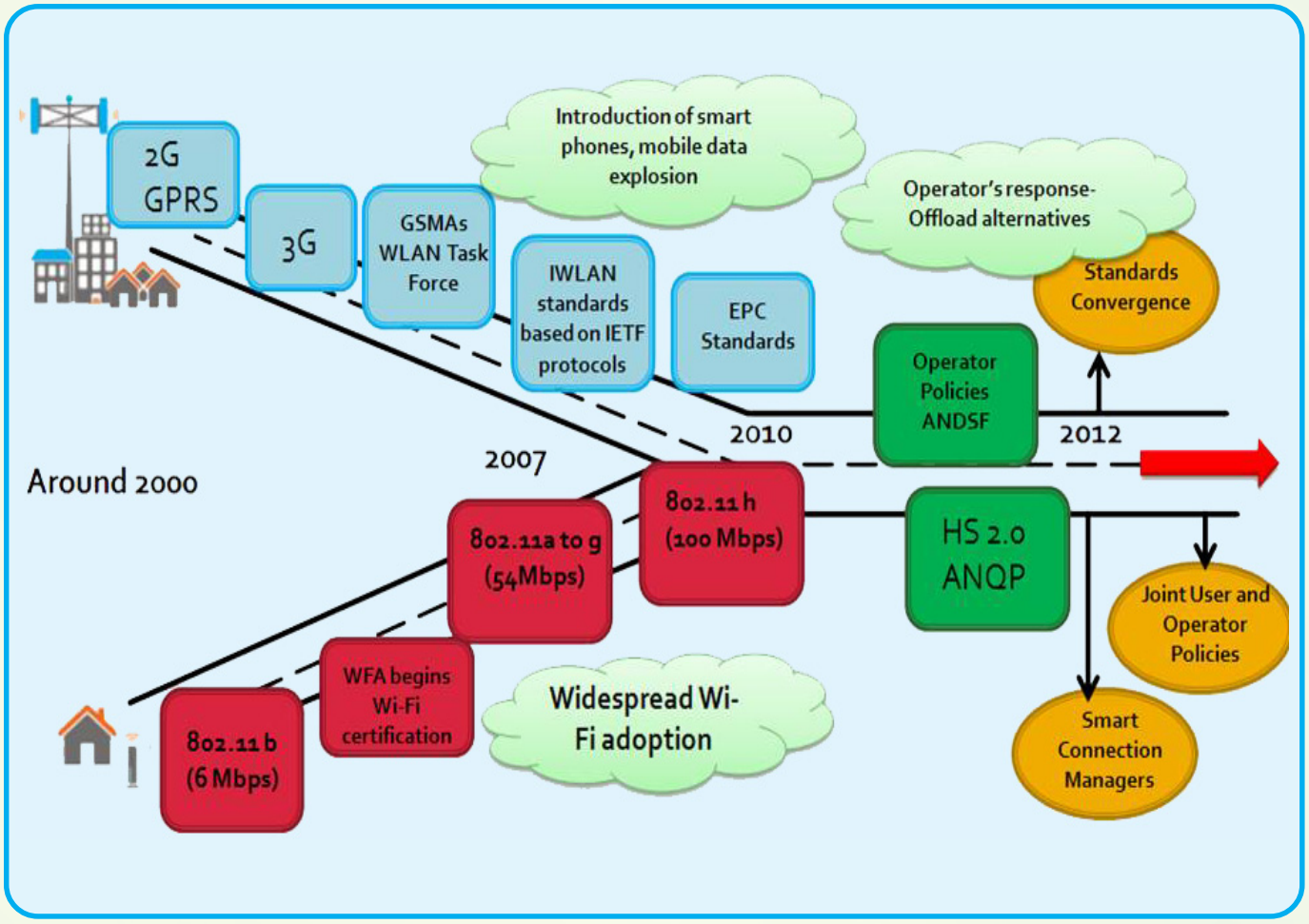
Mobile Data Offload – Wi-Fi Offload



Roadmap to Cellular Wi-Fi Integration

ISO 9001:2008
TELECOMMUNICATION ENGINEERING CENTRE

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• Mobile Data Offload – Wi-Fi Offload

1.0 Introduction

With the advent of smart phones and other similar smart devices which dominate the market, the mobile networks are chiefly dominated by data. The user demand for data is increasing rapidly and reaching to the order of exabytes (1 billion gigabytes). This has led to a paradigm shift in the network planning of the mobile network operators who are now focusing on devising effective and economical ways to cater to the growing user demand. The network operators plan on offloading the data and associated signaling traffic to a cheaper solution to improve their economics. The change in approach is also fuelled by the fact that the further technological developments and enhancements in cellular architecture are bound by physical limitations. Also, to cater to high bandwidth and high speed data, huge capital investments are required which are not economically viable. This has forced the operators to explore alternatives using small cell technologies like Wi-Fi, Femtocells etc. to efficiently handle the growing mobile data traffic. In this edition, we primarily focus on Mobile data offload through Wi-Fi, popularly referred as Wi-Fi offload.

Though the cellular and Wi-Fi radio technologies originated and evolved from two fundamentally different objectives, each has trended towards the other, with wireless data a central use of cellular technology today while over-the-top services provide voice over data networks. This confluence seems headed towards an integrated cellular and Wi-Fi landscape, but the evolutionary nature of the trend has resulted in a broad variety of approaches and solutions. There has been a great deal of interest of late in using Wi-Fi to offload traffic from heavily congested mobile networks. Early deployments consisted of building a parallel Wi-Fi offload network that takes traffic directly to the Internet. The mobile network operator would implement some kind of proprietary client that would manage the offload function. Many subscribers have implemented their own offload strategy by selecting Wi-Fi when it's available. Now, the industry is shifting its focus toward integrating Wi-Fi RANs into the mobile packet core. In this approach, Wi-Fi would take its place alongside 3G/LTE as a cornerstone technology in the mobile world. The mobile device selects the best radio access technology based on the conditions (typically signal strength, application type, default to Wi-Fi, etc.) and the subscriber is automatically authenticated and connected. All RAN traffic is brought back into the mobile packet core as defined in the 3GPP evolved packet core standards.

2.0 Roadmap to Cellular/Wi-Fi Integration

Cellular and Wi-Fi radio technologies originated from two distinct goals. While the cellular technology was motivated by the desire to make telephony technology mobile, on the other hand, the Wi-Fi technology aimed at making data communications wireless. Each technology had its own growth and development path until the need for their convergence mainly triggered by user demand was felt by both the Cellular and Wi-Fi community. This led to extensive standardization work to integrate cellular and Wi-Fi technologies. Figure as shown at cover page depicts the development and convergence roadmap leading to cellular/Wi-Fi integration.

3.0 Definition of Wi-Fi offload

Mobile data offload through Wi-Fi or Wi-Fi offload is one of the implementations of using small cell technologies like Wi-Fi to provide data services to cellular users in a more efficient and economically viable manner. Other small cell technologies like Femtocells etc. may also be employed for the same but Wi-Fi is garnering more attention from the cellular industry to cater to the rising data demand of the users. Smart devices today, are so designed that they prompt the user to log on to Wi-Fi networks for data transfer when one is in range as compared to cellular networks. But this kind of implementation is a very primitive one and is dependent on the user's choice to opt for Wi-Fi network or not. The standardization bodies like IETF, 3GPP, ITU etc. however, have been working to develop specifications for the implementation where the offload from cellular to Wi-Fi networks is more network-driven than user-driven.

4.0 Need for Wi-Fi Offload

The following points justify the need for Wi-Fi offload and also build up a business case for the cellular operators to adopt the same:

- It will cater to the growing mobile data demand and the smart devices usage patterns that have the characteristics of short sessions, high throughput and low latency.

- It will enhance the end user experience by improving service capacity and capability. Also the end user devices are so designed that they perform with better data speeds in Wi-Fi networks and so Wi-Fi has an edge over cellular network in this case as well.
- Using a solution which is more economically viable for providing indoor services will reduce the operating expenditure of the service providers as cellular broadband is more expensive than Wi-Fi.
- Address the issue of spectrum crunch whereby the cellular operators can provide high bandwidth consuming services through Wi-Fi.

5.0 Key aspects for implementation of Wi-Fi offload

For the effective implementation of offloading traffic from cellular networks to Wi-Fi networks, the following aspects need to be addressed:

5.1 Increasing the Wi-Fi footprint to implement offloading solutions

The cellular operators have the option to have agreements with existing wireless internet service providers or to have their own infrastructure to provide traffic offloading. It is up to the operator to choose any of the option that best fits its business scenario. The main intention is to increase the ubiquity of Wi-Fi networks so that they are readily available for offloading mobile data traffic.

5.2 User equipment challenges and enhancements

Wi-Fi offload in true sense requires minimal or no user interaction with the network to initiate offload. Also the seamlessness of the offloading is crucial for satisfying user experience. This requires provision of smart connection manager at the user equipment end which can directly interact with the network and effect offload according to flexible and efficient policies. The connection manager should be able to make decisions regarding network selection, volume of traffic data to be offloaded, application or service specific offload, time-based offload management etc.

5.3 User authentication and interaction with cellular core network entities for policy implementation and charging

Wi-Fi and cellular networks have different mechanisms for authentication and so requirement is to have an authentication mechanism which is acceptable for both the networks. Techniques like SIM based authentication for Wi-Fi networks are gaining ground. Also, till now there have been proprietary implementations of how policy and charging rules are applied in offload scenarios. Standards have been developed for the policy and charging rules applicable in offload scenarios and are being enhanced. ANDSF (Access Network Discovery and Selection Function) and PCRF (Policy & Charging Rules Function) servers' specifications developed by 3GPP cater to this functionality.

5.4 Seamless inter-network mobility considerations

Wi-Fi was mainly developed for local area networks and hence lacked any mobility functionalities but as cellular/Wi-Fi integration gained momentum, the aspect of seamless mobility, while the user moves from network to network was seriously considered. IETF (Internet Engineering Task Force) came up with the specifications for MIP (Mobile Internet Protocol) and PMIP (Proxy Mobile Internet Protocol) to address the mobility issues in Wi-Fi.

6.0 Wi-Fi Offload for different cellular architectures

The standardization in the field of cellular/Wi-Fi integration started as early as 2002 when GSMA formed the 'WLAN Interworking Task Force' group to study the possible interworking and integration scenarios for cellular and Wi-Fi technologies. This resulted in 3GPP formulating a number of specifications for cellular/Wi-Fi integration. These specifications can be seen as divided into two groups depending on the mobile core network they pertain to, viz.UMTS (Universal Mobile Telecommunication System) or EPC (Evolved Packet Core).

The standards dealing with UMTS core network are referred as IWLAN (Integrated/Interworked WLAN) standards and the latter as EPC standards for non-3GPP access.

6.1 Wi-Fi offload for UMTS core network (IWLAN standards)

Data traffic offload in UMTS core network using Wi-Fi are based on the IWLAN standards. These standards cover the aspects of Common Billing and Customer Care, 3GPP system based Access Control and Charging, Access to 3GPP system PS based services, Service Continuity, Seamless services and Access to 3GPP CS Services. These scenarios were

covered under 3GPP TR 22.934 and based on these; various 3GPP TS were released to define the specifications for each scenario.

A simplified representation of UMTS core network architecture incorporating IWLAN is depicted in Figure 1 below.

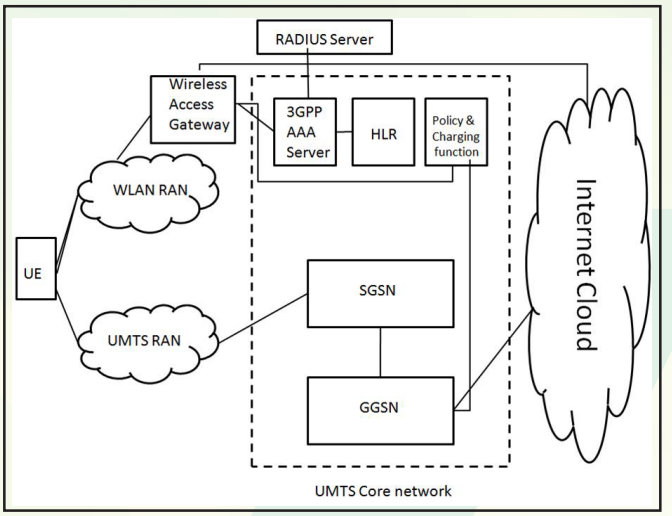

Figure 1:UMTS core architecture supporting IWLAN

Figure1 describes how the User equipment can be connected through the WLAN RAN or UMTS RAN and then be authenticated by the 3GPP core network and then finally connected to provide services.

One of the main goals of the IWLAN solutions was to achieve authentication without manual user intervention, such as entering a username-password, as is common is many Wi-Fi networks. This is made possible by developing authentication protocols based on the use of SIM cards, which are already provisioned in the 3GPP handsets. In addition to providing authentication in a manner transparent to the user, SIM based authentication methods are also familiar to 3GPP based network operators and provide the same level of security as 3GPP devices. Since the SIM based authentication is now done via WLAN networks, which are essentially IP Networks, the basic 3GPP authentication protocols are modified and are known as EAP-SIM (Extensible Authentication Protocol-SIM), EAP-AKA (Extensible Authentication Protocol-Also Known As) and EAP-AKA' protocols, which were standardized by the IETF. A typical flow of the EAP authentication is depicted in Figure 2 below.

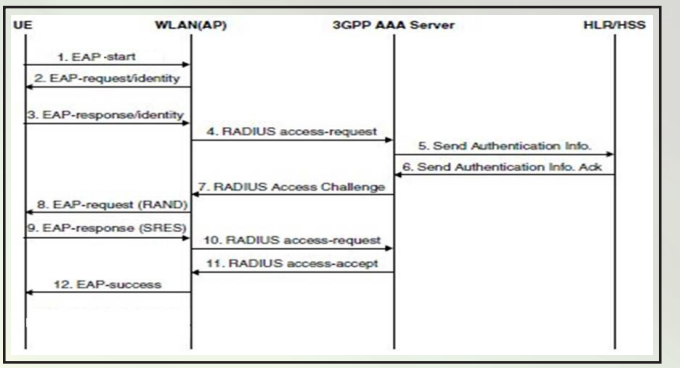

Figure 2: A typical EAP authentication message flow

6.2 Wi-Fi Offload for Evolved Packet Core network (EPC standards for non-3GPP access)

The offloading concepts defined by IWLAN standards were mainly based on loose interworking. The EPC standards for non-3GPP access aim to provide higher level of integration between the WLAN and cellular technologies ensuring tighter interworking. The WLAN access or non-3GPP access as it is referred to, proposed by IWLAN standards was mainly untrusted IP access as the WLAN operator and cellular operator could be different and the level of trust between them could be dependent upon the level of agreements and co-operation. The EPC standards however ushered the era of trusted non-3GPP access as they provided high level of integration between WLAN and cellular architectures and were mainly developed with the view that the cellular operator will also own the WLAN network.

Interworking between 3GPP and non-3GPP networks essentially consists of mobility of IP-Flows between the 3GPP and non-3GPP networks. The EPC standards for non-3GPP access provides for the possibility of managing 3GPP and WLAN interworking at an individual IP-Flow level. That is, it should be possible to support certain IP-Flows on the 3GPP radio interface and certain others on the WLAN radio interface, based on criteria such as QoS requirements, user subscription, type of user equipment, etc. Furthermore, it could also enable dynamic switching of individual IP-Flows from one radio interface to another. This is depicted in Fig 3.

A number of cases of such mobility can be distinguished depending on the following aspects:

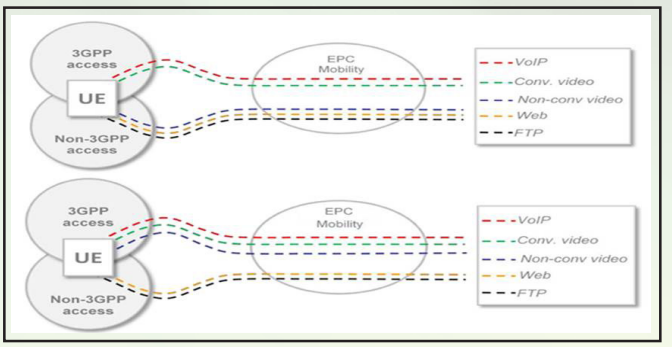

Figure 3: Dynamically moving IP flows between 3GPP and non-3GPP accesses

(1) mobility is on a per IP-Flow basis or per all IP-Flows associated with a PDN connection; (2) mobility is Seamless or Non-Seamless. Seamlessness is defined as preservation of the IP-address of the UE during the mobility process. Different combinations of these two fundamental aspects result in a number of scenarios, such as Wi-Fi offload, referring to mobility of IP-Flow(s) from 3GPP to Wi-Fi networks, and handovers, referring to mobility of all IP-Flows associated with a PDN connection etc.

The 3GPP standard TS 23.401 describes Seamless and Non-Seamless Handover solutions between 3GPP and Non-3GPP access networks, wherein GTP is used as the protocol for the Handover over the interfaces S2a, S2b and S5. Similarly, TS 23.402 describes similar solutions for the cases where PMIP and DSMIP are used for mobility.

Finally, TS 23.261 describes the solutions for Seamless IP-Flow Mobility using DSMIP protocols. This allows for selective assignment of different IP-Flows to different access networks and includes Seamless Wi-Fi Offload as a special case.

7.0 Other offload technologies

At a high level, Cellular Wi-Fi Integration may be seen as a technique for managing data traffic in a mobile operator networks in a smart manner. Cellular/Wi-Fi integration is one technique of such intelligent traffic management, which may be referred to as Radio Interface Offloading.

The other technique would be Network Offloading, referring to intelligent routing of traffic within the backend networks. The problem addressed by IP offload is that by default all IP traffic generated by a mobile device (or sent to a mobile device) is routed to and through the mobile core network. There are good reasons for this: i) it is necessary to ensure full mobility support; ii) it allows the operator to manage both the user's QoE and how its network is used; iii) it is necessary to access operator service.

SIPTO and LIPA are two solutions that 3GPP is standardizing for these problems.

The first of these solutions is Selected IP Traffic Offload (SIPTO). Based on network-specified policies, SIPTO supports offload of IP traffic directly to the internet and away from the mobile core network. The upside to the operator is lower load on its network, however there is a significant price to pay – mobility support for SIPTO traffic can be rather limited, and offloaded traffic cannot access operator services. Thus, the operator must be careful in selecting which traffic to offload.

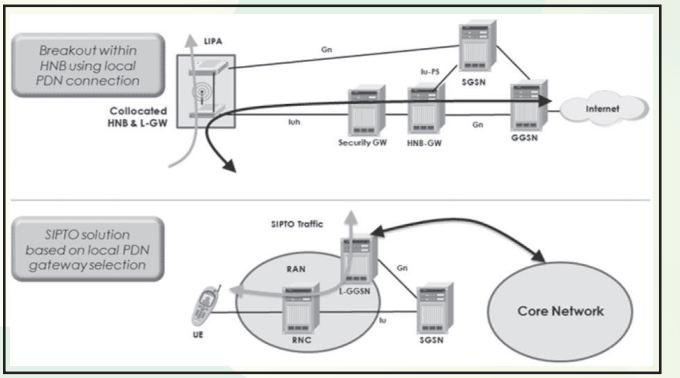

Figure 4: LIPA and SIPTO technologies

Like SIPTO, Local IP Access (LIPA) is designed to optimize IP traffic management. LIPA focuses on IP traffic destined to a local IP Network and is designed to route such traffic locally instead of through the mobile core network. LIPA is defined for use cases such as a home-user trying to access a local server without having to access the wide area network. LIPA is very closely linked to Femtocells implementations and standards specify offload through Home NodeBs or HNBs as shown in Figure 4. As with SIPTO, the price is limited mobility support for the locally routed traffic; also, just like with SIPTO, policy-driven 5-tuple based routing is used to select which traffic is routed locally.

8.0 Security Aspects of Mobile Data Offload

The scope of the security aspects of both IWLAN and EPC standards are defined as follows. These aspects are defined in 3GPP TS 33.402 and TS 33.234 :-

8.1 User identity and device identity confidentiality

User identity confidentiality for procedures between the UE and the core is provided as per the framework of EAP-AKA and EAP-AKA' protocols.

8.2 Entity authentication

Entity authentication is a must for IWLAN/ cellular interworking as there are trusted and untrusted non-3GPP IP accesses are involved. Mutual authentication i.e. the UE is authenticated by the network and the network entity is authenticated by the UE, is supported.

8.3 User data and signalling data confidentiality

Signaling data and user data confidentiality is supported and is mainly provided using the MIP and DSMIP protocols. In case of un-trusted access, IPSec tunnels are established between the UE and a trusted entity in the core network to ensure the same.

8.4 User data and signalling data integrity

Signaling data and user data integrity is supported and is mainly provided using the MIP and DSMIP protocols. In case of un-trusted access, IPSec tunnels are established between the UE and a trusted entity in the core network to ensure the same.

8.5 Security in roaming scenarios

In roaming scenarios, the WAG acts as the anchor between the home and visited networks and all the security mechanisms like authentication policies etc. are relayed by it to the UE.

9.0 Future advancements in technology

The future advancements in the cellular/Wi-Fi integration aim at higher level of convergence to facilitate improved user experience. Following points elaborate the same:-

- Extensive research is being carried out on the development of smart connection managers at UE end to make the offload process user agnostic.
- Leveraging the seamless capabilities of Hotspot 2.0 in offloading by standardizing the interoperability of ANDSF server and ANQRP protocol supported by Hotspot 2.0.
- Integration of Femtocells and Wi-Fi technologies (feasibility study being carried out by Small Cell Forum).
- Network based IP Flow Mobility that is being studied in a work item called MAPIM by 3GPP.
- 3GPP study groups on OPIIS, which looks into operator policies for IP Interface selection; WORM for including both 3G and 4G in Wi-Fi offloading scenarios; enhancements to ANDSF policy solutions; P4C (formerly called BBAI) for interworking with broadband backhaul networks etc.
- IETF is working on enhancing its mobility toolkit i.e. the MIP and PMIP protocols.

10.0 Conclusion

Cellular/Wi-Fi integration and one of its outcomes i.e. Wi-Fi offload is a promising technology enhancement both from the operator and the end-user perspective. Its offerings are tremendous and its true potential should be tapped. Wi-Fi offload in the true sense is aimed to be end-user agnostic provider of seamless mobility and service. Though it is still long way to go to achieve these offload features, but the standardization process bears witness that it is going to happen in the near future.

There are some crucial points which need to be considered for effective deployment of Wi-Fi Offload. One, the dawn of this technology can truly be seen only when the Wi-Fi footprint in India increases to the level that the offload scenarios are feasible and economically lucrative. Another important point which can be envisaged is to form policies to facilitate fair revenue sharing between the Wi-Fi Operator, the Mobile Network Operator and other entities involved if any, so that there is minimal dispute. It should also be considered and assessed whether the Wi-Fi service providers, having integration and revenue sharing with licensed networks, will need to have some type of license obligations. Also to be given serious thought is the spectrum crunch that 2.4 GHz band will face, once Wi-Fi offload solutions are widely deployed. In order to address this, 60 GHz band can be considered as an excellent candidate for Wi-Fi deployments. Security considerations like the impact of Wi-Fi offload solutions on Location Based Services need to be thoroughly examined and addressed.

Activities at NTIPRIT

1. In-service training courses for DoT Officers were conducted at NTIPRIT on the following topics:
   i. Training of Govt Officers in IPv6
   ii. NGN Basics
   iii. Procurement Process (in coordination with vigilance wing DoT) held at DoT HQ.

   Total 23 participants underwent training under the above courses (i) and (ii) held at NTIPRIT.
2. Induction Training of the following batches of Officer Trainees of ITS/BWS:
   i. ITS-2012 Batch (2 officers)
   ii. ITS-2013 Batch (4 officers)
   iii. P&T BWS (Electrical)-2013 Batch (3 officers)
   iv. P&T BWS (Civil)-2013 Batch (3 officers)
   v. P&T BWS (Architect)-2010 Batch (2 officers)

   Technical Modules of the ITS / BWS induction courses as per training calendar were conducted during this period. BWS officers were relieved on 16.10.2015 for field attachment after completion of their classroom modules.
3. Induction Training of the following JTO batch, which was started from 01.06.2015 got completed on 01.10.2015:
   i. JTO Trainees – 2011 Batch (4 officers)
   ii. JTO Trainees – 2013 Batch (5 officers)

   Classroom modules, Field attachment and Experience sharing & presentations conducted during this period.

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दूरसंचार अभियांत्रिकी केंद्र, नई दिल्ली में 15 से 29 सितंबर, 2015 तक हिंदी पखवाड़े का आयोजन सफलता एवं उत्साहपूर्वक किया गया। पखवाड़े का शुभारंभ श्री अजय कुमार मित्तल, वरिष्ठ उप महानिदेशक द्वारा दीप प्रज्वलित कर किया गया तथा उन्होंने सभी उपस्थित अधिकारियों/कर्मचारियों को हिंदी के प्रचार प्रसार हेतु अधिक से अधिक योगदान करने के लिए प्रेरित किया। इस अवसर पर श्री मित्तल जी ने माननीय गृह मंत्री जी का संदेश पढ़कर सुनाया। हिंदी पखवाड़े के दौरान कुल 10 प्रतियोगिताओं का आयोजन किया गया। पखवाड़े के दौरान आयोजित प्रतियोगिताओं में अधिकारियों/कर्मचारियों ने बढ़ चढ़कर भाग लिया।

समारोह का समापन श्री ए.के. दास, उप महानिदेशक (एन आर) की अध्यक्षता में सम्पन्न हुआ जिसमें सभी विजेताओं को पुरस्कार राशि एवं प्रशस्ति पत्र प्रदान किए गए। इस पखवाड़े के दौरान दिनांक 18.09.2015 को एक हिंदी कार्यशाला का भी आयोजन किया गया। कार्यशाला के अतिथि श्री हरिन्द्र कुमार मक्कड़, निदेशक (तकनीकी), राजभाषा विभाग द्वारा ब्रॉड बैंड नीति 2004 विषय पर अनुवाद करवाया, तकनीकी शब्दों पर चर्चा तथा हिंदी के बारे में काफी रोचक एवं ज्ञानवर्धक जानकारियाँ उपलब्ध कराई गई।

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Approvals from Jul 2015 to Oct 2015

S. No.	Name of the Company /Name of Product & Modal No.
1	M/s Polycom Unified Comm. Soln. Pvt. Ltd.
1.1	ISDN CPE, HDX 4000HD
1.2	ISDN CPE, HDX8000HD
1.3	ISDN CPE, HDX 7000HD
2	Fibcom India Ltd
2.1	For Interchange of STM-1, STM-4,STM-16 signals between different Networks, Model No. FIBCOM 6325
2.2	For interchange of STM-4,STM-16 and STM-64 signals between different N/w Fibcom 6335
3	M/s Ericssion India Pvt Ltd
3.1	Switching node with N/W-N/w interfaces at 2048 kbps M-MGW-I
4	M/s Sunren Pvt Ltd
4.1	PABX for N/w Connectivity ST001
4.2	PABX for N/w Connectivity ST003
4.3	PABX for N/w Connectivity ST004
5	M/s NEC India Pvt Ltd
5.1	PABX , SV9100
6	M/s Alcatel Lucent India ltd
6.1	PABX with interface ISDN PRI Omini PCX Office
7	M/s Taraspan Solution Pvt. Ltd.
7.12	PABX with interface ISDN PRI & 2W DEL, Mx-One Classic

Important Activities of TEC during JUL 15 to OCT 15

Revised GRs/IRs issued on

- IR on SIP Terminal
- GR on SIP Terminal
- GR on STP

DCC Meeting conducted on

- IR on Multiline Telephone system
- IR on Executive Telephone system
- IR on USIM Rel 8 for LTE networks including ISIM
- GR on Subscriber Identity Module
- GR on ENUM Server
- GR on NMS
- GR on Data Storage infrastructure
- GR on 20, 30 and 40 mtr mast for cellular network
- GR on Wi-Fi Access point
- SD on IP Interconnect

Sub DCC cum MF meeting conducted on

- IR on Point of sales
- IR on Conference Facility Device
- GR on Ethernet Traffic Analyser
- GR on 10G Ethernet Traffic Analyser (HHT model)
- GR on Non Zero Dispersion shifted metal free optical cable
- GR on Optical Jacket Remover
- GR on Optical High precision Cleaver
- GR on Lithium Iron Battery for Telecom Application

Study/White Papers issued on

- e-waste management

Representation of TEC in Training/Seminar/ Meetings

- ITU-T SG-12 workshop & QSDG meeting at Greece
- ITU-R WP-5A & WP-5D meetings
- 6th APT workshop on Disaster management at Nadi, Fiji
- 2nd meeting of APT Preparatory Grp for WTSA-16 at Bangkok
- Two days training on ISO in TEC in Oct 2015
- ITU-T SG-5 & SG-17 meetings at Geneva

ISO : 9001-2008

Certifications issued by TEC

Type Approval (TA)

Interface Approval (IA)

Certificate of Approval (CoA)

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Regional TEC Contact :

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Western Region	:	022-26610900
Northern Region	:	011-23329464
Southern Region	:	080-26642900

Other Activity

- National Working Group 5, 12, 17 & 20 meeting held in TEC.
- Testing of CISCO Routers and CDOT DWDM in NGN Lab.
- Two Contributions regarding M2M were submitted to SG-20 of ITU-T

Approvals issued by TEC during the period from Jul 2015 to Oct 2015

Interface Approvals.....12

Type Approvals 0

Certificate of Approval.....0

टी ई सी संचारिका : दूरसंचार अभियांत्रिकी केन्द्र
नवम्बर 2015 : खुर्शीद लाल भवन
भाग 19 : जनपथ
अंक 3 : नई दिल्ली–110001

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