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"CORDECT Wireless in Local Loop System"

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ABSTRACT—

Each telephone subscriber's connection to the closest exchange via the conventional wired local loop is costly and unstable. These copper lines are mostly eliminated by Wireless Local Loop (WLL) systems, which may be a more affordable option. One such Wireless Local Loop system that offers toll-quality speech and data capacity at a price lower than a wired local loop is corDECT, which is based on the DECT (Digital Enhanced Cordless Telecommunications) standard. Without frequency planning, it can accommodate high subscriber numbers using micro-cells and Dynamic Channel Selection (DCS). In India and a few other nations, corDECT is becoming more and more popular commercially. We discover that the 1,000-line corDECT system could process 36,000 calls per hour, which is far more than the required 20,000 calls per hour, using a straightforward Queueing Network Model (QNM). A 10,000-line exchange with a BHCA of more than 2,10,000 calls per hour could be added to the system. We also look into the viability of offering 64 kbps data service in addition to voice. It is demonstrated that this calls for just minor hardware upgrades.

Keywords— Local loop, Queueing, micro-cells.

I. Introduction

Traditionally, every phone subscriber is connected to the closest exchange via a set of copper lines. These issues arise from a native loop that is connected in this way:

- The installation and upkeep of copper wire up to the subscriber's premises are expensive. The utility of the wired native loop in providing a line to a subscriber is rather little. Additionally, as copper's value rises, so does this value, which is rising with time.
- Due to the substantial amount of cabling infrastructure required to provide even a few phone lines to isolated settlements, the per-line cost in rural locations is significantly greater.
- The majority of faults occur in the local loop and are caused by cable theft, damage, or waterlogging.
- Due to the restrictions and other difficulties in giving birth to underground wires, quick preparation is difficult.

The problems with native loops will have an affordable solution thanks to wireless technology. Due to easier installation, the wireless service makes network expansion straightforward.

Up until the middle of 2010s a local loop or Access Network (AN) was made up of two copper wires that connected the subscriber's home or place of business to the closest exchange. The normal local loop length in urban areas is 6 to 8 km, and the copper used for it has a diameter of 0.5 mm to 0.6 mm. Nearly 85% of all errors were identified in the local loop, which was difficult to maintain and only intended to convey speech at a frequency of 0 to 4 kHz. Most importantly, it was expensive, challenging, and time-consuming to deploy. If one were to continue using such a strategy, the cost of installing a telecom network would now account for more than 80% of the entire cost due to rising copper and digging expenses.

In collaboration with Analog Devices Inc., the United States, Midas Communication Technologies and the Indian Institute of Technology, Madras created the cutting-edge, field-proven wireless access system known as corDECT.

For brand-new and growing telecommunications networks, corDECT offers a comprehensive wireless access solution with seamless voice and Internet service integration. It is currently the only Wireless Local Loop (WLL) system in existence that offers wireless subscribers both simultaneous toll-quality voice and 35 or 70 kbps Internet access.

The European Tele communication Standards Institute's DECT standard definition forms the foundation for corDECT (ETS). It also contains fresh ideas and creative designs produced through a partnership between a renowned university, a leading R&D firm, and a major semiconductor producer. This partnership has given rise to a number of ground-breaking ideas, such as the Access Network, which separates voice and internet traffic and sends both in the most effective way possible to the telephone network and the internet, respectively, without suffocating either.

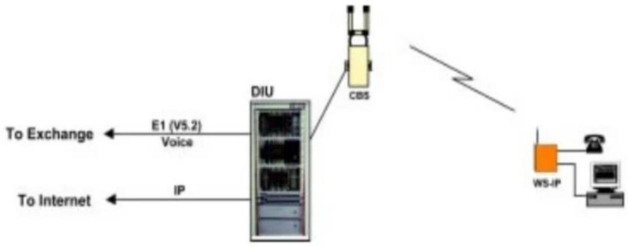

Fig. 1: corDECT Wireless Local Loop [1].

Fig. 1 shows a corDECT wireless local loop system. It is created by the TeNeT Group at the Indian Institute of Technology in Madras, India, as well as Analog Devices Inc. in the United States and Midas Communication Technologies (Pvt.) Ltd. in Madras, India.

There are four main subsystems that make up the corDECT system:

DECT Interface Unit: Controls the system and interacts with the Public Switched Telephone Network (PSTN) is the DECT Interface Unit (DIU).

Compact Base Station (CBS): Twelve simultaneous channels are made available to customers by a compact base station (CBS).

Wallset (WS) is a wireless fixed terminal adaptor with an increased range that may be used with any regular phone, modem, or fax machine.

A **handset (HS)** is a mobile phone that offers voice service to a user. CorDECT employs a micro-cellular architecture with typical cells of 50–300 m. This makes it possible to accommodate subscriber densities of up to 10,000 per square kilometre. It also has the benefit of excellent speech quality and sporadic transmit power of only 250 mW.

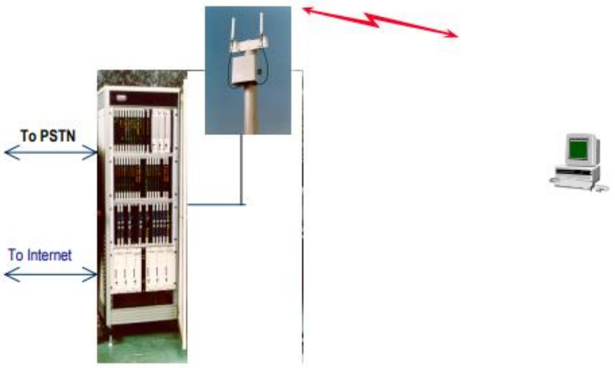

Fig. 2: Physical connection of corDECT wireless in local loop system

Fig. 2 shows Physical connection of corDECT wireless in local loop system. CorDECT offers each customer two lines: a voice line and a 35-kbps dedicated Always-ON Internet connection (at a premium rate of 70 kbps). It is applicable to both urban and rural settings. Base stations must be placed every few kilometres in urban areas in order to service a dense population of customers. It requires low bit rates and broad penetration in rural areas. It provides service to customers within a 25–30 km radius of base stations by using relay base stations in rural regions. CorDECT is currently the least expensive connection option, with a rural deployment costing less than $300 per line.

Technology alone however, would not solve the problem of connecting rural people. The developers of CorDECT have therefore incubated a company called n-Logue Communications in Chennai, India, which has combined the cost advantage of CorDECT with an innovative business model to connect rural India. n-Logue is an Indian rural Internet Service Provider, set up with the idea of providing telephone and Internet services solely to rural India. From day one, n-Logue is a business set up with a thrust on entrepreneurship.

The key to n-Logue's business model is aggregation of demand in a village to be served by an entrepreneur in each village. In each village, a small entrepreneur is assisted by n-Logue to set up a kiosk. The kiosk is equipped with a CorDECT wireless connection, a PC with Multimedia, Web camera, printer, power back-up and a suite of Local Language Applications and a low bit rate video conferencing application in addition to a telephone and is made available to the kiosk operators at a total cost of $1,000 which includes training and maintenance for a year.

II. Methodology

The corDECT DIU can be deployed as an access system, parented to an exchange using either the V5.2 access protocol, or transparently using two-wire interfaces. Alternatively, the corDECT DIU itself can act as a Local Exchange, or even as a direct in-dialing PBX.

All Internet subscribers' PPP connections are terminated at WS-IP by an integrated iKON RAS with the DIU. The RAS then directs the IP packets to the Internet. There are two possible ways to link the RAS to the Internet. On its 10BaseT Ethernet Interface, the RAS could be connected to a switched LAN or a Local Area Network (LAN). The LAN could be used to connect a small Internet router (such as an Intel 9300 or a Cisco 2610). Any convenient leased connection is used to connect the Internet router to the web. Other access systems' Internet traffic might also travel through the router.

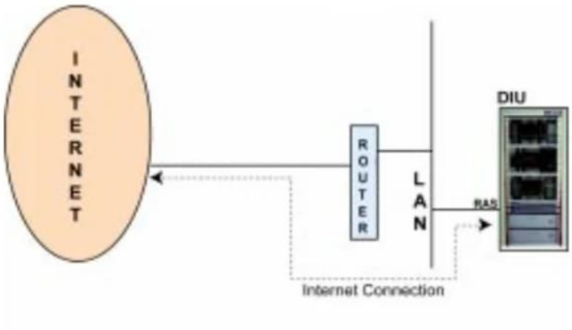

Fig. 3: Internet connection using a local router at the exchange.

Fig. 3 shows Internet connection using a local router at the exchange. Alternatively, the traffic between the Internet and RAS could be carried on n x 64 kbps switched (or leased) circuits. This option can be used only if the DIU is connected to the telephone network on E1 lines (using V5.2, or as an independent LE). The circuits are established between the DIU and a remote router using the telephone network. The RAS traffic (IP packets) could then be routed on such a connection through the DIU, as shown in Figure 4.6. Since the RAS is connected to the DIU on E1 lines, a few 64 kbps slots could be used for this. The maximum number of subscriber connections that a RAS (with two E1's) could then support would be less than 60.
. DCS provides for economical information measure utilization, channel allocation supported the traffic interference things and, most importantly, does not require frequency planning. To be accepted by a service provider, the corDECT system must not only reduce the per line cost but also meet the performance requirements laid down for a wired local loop system.

Hence, it's vital to analyse the performance characteristics of the corDECT system. An approximate analytical model of the corDECT system which could accurately predict the performance characteristics of the system is developed. The model is employed to review the system capability, to identify and improve the bottleneck subsystem, to examine the feasibility of expanding the capacity of the system and to investigate the feasibleness of supporting knowledge additionally to voice within the corDECT system.

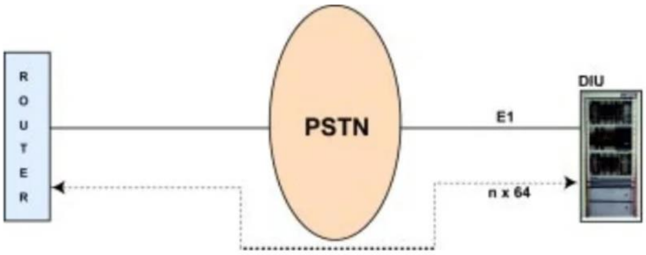

Fig. 4: n*64 kbps internet connection between RAS and remote router.

Fig. 4 shows n*64 kbps internet connection between RAS and remote router. In certain situations, it is possible to locate the RAS remotely, using E1 links to the DIU. This is useful if an operator wishes to install all Internet related equipment at one place and optical fiber is available between different exchanges and the ISP location. While the DIU's could be located at different exchanges, all the RAS's connected to various DIU's could be at one place along with the routers, servers, and other equipment used by the Internet Service Provider.
The advantage accruing from the RAS statistically multiplexing burst traffic from different subscribers is not availed here. This may not pose a constraint as fiber typically provides sufficient bandwidth between exchanges at marginal cost.

Rural Deployment

Providing telecom and Internet service to subscribers in rural areas is a major application of the corDECT Wireless Access System. It can cost-effectively provide this service to areas where subscriber density is as low as 0.2 subscribers per sq. km. For a subscriber density lower than this, corDECT may not be the most cost-effective system. Line-of-Sight (LOS) between a subscriber antenna and Base Station/Relay Base Station is necessary for the corDECT system to provide service to subscribers in sparse (low subscriber density) areas. It is therefore necessary to choose sites for CBS and RBS towers carefully, so that subscribers in a 10 km radius can be provided service. Similarly, antennas have to be mounted at subscriber premises using poles, so that LOS to CBS/RBS is available. The availability of light and compact antennas for the Wallset makes this task somewhat easier.

A DIU along with a RAS could be located either in a rural exchange building or a RLU building, adjacent to a tower (typically 15 m to 35 m high). CBS's mounted on the tower can directly serve rural subscribers in a 10 km radius (or 300 sq. km area).

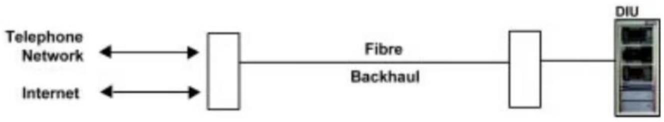

Fig. 5: Fiber backhauls carrying voice and Internet traffic.

Fig. 5 shows Fiber backhauls carrying voice and Internet traffic. Further, subscribers in rural areas may not have reliable power and solar panels may have to be used. A compact solar panel can be connected to the WS or WS-IP to power the unit and charge the built-in battery, with solar power taking over when the mains is off/low. This deployment scenario is adequate for a subscriber density higher than 1 subscriber per sq. km. To serve a pocket of subscribers in a remote area, a BSD could be used. The BSD could then connect to up to four CBS's on a remote tower and serve subscribers in a 10 km radius around it, as shown in Figure 4.10. The BSD requires power back-up at the remote location. This deployment could be cost-effective for a subscriber density as low as 0.2 subscribers per sq. km, provided a digital microwave or fiber link.

III. Technology

CORDECT:

Although it also goes by the name "Digital European Cordless Telecommunications," DECT stands for "Digital Enhanced Cordless Telecommunications". The cordless phone's connection to a base station is frequently utilised in wireless phone networks. Other uses for DECT include baby monitors and industrial remote controls.

The services are provided via interface D1, and there is a local communication structure that is linked to the outside world through a global network. The international networks include Public Switched Telephone Network (PSTN), Public Land Mobile Network (PLMN), Integrated Services Digital Network (ISDN), etc. Along with enabling data transmission, these networks also provide the exchange of addresses and data routing between local networks.

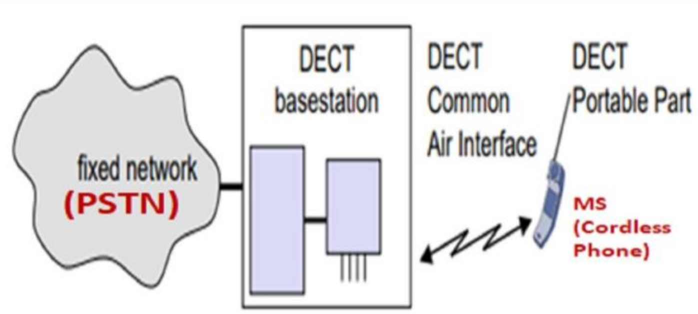

Fig. 6: Working mechanism of corDECT

Fig. 6 shows Working mechanism of corDECT. DECT systems can be used in a variety of ways, and different physical implementation methods can be used depending on the use. However, it is important to keep in mind that all implementations of the system design are based on a single logical reference model.

The corDECT WLL system provides features and services comparable to the best wireline systems. In the Switch Mode, it boasts of all the features of a large digital exchange. The Wallset IP provides simultaneous voice and Internet access as a basic feature that all subscribers can have. Base Stations can be deployed in a multitude of ways, some suited to an incumbent operator, some to a greenfield operator, and others that enable coverage of sparsely populated rural areas. The system also has sophisticated Operations and Maintenance support and a Network Management System for managing a corDECT network.

Wireless Local Loop:

A local loop connects a subscriber's phone to a nearby central office (LCO). However, due to fewer consumers and higher installation costs, local loop of wires deployment is dangerous for the operators, particularly in rural and distant places. Therefore, the deployment of wireless local loop (WLL), which connects customers to the local central office using wireless links rather than copper lines, is the solution.

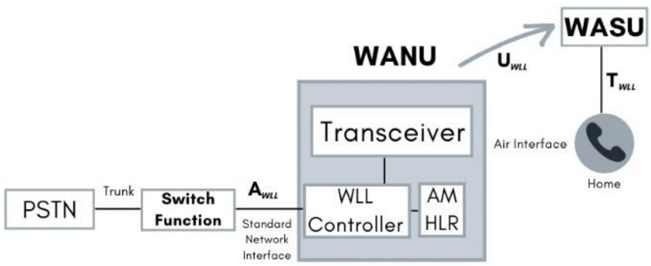

Fig. 7: Architecture of wireless local loop.

Fig. 7 shows the architecture of wireless local loop. The antenna at your home or place of business is linked to the local exchange office. A switch function is used to connect the Local Exchange Office to the PSTN network.

The following are the key elements of a wireless local loop system:

PSTN: It is a circuit switched network called the public switched telephone network. It is an assortment of worldwide circuit switched telephone networks that are linked.

Switch Function: Switch Function alternates between different WANUs on the PSTN.

WANU: The abbreviation WANU stands for Wireless Access Network Unit. The neighborhood exchange office has it. Connected to it are all nearby WASUs. Its duties include voice and data transmission, routing, operation and maintenance, and authentication. It is divided into the following parts:

WASU: For Wireless Access Subscriber Units, use WASU. It is there in the subscriber's home. It connects the subscriber to WANU, and local power sources are used to power it.

The Wireless Access Network Unit (WASU) is composed of the following:

- Many Radio Parts or BST
- Radio Port Control Units (RPCU)
- Home Location Register (HLR)
- Access Manager (AM) that is required for the working of the RPCU

The Wireless Access Network Access Unit is made up of many individual components that complete its functions as a whole. They are Base Transceiver Station, Radio Port, the radio controller, an access manager, and Home Location Register.

The interface that connects the Wireless Access Unit and the switch function that is connected to the PSTN is called the AWLL. And the Air Interface that provides the Connection between the WANU and the user side types of equipment is called UWLL.

IV. Applications

- Global System for Mobile communications (GSM) access.
- Public Switched Telephone Network (PSTN) access.
- Integrated Services Digital Network (ISDN) access.
- Cordless Terminal Mobility (CTM).
- Local Area Network access supporting voice telephony, fax, modem, E-mail, Internet, X.25 and many other services

V. Advantages

- The CorDECT WLL system offers the most cost-effective local loop solution in any circumstance. Low infrastructure costs translate into cheaper capital expenditures and lower traffic volumes than with any other technology.
- Configuration that is scaleable.
- The CorDECT system is built to support subscriber densities ranging from 1 to 10,000 per square kilometre. The standard coverage radius is 5 km, however it can be increased to 10 km.
- High-speed information.
- High-quality voice, 64 kbps data access, and ISDN service are all provided by corDECT.

VI. Conclusion

The corDECT wireless local loop system enables quick and very inexpensive installation of telecom services, even in environments with large subscriber densities. Additionally, these devices work well in extremely congested metropolitan environments. This model predicts that the corDECT system will make more calls per hour than the 20,000 required under the BHCA. The bottleneck was determined to be the SWITCH subsystem. The impact of boosting the processor MIPS at SWITCH to boost system performance. With a 165 MIPSSWITCH processor, we discovered that the OMC is now the bottleneck and the SWITCH is no longer. According to this research, the corDECT architecture might be expanded to a 10,000-line exchange by making a few relatively small adjustments, such using two CPUs to speed up SWITCH server processing.

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