

On scene Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS00003
2000 Ford Taurus
Texas
March, 2000

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crash-worthiness performance of the involved vehicle(s) or their safety systems.

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16. Abstract <p>The crash occurred in Texas in March, 2000 at 1550 hours. The crash took place at a four-leg intersection. The weather was cloudy, but the asphalt roadway was dry. The north-south undivided roadway has two lanes, one for each travel direction. The east-west undivided roadway has two lanes, one for each travel direction. North-south traffic is controlled by stop signs at the intersection. There are no traffic controls for east-west traffic. The speed limit for both roadways is 89 km/h (55 mph). The case vehicle, a 2000 Ford Taurus SE 4-door sedan driven by a restrained 33-year-old male, was traveling westbound at a driver reported speed of 97-105 km/h (60-65 mph). The other vehicle, a 1995 Ford Aerostar XL Van driven by a restrained 13-year-old female, was traveling southbound and accelerating into the intersection from a stop at an estimated speed of 20 km/h (12.5 mph). She is reported to have been somehow distracted. The front right seat of this vehicle was occupied by a restrained male. As the driver of the other vehicle accelerated into the intersection, the front of the case vehicle (12FDEW2) struck the left-front side of the Ford van. At impact, both the driver's air bag and the front right passenger's air bag in the case vehicle deployed. The driver's side seat belt pretensioner also fired at this time.</p> <p>The impact caused the case vehicle to rotate in a counterclockwise direction and the other vehicle in a counterclockwise direction. The rear-right of the case vehicle (09RPAW2) "side slapped" the rear-left of the other vehicle. The rear right side glass was broken during this contact. Both vehicles continued moving in a south-west direction and ran off the roadway. The case vehicle continued in a counterclockwise rotation and came to final rest facing in a northerly direction--having rotated approximately 180-degrees. The other vehicle came to final rest west of the case vehicle facing in a southern direction. EMS personnel arrived at the scene at 1537 hours and transported the driver of the case vehicle to a clinic for "C" type injuries. The driver and front right occupants of Vehicle 2 were also transported to the same medical center for "A" type injuries. Vehicles 1 and 2 were towed from the scene due to the damage.</p>				
17. Key Words Air bag, deployment, injury, accident		18. Distribution Statement		
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**Dynamic Science, Inc.
Accident Investigation
Case Number: DS00003**

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BACKGROUND:

Description: This Advanced Occupant Protection Systems case was generated by DSI through existing insurance contacts. NHTSA was notified of the case on June 21, 2000. DSI was assigned the case on June 22, 2000 and an on-site investigation was conducted.

Investigation Type: On-scene

Crash Location: Texas

Crash Date: March, 2000

Notification Date: August, 2000

Field Work Completed: August, 2000

SUMMARY:

The crash occurred in Texas in March, 2000 at 1550 hours. The crash took place at a four-leg intersection. The weather was cloudy, but the asphalt roadway was dry. The north-south undivided roadway has two lanes, one for each travel direction. The east-west undivided roadway has two lanes, one for each travel direction. North-south traffic is controlled by stop signs at the intersection. There are no traffic controls for east-west traffic. The speed limit for both roadways is 89 km/h (55 mph).

The case vehicle, a 2000 Ford Taurus SE 4-door sedan driven by a restrained 33-year-old male, was traveling westbound at a driver reported speed of 97-105 km/h (60-65 mph).



Figure 1. Path of Vehicle 1 (west)



Figure 2. Path of Vehicle 2 (SE)

The other vehicle, a 1995 Ford Aerostar XL Van driven by a restrained 13-year-old female, was traveling southbound and accelerating into the intersection from a stop at an estimated speed of 20 km/h (12.5 mph)¹. She is reported to have been somehow distracted. The front right seat of this vehicle was occupied by a restrained male.

As the driver of the other vehicle accelerated into the intersection, the front of the case vehicle (12FDEW2) struck the left-front side of the Ford van. The case vehicle sustained a longitudinal delta v of -61.8 km/h (-38.4 mph)² as computed by WinSmash. These results appear high. The downloaded Electronic Data Recorder (EDR) data indicates a cumulative longitudinal delta v of -40 km/h (-25 mph) at the 78 ms mark. The EDR report is included as an attachment to this report.

At impact, both the driver's air bag and the front right passenger's air bag in the case vehicle deployed. The driver's side seat belt pretensioner also fired at this time.

The police report indicated that the Ford van was equipped with a driver's air bag and that it deployed.

The impact caused the case vehicle to rotate in a counterclockwise direction and the other vehicle in a counterclockwise direction. The rear-right of the case vehicle (09RPAW2) "side slapped" the rear-left of the other vehicle. The rear right side glass was broken during this contact. Both vehicles continued moving in a south-west direction and ran off the roadway.

The case vehicle continued in a counterclockwise rotation and came to final rest facing in a northerly direction--having rotated approximately 180-degrees. The other vehicle came to final rest west of the case vehicle facing in a southern direction.



Figure 3. Exterior, Vehicle 1



Figure 4. Exterior, Vehicle 1 (impact 2)

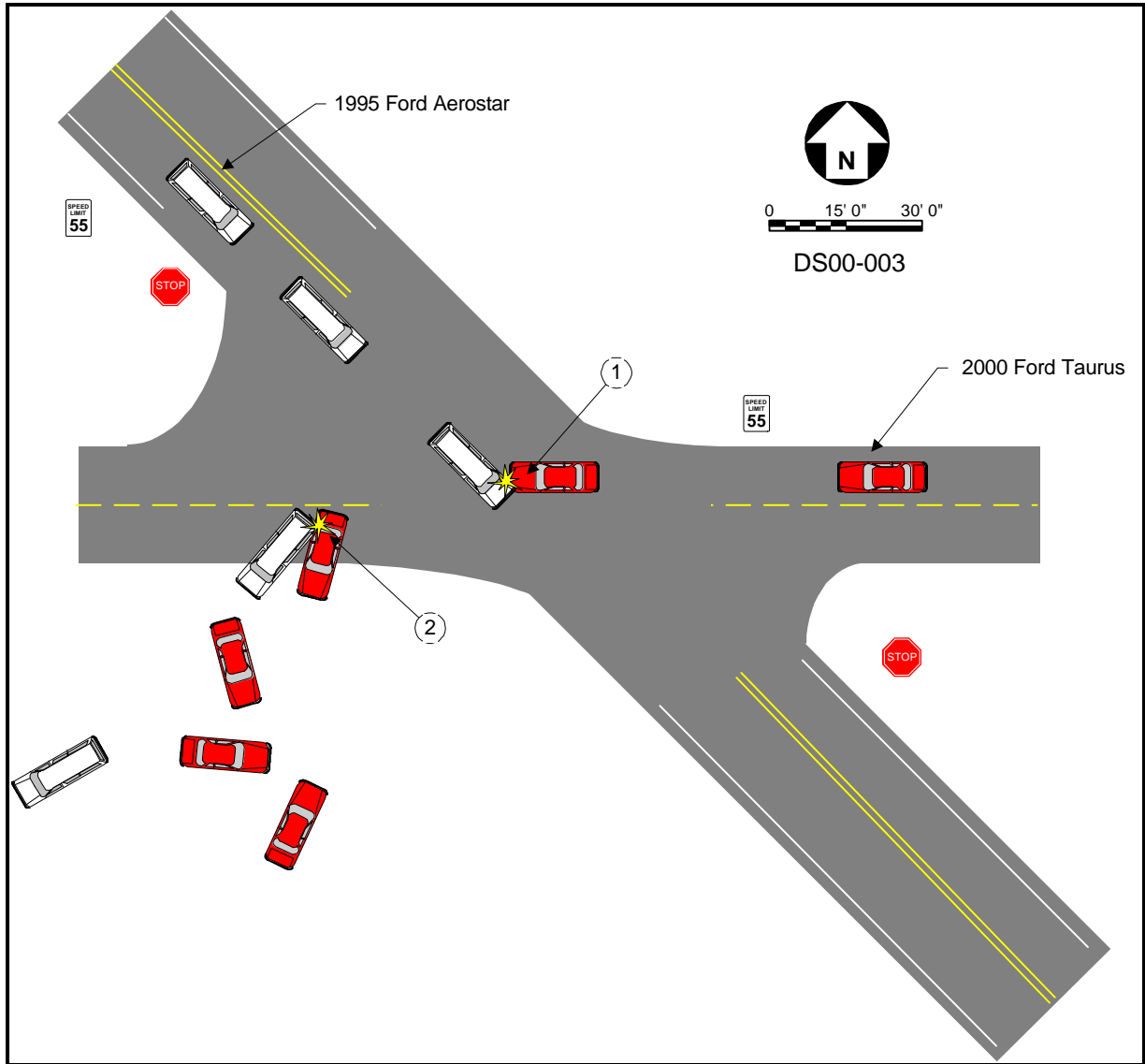
¹Calculated using an acceleration rate of 1.22 mps² (4 fps²)

²Calculated using stiffness values calculated from NCAP tests on identical vehicles.

EMS personnel arrived at the scene at 1537 hours and transported the driver of the case vehicle to a clinic for “C” type injuries. The driver and front right occupants of Vehicle 2 were also transported to the same medical center for “A” type injuries.

Vehicles 1 and 2 were towed from the scene due to the damage.

Scene Diagram



DETAILED INFORMATION**Vehicles**2000 Ford Taurus

Description:	2000 Ford Taurus SE 4-door sedan	
VIN:	1FAFP55S0YGXXXXXX	
Odometer:	3,928 km (2,441 miles)	
Engine:	3.0L EFI DOHC V6	
Reported Defects:	None	
Cargo:	None	
Damage Description:	Moderate front to rear crush across front bumper. Hood and right fender damage. Right rear door damaged from second impact.	
CDC:	Impact #1: 12FDEW2 Impact #2: 09RPAW2	
Delta V (Impact #1):	Total	63.9 km/h (39.7 mph)
	Longitudinal	-61.8 km/h (-38.4 mph)
	Latitudinal	-16.6 km/h (-10.3 mph)
	Energy	57,110 joules (42,127 ft-lbs)

1995 Ford Aerostar

Description:	1995 Ford XL Aerostar 4x2 wagon	
VIN:	1FMCA11U3SZXXXXXX	
Odometer:	Unknown	
Engine:	3.0L EFI V6	
Reported Defects:	None	
Cargo:	Unknown	
Damage Description:	Vehicle towed from scene	
CDC:	Unknown	
Delta V (Impact #1):	Total	61.9 km/h (38.4 mph)
	Longitudinal	-56.1 km/h (-34.8 mph)
	Latitudinal	26.2 km/h (16.2 mph)
	Energy	569,195 joules (419,692 ft-lbs)

Occupants

<u>2000 Ford Taurus</u>	Occupant 1
Age/Sex:	33/Male
Seated Position:	Front left
Seat Type:	Bucket
Height:	178 cm (70 in.)
Weight:	86 kg (190 lbs.)
Occupation:	Salesman
Pre-existing Medical Condition:	None
Alcohol/Drug Involvement:	None
Driving Experience:	17 years
Body Posture:	Normal, upright
Hand Position:	Both hands on steering wheel—10 and 2 o'clock positions
Foot Position:	Right foot on brake, left on floorboard
Restraint Usage:	Lap and shoulder belt used properly
Air bag:	Deployed during initial impact

Occupants

<u>1995 Ford Aerostar XL van</u>	Occupant 1	Occupant 2
Age/Sex:	13/Female	Unknown/Male
Seated Position:	Front left	Front right
Seat Type:	Unknown	Unknown
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	NA	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Unknown—presumed to be less than 1 year	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	One foot on accelerator	Unknown
Restraint Usage:	Lap and shoulder belts used per police	Lap and shoulder belts used per police
Air bag:	Deployed	None available

Injuries and Injury Mechanisms

2000 Ford Taurus

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Shoulder contusion, left	790402.1,2	923.0	Seat belt
	Chest contusion, left	490402.1,2	922.1	Seat belt
	Abdomen contusion, center	590402.1,4	922.2	Seat belt
	Strain, upper back, left side	640478.1,7	847.1	Inertial forces

1995 Ford Astro van

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Police reported "A" type injuries			
RF Occupant:	Police reported "A" type injuries			

Occupant Kinematics

The restrained driver of the case vehicle was seated in a normal upright manner. He was wearing the available lap and shoulder belts. The shoulder belt upper anchorage adjustment was in the full up position. The tilt steering wheel was positioned in the center. Both hands were on the steering wheel (10 and 2 o'clock positions). The cloth-covered bucket seat was adjusted to be between the rear most and middle track position. The driver was wearing glasses at the time of the crash. The glasses had plastic lenses and metal frames. At impact, the steering wheel mounted air bag deployed and the driver's seat belt pretensioners fired. The driver pitched forward and began loading the lap and shoulder belts—causing the contusions to his shoulder, chest, and abdomen. The driver's left knee contacted the lower instrument panel. As the air bag deployed, the driver loaded the air bag/steering wheel causing a small amount of shear capsule separation on the right side. The driver's face contacted the air bag and his glasses were knocked off and deformed. The driver's head rebounded to some degree—causing the upper back strain.



Figure 6. Right steering column shear capsule

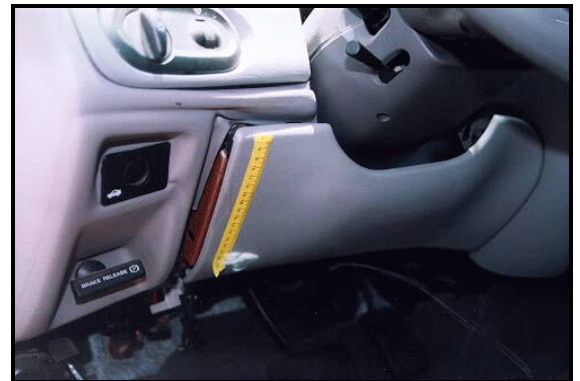


Figure 7. Left knee contact to left instrument panel



Figure 8. Driver's seated position

Attachment 1. Calculations

CASE NUMBER: None

Comments: v2 pulling out from stop

**** END VEL W/ A RATE, I VEL, DISTANCE ****

$Ve = \sqrt{Vi^2 + 2 \times a \times D}$

$Ve = \sqrt{0.00^2 + 2 \times 4.00 \times 42.00}$

$Ve = \sqrt{0.00 + 336.00}$

$Ve = \sqrt{336.00}$

Ve = 18.33

Ve = Ending Velocity in FPS.
 Vi = Initial Velocity in FPS.
 a = Acceleration in FPS².
 D = The Distance in Feet.
 2 = A Constant.

INPUTS:		RESULTS:	
The Initial Vel in FPS is:	0.00	The Ending Vel in FPS is:	18.33
The Acceleration Rate is:	4.00		
The Distance in Feet is:	42.00		

Printed: 08/02/00

AR 98 Professional: © 1994-99, Maine Computer Group

Attachment 2. EDR report

2000 Taurus/Sable EDR Report - Summary Page

Investigation Data

File Name:	DS00-003.hex	File Save Date:	21-Jul-2000
File Read-out Date:	N/A	Report Date:	21-Jul-2000
Report Version:	1.2		

EDR Control Module Data

Data Validity Check:	Valid	EDR Model Version:	141
Left (Driver) Side Bag Deployment Time (ms):			Not Deployed
Right (Passenger) Side Bag Deployment Time (ms):			Not Deployed
Passenger Airbag Switch Position During Event:			N/A
Diagnostic Codes Active When Event Occurred:			0

Algorithm Times

Actual initiation depends on restraint system status (below).

	ms
Time From Algorithm Wakeup to Pretensioner:	7
Time From Algorithm Wakeup to First Stage - Unbelted:	8
Time From Algorithm Wakeup to First Stage - Belted:	8
Time From Algorithm Wakeup to Second Stage:	12

Restraint System Status

Driver Seat Belt Buckle:	Engaged
Passenger Seat Belt Buckle:	Not Engaged
Driver Seat Track In Forward Position:	No
Passenger Seat Weight Switch Position:	N/A

Deployment Initiation Attempt Times

	Driver	Passenger
Time From Algorithm Wakeup to Pretensioner Deployment Attempt:	7	Unbelted
Time From Algorithm Wakeup to First Stage Deployment Attempt:	8	8
Time From Algorithm Wakeup to Second Stage Deployment Attempt:	12	12

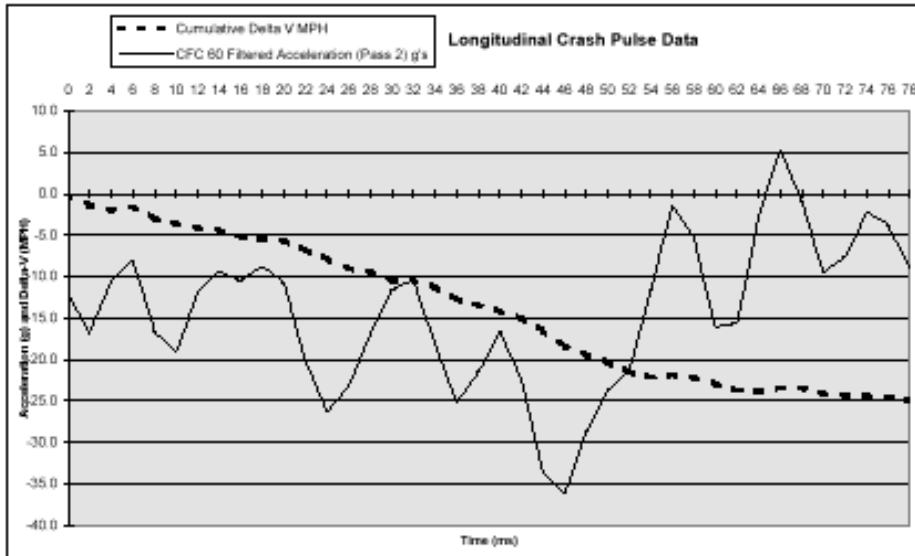
Notes

1. Read-out date is set by the PC interface tool.
2. Features and data parameters which are not available on the module are marked "N/A".
3. CFC 60 is a Butterworth 4-pole phaseless digital filter. (See SAE J211 Part 1 Appendix C dated March 1995.)
4. Total and maximum Delta-V results are not available from truncated/incomplete crash pulses.
5. Algorithm wakeup (0 ms) is not the first moment of vehicle contact or impact.
6. The Excel "Analysis ToolPak" Add-in must be enabled for this spreadsheet to operate properly.

2000 Taurus/Sable EDR Report - Charts

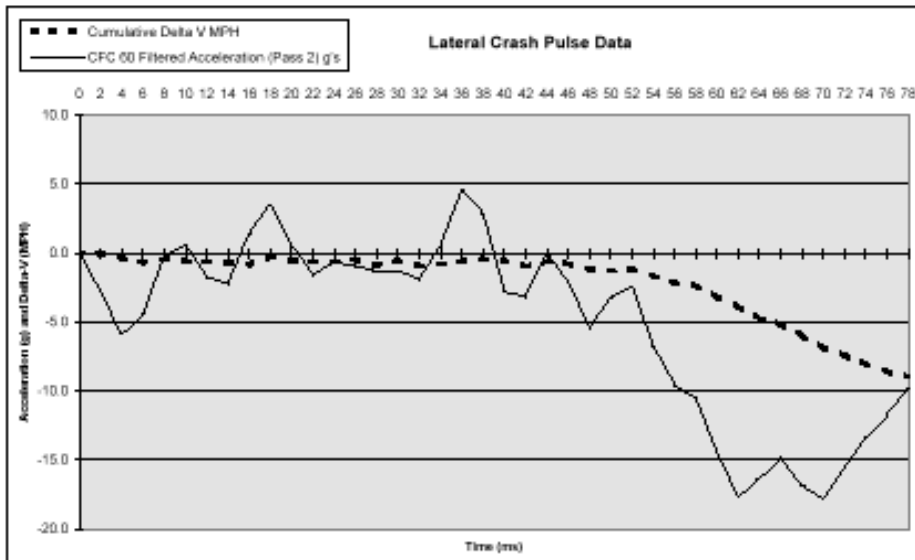
Longitudinal Cumulative Delta-V

Time (ms)	0	10	20	30	40	50	60	70	78
Delta-V (MPH)	-0.2	-3.6	-5.7	-10.3	-14.2	-20.3	-22.9	-24.1	-25.0



Lateral Cumulative Delta-V

Time (ms)	0	10	20	30	40	50	60	70	78
Delta-V (MPH)	0.0	-0.6	-0.5	-0.5	-0.5	-1.3	-3.2	-6.9	-9.0



2000 Taurus/Sable EDR Report - Memory Dump

Hexidecimal Module Memory Dump

Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
0800	0F	4A	40	76	14	FB	FF	FF	FF	FF	0E	24	0F	2D	3A	4C
0810	C8	FF	0D	FF	52	6D	52	60	60	52	E3	20	3C	78	D6	A0
0820	08	03	28	37	5F	0F	0F	0A	F5	0A	B7	84	A1	5E	D5	AA
0830	03	0C	1B	1E	00	FF	3C	3C	80	06	28	64	64	00	0C	01
0840	5A	96	50	FF	FF	FF	EF	DF	05	E7	FF	72	4E	13	25	B1
0850	EC	14	09	0F	01	FF	FF	88	7F	FF	CD	44	08	FF	FF	95
0860	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0870	05	39	22	6C	6E	00	8F	FF	59	46	31	41	00	02	FF	13
0880	02	F0	80	12	F0	80	30	F0	80	06	F1	7F	35	F2	7F	FF
0890	38	F1	80	FF	FF	00	FF	FF	00	FF	FF	00	FF	FF	00	FF
08A0	44	00	04	00	00	00	21	01	00	00	FF	FF	FF	FF	FF	FF
08B0	02	FF	81	38	00	8D	01	FF	FF	FF	FF	FF	24	01	CF	6A
08C0	FF	21	01	CF	6A	42	01	CF	6B	51	02	51	10	96	FF	F2
08D0	01	0E	0C	80	02	58	16	87	1F	BE	01	0A	00	8C	01	04
08E0	00	F0	01	36	00	A0	01	54	00	3F	02	30	02	C7	02	8A
08F0	05	14	07	08	01	2C	03	CA	04	CE	06	40	73	33	00	A0
0900	3E	FF	00	03	00	4B	01	CC	00	03	0F	FF	00	14	00	78
0910	00	A0	00	6E	0A	16	FF	01	00	00	00	7F	0F	0C	0F	02
0920	03	5A	32	46	05	50	02	02	FA	1E	08	0C	0A	1C	02	23
0930	09	06	28	32	16	20	16	1F	5F	FF	FF	02	FF	FF	FF	11
0940	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0950	08	0C	08	0C	07	00	00	04	00	00	06	07	06	05	0A	0A
0960	05	06	09	0A	07	0F	03	0C	07	0C	08	11	10	24	0B	0A
0970	07	10	B7	90	A3	80	AF	AF	7A	61	65	81	CF	56	C3	E2
0980	0D	0D	92	09	C6	97	B8	AA	9A	A6	A0	AA	A7	AD	A5	A0
0990	A7	AA	AA	B3	AE	AC	A8	AD	80	AD	AD	9F	A4	AA	A7	9A
09A0	6D	89	B6	61	85	8C	9A	7E	96	98	71	72	6C	96	70	A5
09B0	7E	5E	84	7E	7C	6D	4D	74	7B	6E	85	80	95	80	7F	9D
09C0	B7	A3	82	9B	9F	9F	8D	80	7F	71	72	89	7B	80	7B	79
09D0	9A	73	7E	80	84	6D	93	6C	85	8A	89	7B	6B	92	77	6F
09E0	79	87	69	69	77	5B	61	57	6F	58	59	67	64	66	6E	00
09F0	00	00	00	00	00	00	00	FF	FF	81	00	FF	FF	FF	FF	04