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Cell Phone: A Vital Clue

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***Abstract*—**Increasing use of cell phone as a medium of human interaction is playing a vital role in solving riddles of crime as well. A young girl went missing from her home late in the evening in the month of August, 2008 when her enraged relatives and villagers physically assaulted and chased her fiancée who often frequented her home. Two years later, her mother lodged a complaint against the relatives and the villagers alleging that after abduction her daughter was either sold or killed as she had failed to trace her. On investigation, a rusted cell phone with partial visible IMEI number, clothes, bangles, human skeleton etc. recovered from abandoned well in the month of May, 2011 were examined in the lab. All hopes pinned on identity of cell phone, for only linking evidence to fix the scene of occurrence supported by call detail record (CDR) and to dispel doubts about mode of sudden disappearance or death as DNA technology did not help in establishing identity of the deceased. The conventional scientific methods were used without success and international mobile equipment identification number of the cell phone could be generated by using statistical analysis followed by online verification.

***Keywords*—**Call detail record, Luhn algorithm, stereomicroscope.

I. Introduction

INDIA possesses a diversified communication system that links all parts of the country by internet, telephone, telegraph, radio and television. UN reported that mobile phone has spread faster than any other technology and can improve the livelihood of the poorest people. Aforesaid system includes some of the most sophisticated technology in the world and constitutes a foundation for further development of a modern network. India has the world's second largest mobile phone users with 894 millions till December 2011. The mobile phone subscription grew from 12.4 millions to over 6 billions during the period 1990 to 2011 [1] penetrating the developing economics and reaching the bottom of economic pyramid. Mobile phones are used for variety of purposes, keeping in touch with family members, conducting business, having access to a telephone in the event of emergency and also provide a means to individuals for unlawful activities. Digital communication and interaction has grown to nearly two- thirds of world population. Being ubiquitous in today's world the digital evidence from the cell phone and other equipments with computers embedded in them have emerged as an important resource for both criminal investigators and defense lawyers as they can help in establishing when events occurred, where victims and suspects were, with whom they communicated, may show their intent to commit crime as well as a witness to the scene of crime. Further, a cyber crime report [2] has estimated that US tops the list with 23% of the crime; followed by China-9%; Germany 6%; UK-5%: Spain-4%; Italy, France, Turkey, Poland, India- 3% each; Canada, Russia, Mexico, South Korea, Taiwan, Japan-2% each; Australia, Argentina and Israel- 1% each; and all other countries together 19%. Likewise, cyber crime cases registered under IT Act and Indian Panel Code reported in India as per National Crime Record Bureau statistics 2009-2010 revealed that Maharashtra tops the list with 17% followed by Karnataka 13%, Kerala and Andhra Pradesh 12% each, Punjab 9%, Gujarat and Chandigarh 6% each and Tamil Nadu 5%. Digital evidences are increasingly relied upon in forensic examinations and legal proceedings in the modern court room. But at the same time it is technically complex and is difficult for most legal practitioners to understand it fully. It is even more confusing to layman jurors with little or no technical understanding of the nature, or it's evidentiary worth [3].

Most cell phone owners thinks simply removing a phone's SIM card removes personal information, but the phones internal memory, even communication exchanged between the phone and its sever, remain. The cell phone contains a great amount of information that essentially a subjective picture of our habits, our friends, our interests and activities, and even has location tracking.

Due to newness of technology there have been a few reports on the use of digital forensic evidence. But such evidences has played pivotal role in the dispensation of justice. In the case State (NCT of Delhi) vs. Afsan Guru and Shaukat Hussain Guru [4] the Supreme Court relied on the evidence provided with the help of unique International Mobile Equipment Identity (IMEI) number to convict the accused for the offences. The Delhi High Court accepted the mobile phone as an impeccable evidence in the case Gajraj vs. State [5], as the call record suggested that the said handset was in the possession of accused soon after the death of the deceased. Again, in case Vinod Kumar vs. State [6], Delhi High Court accepted the evidence that revealed IMEI number of mobile phone used by accused connected him with the crime of murder of the deceased. A 33-year old man was sentenced to 20 years in jail for murdering a gardener and robbing him of his mobile phone and money, with a Delhi court terming it as a rare case resulted in conviction only on "electronic evidence" [7]. The accused was caught after the victim's mobile phone was put on surveillance with the help of its IMEI number and

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was found being used with a different SIM. In the Duke alleged rape case [8] the court exonerated the innocent players on the basis of cell phone tracking evidence.

II. Brief Facts of the Case

A cell phone make Nokia 1600 (Fig. 1) in rusted and partially damaged condition along with human skeleton, broken bangles, female clothes was recovered, from a abandoned well after two years of disappearance of the girl under mysterious circumstances from her home late in the evening, by the special investigation wing of the police on the complaint of the mother of the deceased. She (mother) believed that family members, relatives and villagers behind the sudden disappearance of her daughter, as all were against the choice of the boy's engagement with her daughter. The cell phone was sent to forensic laboratory to ascertain its IMEI number and to know its owner being found near the skeleton. The call detail record indicated the location of the girl around the area. The skeleton was referred for DNA analysis along with reference standards. But, the DNA from the skeleton could not be isolated due to the putrefaction and non generation of profile as revealed by the investigating agency. Accordingly, the only remaining evidence cell phone was there to tell the tale of missing girl.

Fig. 1 Cell phone in rusted and partially damaged condition received from investigating agency

III. Materials and Methods

The cell phone was tested for its working in the laboratory and to know the IMEI number. Then a new battery compatible with Nokia 1600 was procured from local market, used to test the cell phone for its operation but without success as the cell phone had remained in the abandoned well for a considerable period of time.

The battery from the mobile phone was taken out to find out IMEI number, printed beneath. The part of IMEI number was found defaced. Efforts were made to make out the defaced number with the help of conventional tools used in the lab viz. Stereomicroscope, Compact Video Microscope IR light illumination, and side light etc. but of little help. Then, checksum formula - Luhn's formula [9] known as "modulus 10" or "mod 10", was used to find out IMEI number.

IV. Examination and Results

Step-1: A new battery compatible with Nokia 1600 was tested for its working, but without results. The battery was removed and endeavored to read appended IMEI number with naked eye and the IMEI number could be read as: 354534/01/0-----/-.

Step-2: Another attempt was made to make out the numbers with the instruments and different sources of light viz. Stereomicroscope, Compact Video Microscope, IR light illumination, side light etc. The conventional methods helped to read more digits of incomplete appended IMEI number. The enhanced number could be read as: 354534/01/000554/- (Fig. 2). But that too did not serve the purpose.

Fig. 2 Stereomicroscopic picture of enhanced IMEI

Step-3: Finally, the Luhn algorithm (US Patent for a hand-held, mechanical device for computing the checksum.) was used to find out the check digit of the IMEI number. The algorithm detects single digit error as well as all transpositions of the adjacent numbers. To count this number, moving left from the check digit, double the value of every second digit. The sum was calculated by adding the digits of the product and the un- doubled digits of the original number. Then modulo of 10 was calculated. The number in the Step 2 was: 354534/01/000554/-.

Assuming check digit as X, Every second digit was doubled and sum was calculated 36+X. (Table I) The check digit (X)

was obtained by computing the sum of digits then computing 9 times that value modulo 10 [in equation form, (36*9 mod 10)].

TABLE I
COMPUTATION OF CHECKSUM

IMEI No.	3	5	4	5	3	4	0	1	0	0	0	5	5	4	x
Double every other number	3	1 + 0	4	1 + 0	3	8	0	2	0	0	0	1 + 0	5	8	x
Sum of all numbers	36+X														

In algorithm form:
1.Computed the sum of the digits (36).
2.Multiplied by 9 (324).
3.The last digit, 4, is the check digit.

Alternate Method: The check digit (X) was obtained by computing the sum of digits then subtracting the units digit from 10 (36 = Units digit 6; 10 - 6 = check digit 4).

In algorithm form:
1. Computed the sum of the digits (36).
2. Took the unit digit 6.
3. Subtracted the unit digit from 10.
4. The result, 4, is the check digit.

To make the Sum divisible by 10, assuming X=4, the account number could be validated as: 354534010005544.

To verify the obtained check digit the modulo10 was calculated as shown below:

Double every second digit from the right most:

(5x2)=10, (5x2)=10, (4x2)=8, (1x2)=2, (0x2)=0, (5x2)=10,(4x2) =8

Sum of all the individual digits were calculated:

3+ (1+0) +4+(1+0) +3+(8) +0+(2) +0+(0) +0+(1+0) +5+(8) +4=40

Since the sum is multiple of 10. Hence the number is probably valid. Therefore, IMEI number could be: 354534/01/000554/4. The IMEI number thus obtained was verified from the international numbering plan via online analysis www. numberingplans.com (Fig. 3).

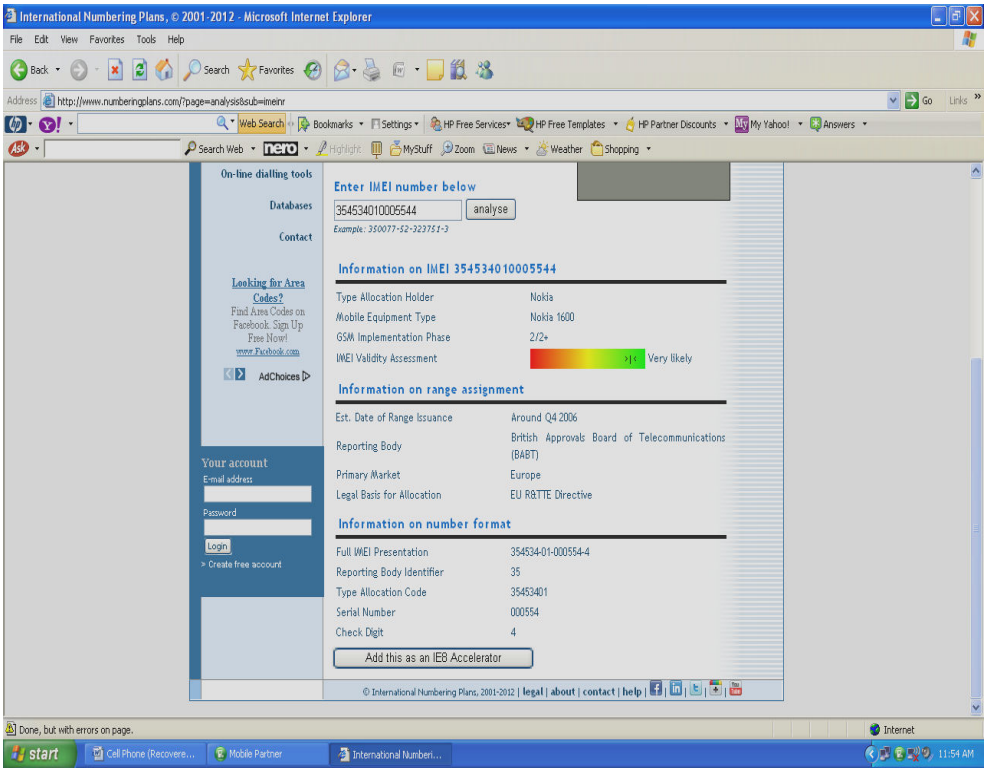

Fig. 3 Screen Print of Online Analysis of IMEI Number

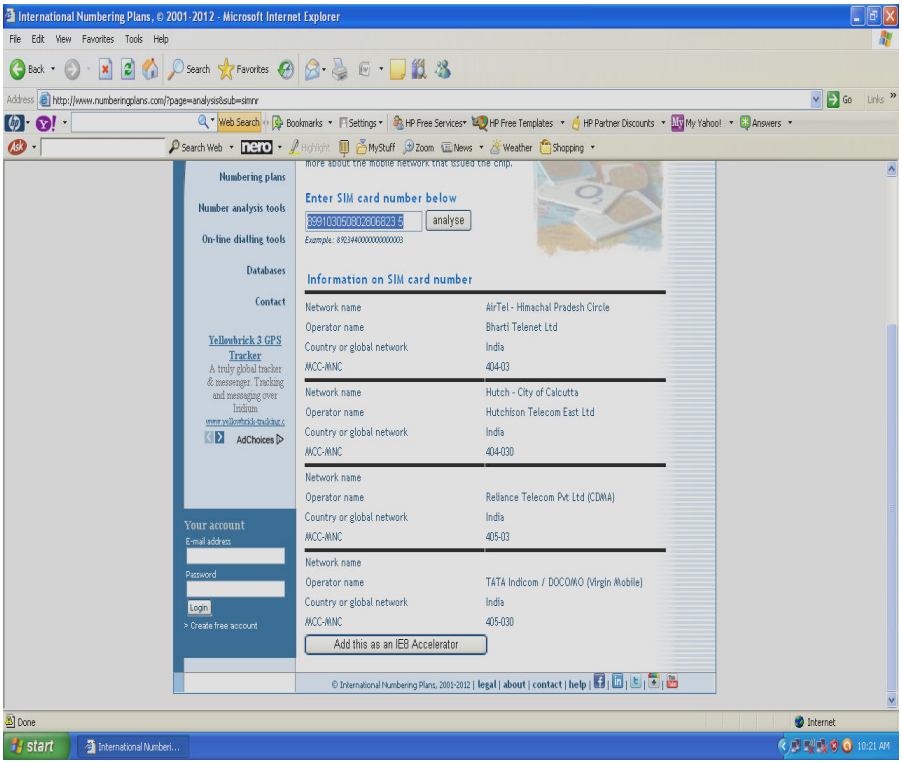

Fig. 4 Screen print of SIM card analysis

The SIM card from the mobile phone was also taken out. The efforts were made to generate the information on the basis of numbers printed on the SIM card. The online analysis of the number present revealed that the SIM card belonged to Air Tel- Himachal Pradesh circle (Fig. 4).

V. Conclusions

IMEI or Electronic Serial Number (ESN) or Mobile Equipment Identified Number (MEID) number is a series of number that identifies the key elements of the phone. Not only each number is different, but each number can explain the origin of the phone, the model and the serial number. The IMEI number is a 17 or 15 digit code. Essentially the numbers are required to track the movement of the mobile user.

In India, the import or the use of mobile phones without IMEI number was banned and discontinued in 2009 in accordance with the parameters laid down by security agencies and Union Home Ministry [10] to put a check on the mobile phone without IMEI number in the interest of national security.

Likewise, SIM card securely stores the service subscriber key, used to identify subscriber on mobile telephony devices (such as mobile phones and computers). In the present study the information about subscriber's circle was obtained through on line analysis and is supportive of its belonging to the Himachal Pradesh circle.

The investigating agencies procured the CDR of the cell phone belonging to the deceased and the suspects from the service providers. The IMEI number in the CDR (deceased cell phone) matched with the calculated IMEI number. Therefore, the ownership of the cell phone was in favor of human skeleton, corroborated by the tower location in the CDR and supported by the version of the villagers who admitted to have had chased her.

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