Uniform. All resources should be used uniformly to prevent collisions. For example, page messages should be evenly distributed over all paging channels and all of the slot resources within the paging channels to avoid overloading of a single channel.

Reproducible. It is advantageous for both the BS and the MS to be able to independently reproduce the choice of resources from information known to both. For example, from information known by both BS and MS, the MS should be able to reproduce the base station's choice of paging channel.

In IS-95, a uniform choice among a number of resources is made by using a hash function [1]. The hash function allows a uniform distribution through a method that is reproducible at both the MS and the BS by using (a) the number of resources and (b) a parameter (called a hash key) that is known by both the BS and MS as inputs.

Let K = the hash key parameter and N = the number of resources, with the input of a hash key K, the output of hash function $h(K)$ will be an integer value between 0 and $N-1$, thus taking N values

$$0 \le h(K) \le N-1 \tag{9.1}$$

IS-95 specifies the following hash function, R as

$$R \equiv h(K) = \left\lfloor N \times \frac{(40,503 \times K) mod 2^{16}}{2^{16}} \right\rfloor \tag{9.2}$$

The hash key is determined from the HASH_KEY parameter, a binary number generated from either the 32-bit binary electronic serial number (ESN) (see Figure 9.1) or the least significant 32 bits of binary encoded international mobile subscriber identity (IMSI) of the MS (see Figure 9.2).

$$\text{HASH_KEY} = L + 216\,H \tag{9.3}$$

where
L = number formed by the 16 least significant bits of the HASH_KEY
H = number formed by the 16 most significant bits of the HASH_KEY

$$K = L \oplus H \oplus DECORR \tag{9.4}$$

where *DECORR* is a modifier intended to decorate the different hash function selections made by the same MS. If L' denotes the 12 least significant bits of HASH_KEY, then Table 9.1 shows the values of parameters used in the IS-95 hash function.

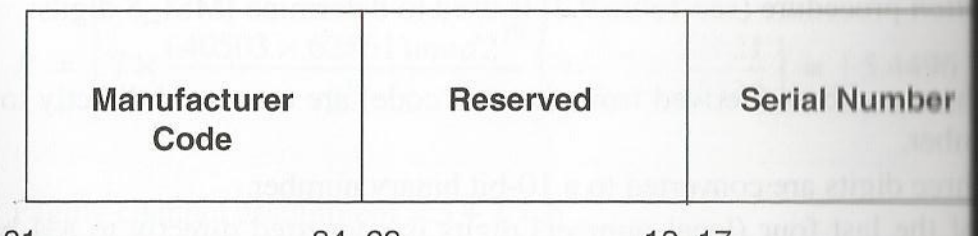
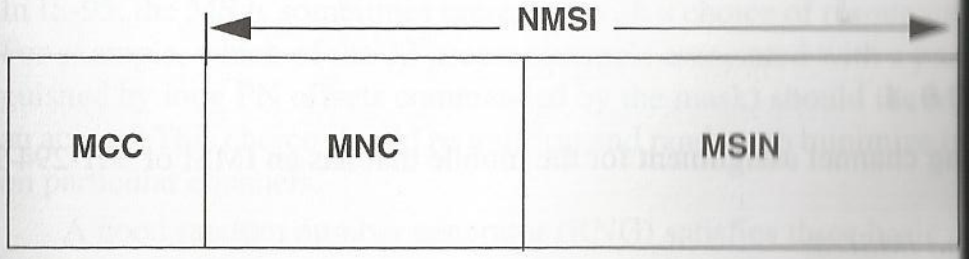


Figure 9.1 Electronic Serial Number (ESN)



MCC: Mobile Country Code (3 digits)
MNC: Mobile Network Code
MSIN: Mobile Station Identification Number
NMSI: National Mobile Station Identification (up to 12 digits)

Figure 9.2 International Mobile Subscriber Identity (IMSI)

Table 9.1 IS-95 Hash Function Parameters

Application	*N*	*DECORR*
CDMA channel # (central frequency)	Number of channels (up to 10) in list sent to MS	0
Paging channel	Number of channels (up to 7) list sent to MS	$2 \times L'$
Paging slot #	2048	$6 \times L'$
Access channel randomization	2^M, $M \le 512$ is in broadcast message	$14 \times L'$

Table 9.2 Initial Rotation of IMSI Digit Values

i_1	0	1	2	3	4	5	6	7	8	9
d_{i_1}	9	0	1	2	3	4	5	6	7	8