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BellSouth E911 Service Interfaces to Customer Premises Equipment at Public Safety Answering Point

Technical
Reference

NOTICE

This Technical Reference is published by BellSouth Telecommunications Incorporated to provide a description of the interfaces between a telephone company Enhanced 911 (E911) 1A ESS™ tandem office and an E911 Public Safety Answering Point (PSAP) and between the telephone company E911 database system and a PSAP.

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BELLSOUTH E911 SERVICE INTERFACES
TO CUSTOMER PREMISES EQUIPMENT AT A
PUBLIC SAFETY ANSWERING POINT

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BELLSOUTH E911 SERVICE INTERFACES
TO CUSTOMER PREMISES EQUIPMENT AT A
PUBLIC SAFETY ANSWERING POINT

1.   Introduction

1.1   This Technical Reference is published by BellSouth Telecommunications, Inc. to provide a description of the interfaces between a telephone company Enhanced 911 (E911) 1A ESS ™ tandem office and an E911 Public Safety Answering Point (PSAP) and between the telephone company E911 database system and a PSAP. These interfaces provide the network interaction with customer premises equipment that provide E911 PSAP functionality.

1.2   Reason for Reissue

This document has been re−issued to change the format of the text portion of the response from the E911 Data Base (Figure 2).

2.   Overview Of Enhanced 911 Service

The number 911 is the 3−digit telephone number that has been designated for public use throughout the United States to report an emergency and/or request emergency assistance. The number 911 is intended as a nationwide universal telephone number which provides the public with direct access to a public safety answering point (PSAP). A PSAP is an agency or facility which is designated and authorized to receive and respond to emergency calls requiring one or more public services such as police, fire, and/or ambulance services. Any one agency or a group of agencies may be designated as a PSAP. One or more attendants are located at a PSAP facility to receive and handle emergency calls in accordance with local requirements.

With E911 service, a telephone company switching office is arranged to serve as a tandem for all 911 calls from other local offices in the 911 service area and as a local office for 911 calls originated by customers served by the E911 tandem office. Calls may be routed by this tandem office to one or more PSAPs in the 911 service area selectively. Calling party number identification is passed via the trunk facility to the PSAP location for display at the PSAP answering position. Additional information associated with the calling party number as stored in the telephone company E911 database can also be delivered to the PSAP answering position. This information is queried in real time from the database over dedicated data links by the customer premises control equipment.

This document describes the interfaces between an individual PSAP and the telephone company tandem and between the PSAP and the database system. An overview of a typical E911 system is given in Figure 1.
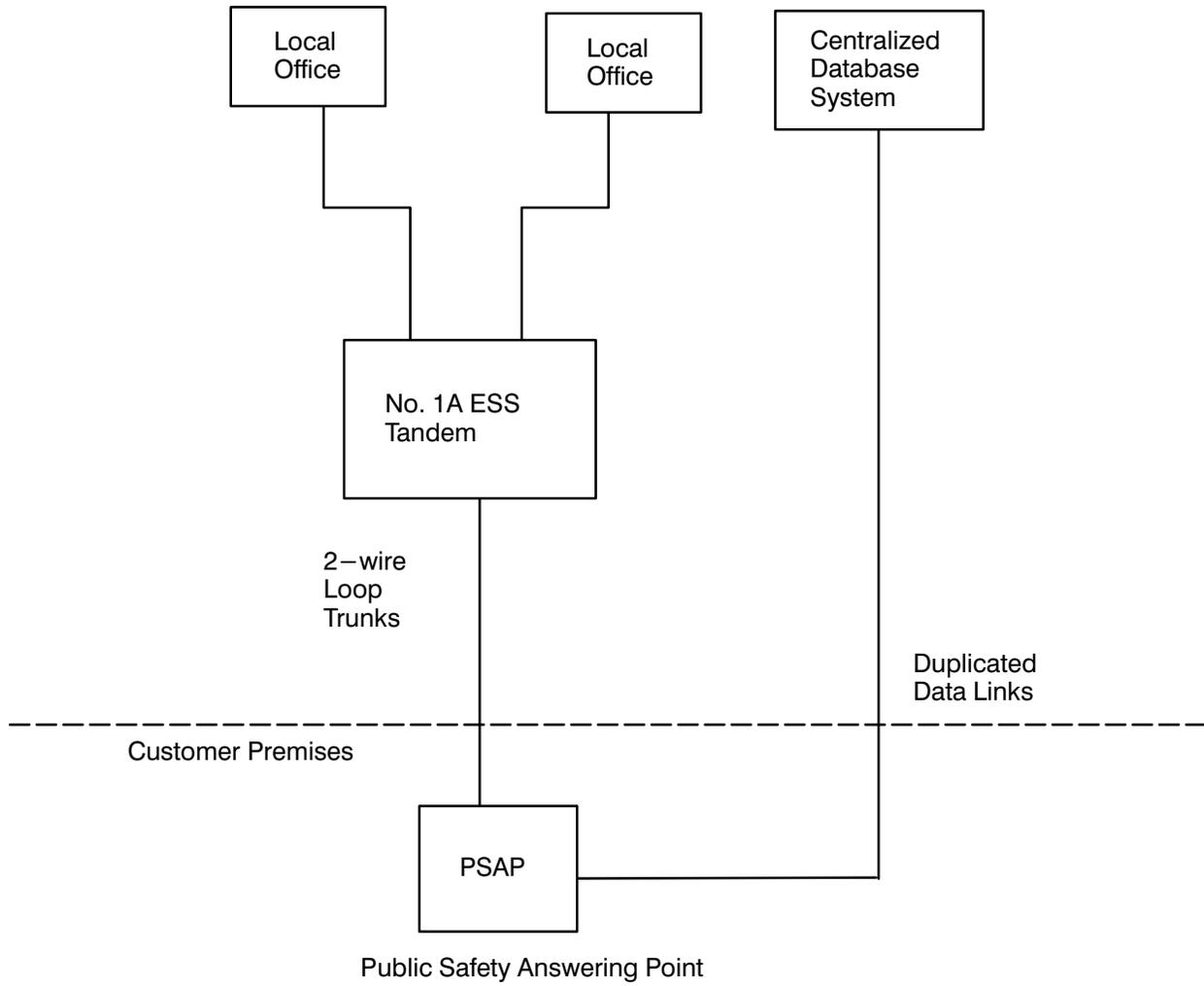
™ Registered trademark of AT&T

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┌──────────┐        ┌──────────┐        ┌──────────────┐
│  Local   │        │  Local   │        │ Centralized  │
│  Office  │        │  Office  │        │  Database    │
│          │        │          │        │  System      │
└────┬─────┘        └────┬─────┘        └──────┬───────┘
     │                   │                     │
     │                   │                     │
     └──────┐    ┌───────┘                     │
            │    │                             │
        ┌───┴────┴────┐                        │
        │ No. 1A ESS  │                        │
        │ Tandem      │                        │
        │             │                        │
        └──────┬──────┘                        │
               │                               │
   2−wire      │                               │
   Loop        │                               │
   Trunks      │                               │
               │                  Duplicated   │
               │                  Data Links   │
 ──────────────┼───────────────────────────────┼──────
   Customer Premises                            │
               │                                │
         ┌─────┴──────┐                         │
         │            │                         │
         │   PSAP     ├─────────────────────────┘
         │            │
         └────────────┘
      Public Safety Answering Point
```

Figure 1 − E911 System Overview

3.   E911 Interfaces

3.1   Trunk Interface

Two wire, 1−way, outgoing trunks arranged for loop−reverse battery operation are provided in the central office and connected to the PSAP through a standard local loop. The tandem trunks will be terminated at the network interface point at the customers premises in standard RJ21X jacks.

The electrical characteristics and signaling states used by trunks of the above type that may be used by the ESS tandem office are given in the Signaling section of Bellcore's, *LATA Switching Systems Generic Requirements* (LSSGR Section 6) [3] document. Additional information on local loop characteristics can be found in the documents *Description of the Analog Voiceband Interface Between the Bell System Local Exchange Lines and Terminal Equipment[1] and Lightning and 60−Hz Disturbances at the Bell Operating Company Network Interface*[2].

(a)   Calling Number Identification

The telephone number of the station calling into the PSAP is delivered to the PSAP equipment using standard Automatic Number Identification (ANI) techniques over the tandem trunks. Operation of ANI number delivery is described in the *Automatic Number Identification (ANI)* and *Operator Number Identification (ONI)* section of the LSSGR[4]. Typically the number delivered to the PSAP is displayed at the answering position by the customer premises equipment. The PSAP is also required to formulate a request for associated data from the E911 database based on this number. See section 3.2 for a description of this activity.

Once the PSAP detects that the E911 tandem has seized an idle trunk by the presence of an off−hook condition, the PSAP is expected to send a start pulsing signal (250 ±50 ms wink) within 4 seconds. If the wink signal is not received within 16−20 seconds, the tandem will retry once on a different E911 trunk after placing the original trunk on a maintenance list.

The E911 tandem will begin outpulsing the calling number as multifrequency (MF) tones within 4 seconds of receipt of the wink signal. If no calling number is received or if distorted tones are received, the PSAP should assume ANI failure has occurred and proceed to return audible ringing to the calling party and signal an attendant to answer. No calling information would be available to present to the attendant in this case.

Once the ANI digits are received, the customer provided equipment should return audible ringing to the 911 calling party at the same time as attendant positions are alerted of the incoming call by the customer provided system. Once an attendant answers, the customer provided equipment should remove audible ringing and cut the incoming call through to the position. At the same time, the position answering the call

must be identified and encoded along with the calling telephone number and delivered to the telephone company database system. This system will return information, relating to the calling telephone number, suitable for display on a terminal at the attendant position answering the call. The customer premise equipment is responsible for decoding the ANI MF data and formatting the ASCII encoded request to the data base system. This data base interface is described in section 3.2 of this document.

The format of the information sent by the tandem will be $KP-A-NXX-XXXX-ST$. The KP and ST are standard MF signals. The calling number is given by the $NXX-XXXX$. The "A" is coded as in Table 1 and represents the numbering plan area (NPA) from which a 911 call originated in those cases when the 911 service area includes two or more NPAs. In cases where special attention or handling may be required, the 4, 5, 6 and 7 digits are used. Examples of such cases are a 911 call originated via a foreign exchange (FX) line serving a station which is not physically located in the 911 service area or a telephone number which does not have an emergency service number (ESN) assigned.

TABLE 1
"A" DIGIT ENCODING

Digit	Use
0	NPD 0 (Lowest Numbered NPA)
1	NPD 1 (Second Numbered NPA
2	NPD 2 (Third Numbered NPA)
3	NPD 3 (Highest Numbered NPA)
4	NPD 0 (Special handling required)
5	NPD 1 (Special handling required)
6	NPD 2 (Special handling required)
7	NPD 3 (Special handling required
8	Maintenance test call
9	Not Used

If the E911 tandem office is unable to present a valid calling number, either $0-911-0TTT$ or $0-911-0000$ is sent signifying the following:

> $0-911-0TTT$ is sent due to ANI failures, calls from multiparty or billing only numbers, or possibly a 911 call received via a message trunk from outside the local tandem area. The digits TTT indicate the Emergency Service Central Office Number associated with the originating office to tandem trunk.

0−911−0000 is sent when an anonymous call is made to a PSAP. An anonymous call is a 7−digit call (non−911) to the directory number of a PSAP. ANI identification is not available for such calls. A PSAP may be assigned a nondialable number to preclude such calls.

(b)   **Call Transfer Interface**

Transfer of an incoming call to an alternate PSAP is available as a standard service. The primary PSAP may implement transfer to a secondary PSAP using the standard Call Transfer and Speed Calling features of the tandem office. These features are implemented by switch hook flashes and abbreviated dialed digits issued by the customer premises equipment to the tandem office trunks. The answering position may be provided a single button interface to these features by the customer premises control equipment if so arranged or they may be manually exercised by a standard station set at the answering position.

Normal call transfer sequences are used to initiate call transfer. The PSAP equipment should send an on−hook flash signal of 500 $\pm$ 50 ms to the tandem office. Normally the tandem will seize a three port conference circuit and a DTMF (Dual Tone Multifrequency) receiver will be attached to the trunk to receive the transfer digits and dial tone will be returned to the PSAP initiating the transfer. If these facilities are not available in the tandem due to load conditions, the flash signal will be ignored. After detecting dial tone, the desired transfer destination should then be sent by the PSAP as DTMF pulses conveying either the Speed Calling digits or regular directory number of the destination.

Three types of Call Transfer may be provided, selective, fixed and manual.

Selective Call Transfer − activated by receipt of a *1X speed calling sequence from the PSAP equipment, where X is 1 to 6. The E911 tandem will selectively route the call to the desired type (specified by the "X" code) of secondary PSAP designated for the calling party's jurisdiction. The association of various PSAPs with selective Speed Calling codes should be done as part of the installation process for the E911 system.

Fixed Call Transfer − activated by receipt of *NX speed calling sequences, where N is 2 to 4 and X is 0 to 9. Only a single direct translation to a prespecified directory number will be performed by the tandem in this case.

Manual Call Transfer − the PSAP attendant manually performs the on−hook flash sequence and then directly dials either the Speed Calling Code as specified in Fixed Call Transfer or the directory number of the destination.

(c)   **Trunk Supervision of Disconnect**

The E911 tandem maintains supervision of the off−hook status in both directions. To drop an incoming call, the PSAP equipment must present an on−hook condition greater than 1.2 seconds. The tandem will disconnect the call in both directions, sending on−hook to the PSAP, and idling the incoming trunk. This prevents an incoming call that remains off−hook from tying up the PSAP trunk.

If a three party call has been established by the call transfer feature, the following disconnect supervision applies.

Primary PSAP

(1)   Receipt of a flash signal (550 $\pm$ 50 ms on−hook) from the initial PSAP in a 3 party call setup will release the added party and maintain a 2−party connection between the calling party and the primary PSAP.

(2)   Receipt of an on−hook signal longer than the minimum disconnect timing interval (1.2 seconds) from the initial PSAP will disconnect that PSAP from the call and maintain the connection between the calling party and the added party.

Added Party

(1)   If an added party sends an on−hook signal for longer than 11 seconds, it will be disconnected but the original PSAP will remain connected to the calling party.

(2)   If the added party returns off−hook before a 10 second interval has expired, it will be returned to the three party connection.

(3)   If the primary PSAP sends a flash signal during the 10 to 11 second interval after the added party has sent an on−hook signal, the added party is disconnected immediately. The primary PSAP remains connected to the calling party.

(4)   If one of the original parties disconnects before an added party's disconnect timing interval expires, that party is immediately released. However, the tandem office continues the timing interval and will reconnect the added party to the party remaining off−hook if the added party returns off−hook within the interval.

Calling Party

Upon detection of calling party disconnect, the calling party is released. The primary PSAP and the added party remain connected until either disconnects or the primary PSAP releases the added party.

(d) **Night Service / Alternate PSAP**

All calls destined for a PSAP may be automatically directed to an alternate PSAP or other answering location. This feature is available for each PSAP. A single directory number is assigned in the tandem office for alternate routing and is used in any of the conditions where an alternate is needed. These conditions could be traffic busy, night service, or power loss or other failure at the PSAP.

Whenever calls are routed to an alternate PSAP, the ANI information of the calling party is also made available to the alternate PSAP. The tandem switch presents the calling number to the secondary PSAP using the same mechanism described in section (a) as used for a primary PSAP.

Alternate or night service is activated from the PSAP by key activation of a control lead to the tandem office. The network interface required for this separate control lead is given in Bellcore Technical Reference TR−TSY−000349, see page 12 [5].

(e) **Tones Used**

Standard tones (dial, busy, reorder, and audible ringing) are provided by the E911 tandem office for attendant transfer calls. Interrupted high tone (120 ipm) is also provided when speed dialing transfer is attempted, but not subscribed to by the PSAP.

(f) **Trunk Maintenance Test Calls**

From time to time the telephone company will place a test call to verify the integrity of the trunk circuit to the customer's premises. This call will be identified by the special ANI code given in Table 1 (KP−8−ST). The PSAP shall connect the trunk so identified to a permanent busy tone (continuous 60−ipm tone). This must be done within 20 seconds after receipt of the wink start pulse, otherwise, the E911 tandem office would consider the trunk test a failure. The tandem will disconnect approximately 5 seconds after receiving the 60−ipm tone. The PSAP should then immediately release the trunk also.

3.2 Database Interface

The telephone company provides a centralized database including information for each directory number used by subscribers to the network. This information usually contains address and other information useful for a public service response to emergency situations where a call is placed from a phone near the site of the emergency. A unique protocol is used over redundant data links between a PSAP and telephone company E911 Processors to retrieve this information. The PSAP equipment is responsible for formatting a request per this protocol and placing it on the data links. The returned information text is available to the PSAP equipment to display on a terminal at an attendant position or in some other manner per the design of the equipment provider.

(a) **Physical Interface**

Access to the telephone company E911 centralized database is provided by asynchronous private line modem links to duplicated E911 Processors. These processors are located in BellSouth data centers. Two links are required for reliability; they are functionally identical. The E911 Processors receive the request from the PSAP, query the database and return the stored information to the PSAP over the data link. The actual network interface is that of a private line voice grade channel as described in Reference 1, or digital data service. Digital facilities should be ordered with secondary channel. This feature is necessary in order to deploy an end−to−end diagnostic and configuration capability from the master end (Data Center) without disruptive consequences. The characteristics of the equipment used to modulate these links are:

> 1200 baud asynchronous private line modem
> (Bell 202T compatible)
> or 2400 baud digital Channel Service Unit/Data Service Unit
> (CSU/DSU)
> 10 bit data character
> > 1 start bit
> > 8 data bits (8th bit ignored)
> > 1 stop bit
> Full duplex
> Continuous carrier

For reliability, an individual request is expected to be received from the PSAP over both links simultaneously by the duplicated E911 Processors. Responses from the database system are presented over one of the links only. Both links must be monitored by the PSAP for responses since they are randomly chosen by the E911 Processors. If one link is out of service, only the good link will be chosen by the E911 Processors for responses.

(b) **Link Protocol**

The protocol used over the data links consists of a request message sent from the PSAP to the E911 Processors and the response message from the data base to the PSAP. In addition a status message or "heartbeat" is expected from the PSAP during idle periods.

(1) **Request Message Format**

Requests from the PSAP for additional data contained in the E911 database maintained by the telephone company shall consist of 13 ASCII encoded digits terminated by a carriage return. The message format for an inquiry is given in Table 2.

TABLE 2
DATABASE REQUEST MESSAGE

Digit Position	Contents		
1	NPD	–	Caller's Area Code as provided in ANI sequence. ("A" Digit)
2−4	NXX	–	Exchange prefix for caller's serving office.
5−8	TN	–	Caller's directory number.
9−10	POS	–	PSAP position answering call, range 01−45 decimal.
11−12	TRNK	–	Incoming trunk number over which call was received, range 01−45 decimal.
13	CHECK	–	One digit, that when added to the sum of the previous twelve digits, causes the sum to be evenly divisible by 8.
14	CR	–	Carriage return, hex 0D, signals end of request.

Example: "0555121201020<CR>" would be transmitted for 555−1212 on position 1 trunk 2. Note the check digit is 0 since the sum equals 24. Digit position 1 is transmitted on the data link first in the sequence.

NOTE: **A request of all zeroes, "0000000000000<CR>" would be interpreted as indication that repair is needed on the PSAP ANI equipment. Upon occurrence of a large number of such messages, the telephone company E911 maintenance center would notify responsible customer PSAP maintenance personnel.**

(2)   **Data Base Response Message Format**

The E911 Processor provides an immediate response to a request with either an ASCII ACK (hex 06) or NAK (hex 15) character. If the negative acknowledgement, NAK, is received, the request should be retransmitted only once by the PSAP.

The database response message is delimited by the ASCII STX (hex 02) and ETX (hex 03) characters. Response messages are presented over one of the two data links randomly chosen. The format of the text messages is given in Table 3.

TABLE 3
DATABASE RESPONSE MESSAGE

Character Position	Contents		
1	STX	–	Hex 02, Indicates start of message.
2	TYPE	–	One digit message type designation as described below.
3–4	POS	–	Two digit position number, range 01–45. POS of 00 is valid for TYPE 3 or 5 only.
5–324	Text	–	Up to 320 characters of text formatted from the telephone company database. The format of the text portion of the message is shown in Figure 2.
variable	ETX	–	Hex 03, immediately follows text to indicate end of message.

TYPE Designations

TYPE = 1 (hex 31)   Data retrieved, only one path available.
TYPE = 2 (hex 32)   Date retrieved, both paths operational (normal).
TYPE = 3 (hex 33)   Broadcast message from host (text may or may not be included).
TYPE = 5 (hex 35)   Broadcast from host indicating host going out–of–service, text length = 0, POS = 00.
TYPE = 9 (hex 39)   No address data found, text portion of message is of form "NPA–NXX–TN NO RECORD FOUND"
TYPE = 0,4,6,7,8   Not used

NOTE: **If a problem is suspected in the received text, the PSAP may resend the request message.**

FIELD	LENGTH	TYPICAL VALUE
<CR>	1	hex 0D
punctuation	1	(hex 28
NPA	3	205
punctuation	1	) hex 29
space	1	hex 32
NXX	3	456
punctuation	1	− hex 2D
Line Number	4	7890
space	3	hex 32
Time	5	14:25
space	4	hex 32
Date	5	08/12
<CR>	1	hex 0D
House Number	8	8600
House Number Suffix	4	−1/2
space	1	hex 32
Direction	2	NW
space	1	hex 32
Street Name	48	WALNUT STREET
City	18	BIRMINGHAM
State	2	AL
space	1	hex 32
ESN	3	056
space	1	hex 32
Class of Service	4	LECR
<CR>	1	hex 0D
Customer Name	32	JOHN DOE
Location Info	20	BLG 3, FLR 10
space	1	hex 32
punctuation	2	P#
space	1	hex 32
Pilot NXX	3	454
punctuation	1	− hex 2D
Pilot Line Number	4	7891
<CR>	1	hex 0D
Additional Information	20	(see note 1)
space	1	hex 32
punctuation	4	LEC:
Telco Company ID	5	BELSO
<CR>	1	hex 0D
<LF>	1	hex 0A
ESN Text (variable)	71	JEFFERSON COUNTY SO
		FIRE STATION 2
		JEFFERSON EMS

NOTE 1: This data field contains additional information that may be helpful to the PSAP. One example is to display the Remote Call Forwarding (RCF) telephone number that may be used as an interim solution for telephone number portability between local telephone companies. The caller may only be familiar with the RCF number contained in this field rather than the telephone number contained in the first part of the response text. Either number may be used for call−back purposes. The field will contain spaces if no additional information is available.

Figure 2 − Format Of Text Portion Of Response From E911 Data Base

(3) **Status Messages**

During otherwise idle periods, the PSAP equipment shall place a "heartbeat" sequence on the data links consisting of the characters "H<CR>" (hex 48 and hex 0D) at a minimum of once every two minutes. Absence of data or a "heartbeat" on the data link from the PSAP for more than two minutes will be interpreted by the E911 Processors as a problem at the PSAP and reported to telephone company maintenance personnel.

Upon notice of lack of a "heartbeat" from a PSAP, the telephone company E911 maintenance center will check the data links for possible trouble conditions. If the data links are found operational the maintenance center will take action to notify responsible customer PSAP personnel of the failure.

<div align="center">**References**</div>

1. "Description of the Analog Voiceband Interface Between the Bell System Local Exchange Lines and Terminal Equipment," PUB 61100, Bellcore, January 1983.

2. "Lightning and 60−Hz Disturbances at the Bell Operating Company Network Interface," TR−EOP−000001, Bellcore, Issue 2, June 1987.

3. "LATA Switching Systems Generic Requirements (LSSGR) Section 6," TR−TSY−000506, Bellcore, Issue 2, July 1987.

4. "LATA Switching Systems Generic Requirements (LSSGR)," TR−TSY−000064, Bellcore, Issue 2, July 1987.

5. "Interface Between Miscellaneous Control Functions of Customer Premises Equipment and 1/1A ESS Centrex Switching Systems," TR−TSY−000349, Bellcore, Issue 1, November 1986.

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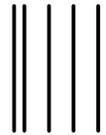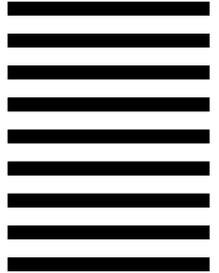
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