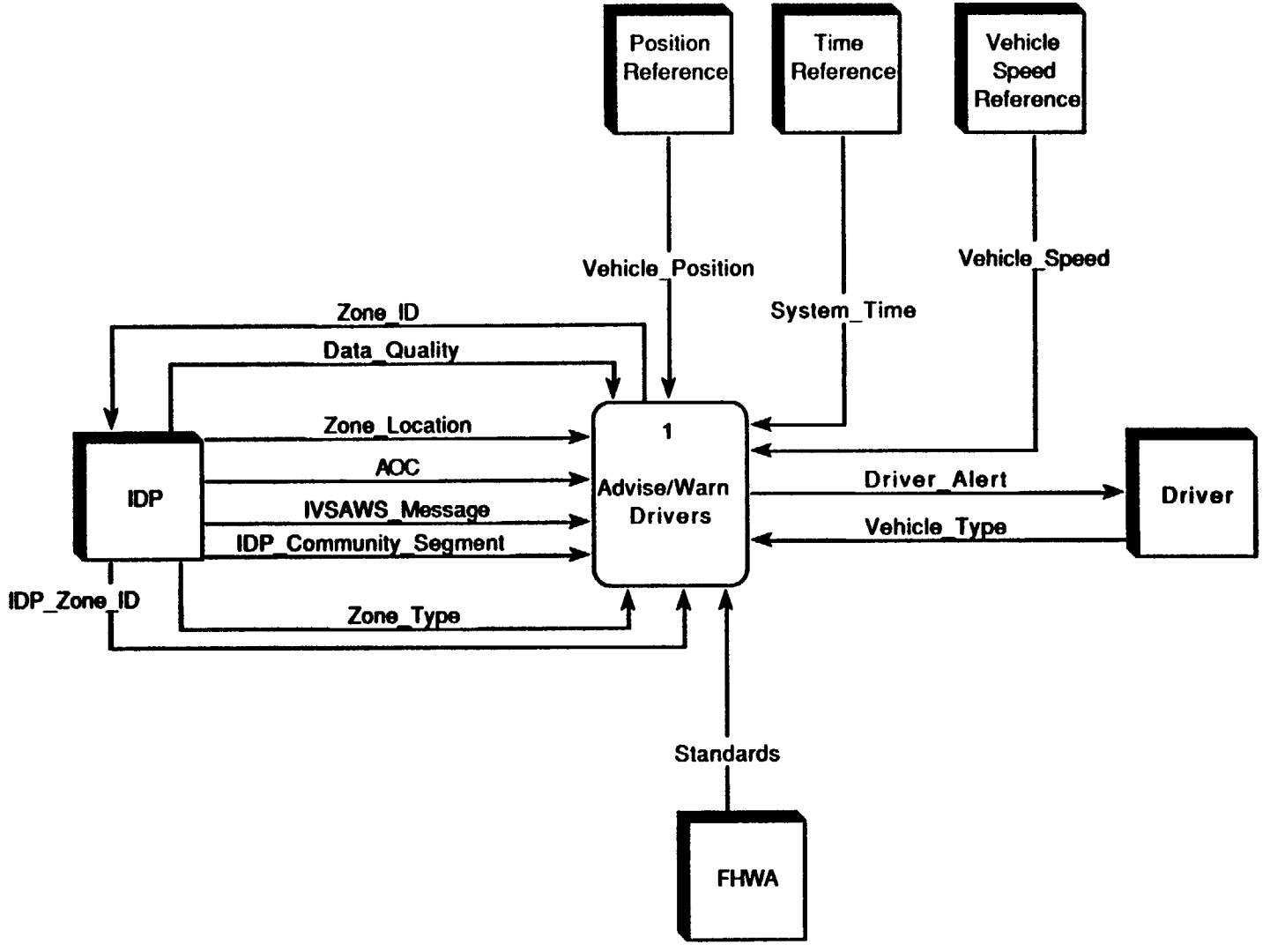


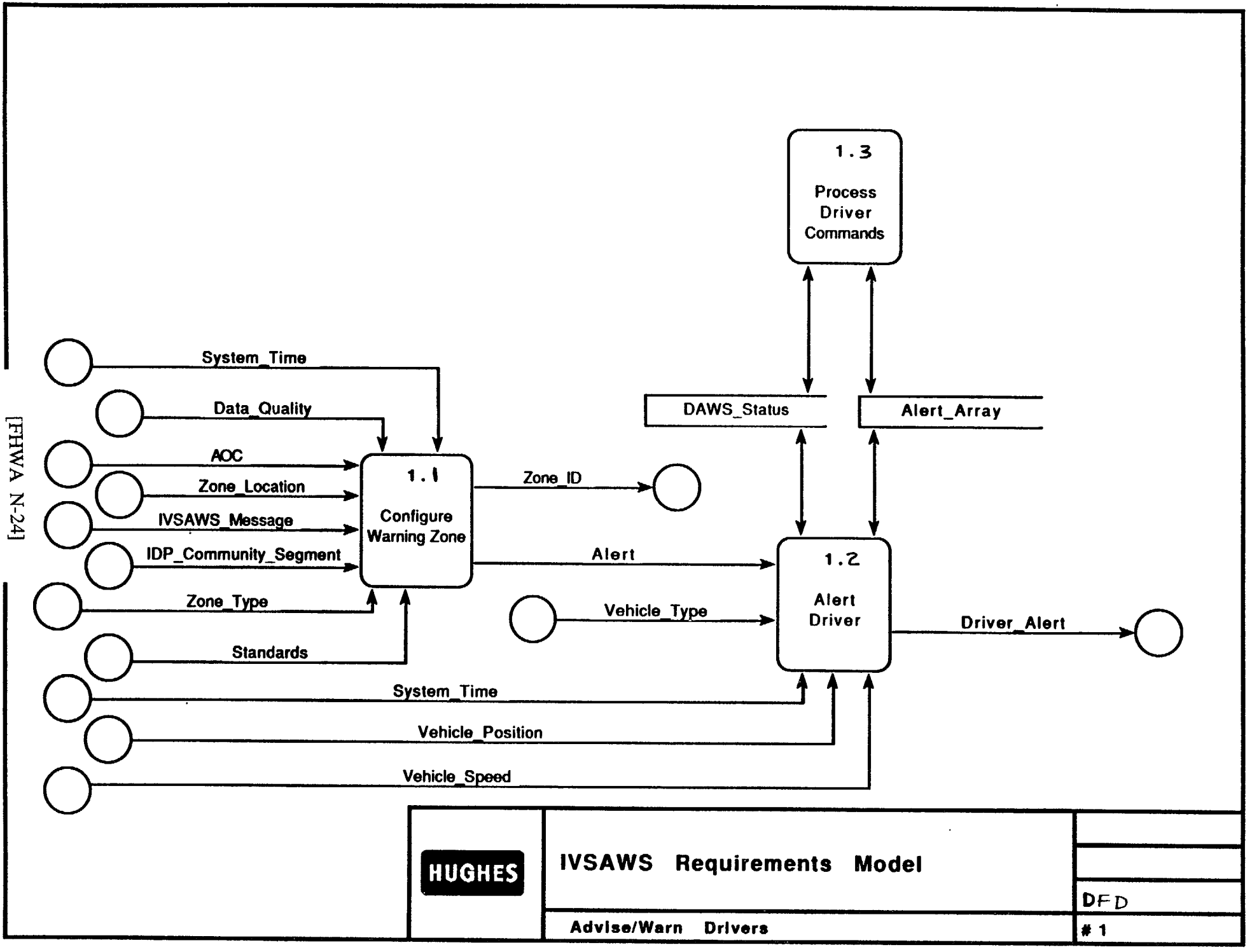
HUGHES

IVSAWS Requirements Model

Data Context Diagram

0

[FHWA N-23]


1.3
Process Driver Commands
DAWS_Status
Alert_Array
System_Time
Data_Quality
AOC
Zone_Location
IVSAWS_Message
IDP_Community_Segment
Zone_Type
Standards
1.1
Configure Warning Zone
Zone_ID
Alert
1.2
Alert Driver
Vehicle_Type
Driver_Alert
System_Time
Vehicle_Position
Vehicle_Speed
HUGHES
IVSAWS Requirements Model
Advise/Warn Drivers
DFD
1

[FHWA N-24]

```
do continuously

    check each Alert in Alert-Array

    if (Alert-Priority >= Priority-Threshold and
        Standardized-Zone-Type is ENABLED (check Enabled-Types in DAWS-Status) and
        Suppressed = FALSE and
        NOT In-AOC)

            if Vehicle-Position is within area defined by AOC-Coordinates

                compute Driver-Alert-Distance using Vehicle-Speed, Zone-Type, and Vehicle-Type

                when ! Vehicle-Position - Zone-Location != Driver-Alert-Distance

                        if Vehicle-Direction is within Vaild-Direction

                            set In-AOC TRUE

                            set MODE = NORMAL

                            output Alerted

                            output Driver-Alert

                            output Current-Alert
```

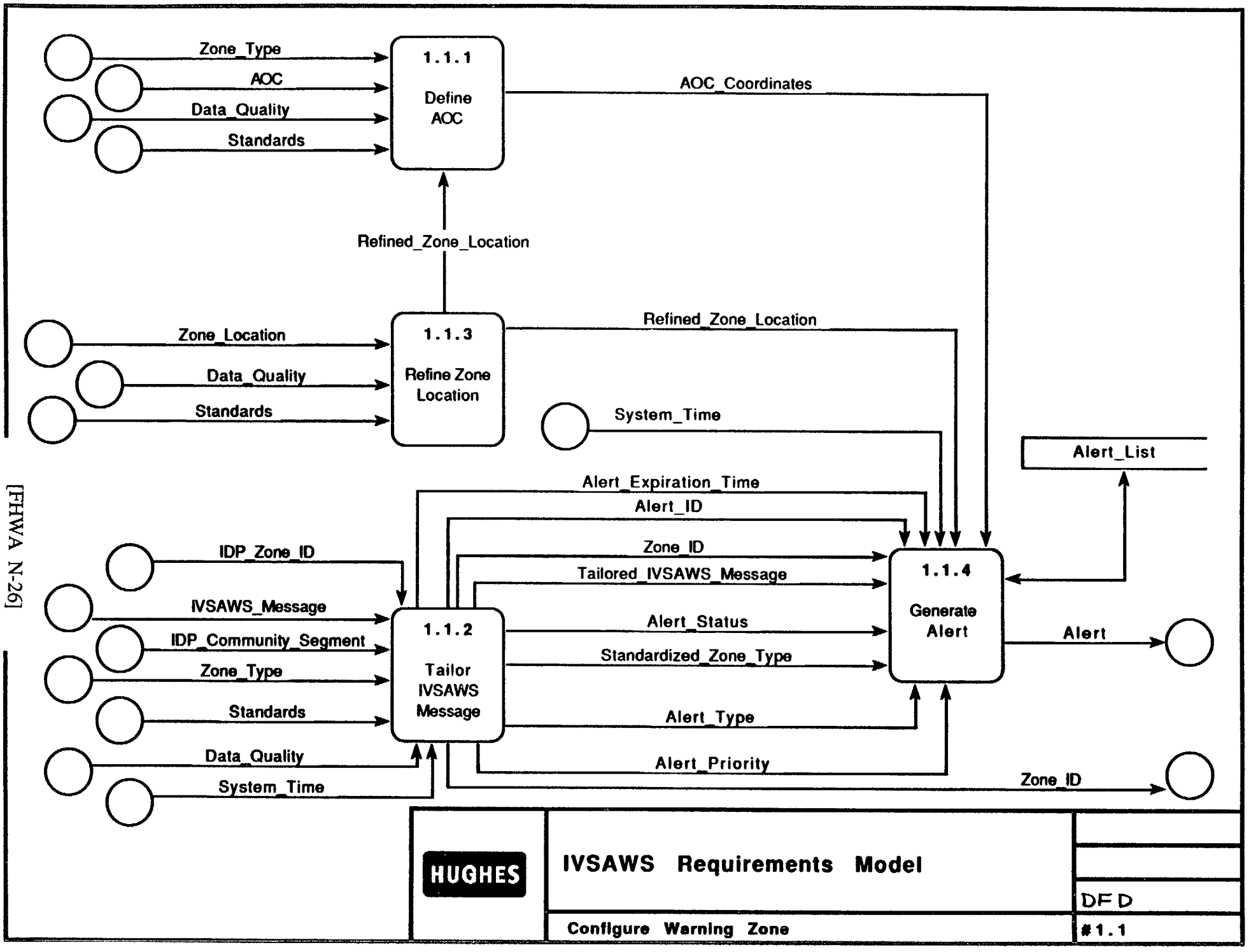
```
do continuously

    monitor Vehicle-Position

    compute Vehicle-Direction
```

```
do continuously

    check each Alert in Alert-Array
```


Zone_Type
AOC
Data_Quality
Standards
1.1.1
Define AOC
AOC_Coordinates
Refined_Zone_Location
Zone_Location
Data_Quality
Standards
1.1.3
Refine Zone Location
Refined_Zone_Location
System_Time
Alert_List
Alert_Expiration_Time
Alert_ID
Zone_ID
Tailored_IVSAWS_Message
IDP_Zone_ID
IVSAWS_Message
IDP_Community_Segment
Zone_Type
Standards
Data_Quality
System_Time
1.1.2
Tailor IVSAWS Message
Alert_Status
Standardized_Zone_Type
Alert_Type
Alert_Priority
1.1.4
Generate Alert
Alert
Zone_ID
HUGHES
IVSAWS Requirements Model
DFD
Configure Warning Zone
#1.1

```
    if Repeat_Alert
        output Driver_Alert
        set Repeat_Alert = FALSE
```

```
do continuously
    check each entry in Alert_Array
        if In_AOC
            if Vehicle_Position is outside area defined by AOC_Coordinates
                set In_AOC FALSE
```

```
when Alert_Sent
    read Alert
    if Alert_Type = ADVISORY or WARNING
        search Alert_Array for a record with same Alert_ID
        if Alert already in Alert_Array
            do nothing
        otherwise
            store Alert in Alert_Array until System_Time = Alert_Expiration_Time then
            delete Alert from Alert_Array
    if Alert_Type = DELETE
```

```
search Alert-Array for Alert with same Alert-ID
if Alert in Alert-Array
    delete Alert from Alert-Array
```

```
when Change-Mode
    if Mode = NORMAL
        set Mode = SUPPRESS
    if Mode = SUPPRESS
        set Mode I PRIORITY
    if Mode = PRIORITY
        set Mode = CLASS
    if Mode = CLASS
        set Mode = ALL-CALLS
    if Mode = ALL-CALLS
        set Mode = NORMAL
```

```
when Repeat
        read Alert-ID of Current-Alert
        find Alert in Alert-Array with same Alert-ID
        set Repeat-Alert for that Alert TRUE
```

```
when Select
    if Mode = SUPPRESS
        read Alert-ID of Current-Alert
        find Alert in Alert-Array with same Alert-ID
```

```
        if Suppressed = TRUE
            set Suppressed = FALSE
        if Suppressed = FALSE
            set Suppressed = TRUE
    if Mode = APPLICATIONS
        if Current-Application is ENABLED (check Enabled-Applications in DAWS-Status)
            disable Current-Application
        if Current-Application is DISABLED (check Enabled-Applications in DAWS-Status)
            enable Current-Application
    if Mode = ALL-CALLS
        if All-Call = ON
            set All-Call = OFF
        if All-Call = OFF
            set All-Call = ON
```

```
when Next
    if Mode = SUPPRESS
        set Current-Alert to next alert in Alert-Array
    if Mode = PRIORITY
        set Priority-Threshold = (Priority-Threshold +1) mod 8
```

```
    if Mode = APPLICATIONS
        set Current_Application = next application in Application_List
```

```
when Previous
    if Mode = SUPPRESS
        set Current_Alert to previous alert in Alert_Array
    if Mode = PRIORITY
        set Priority_Threshold = (Priority_Threshold -1) mod 8
    if Mode = APPLICATIONS
        set Current_Application = previous application in Application_List
```

when Location-Refined

if Data-Quality = STANDARD-FORMAT

set AOC-Coordinates = AOC

else

examine Standards

convert AOC to AOC Coordinates in standard format based upon Standards and Zone-Type and Refined-Hazard-Location

output AOC-Coordinates

set AOC-Defined TRUE

---

when Disable-Zone

clear AOC-Coordinates

output AOC-Coordinates

set AOC-Defined TRUE

```
when Enable_Zone
    if Data_Quality = STANDARD_FORMAT
        set Tailored_IVSAWS_Message = IVSAWS_Message
        set Standardized_Zone_Type = Zone_Type
    else
        examine Standards
         convert IVSAWS_Message to Tailored_IVSAWS_Message in standard format
        generate Standardized_Zone_Type based upon IVSAWS_Message and Standards

    if IDP_Community_Segment = PUBLIC
        set Alert_Status = UNCONFIRMED
    else
        set Alert_Status = CONFIRMED
     generate Alert_Expiration_Time based upon Standards
     generate Alert_Priority based upon Standards
     generate unique Alert_ID
    generate unique Zone_ID
    set Alert_Type = ADVISORY or WARNING based upon Standards
     output Alert_Timeout and Alert_ID and Tailored_IVSAWS_Message and Alert_Status and
            Standardized_Zone_Type and Alert_Type and Alert_Priority
    set Message_Tailored TRUE
```

when Disable-Zone

generate Alert-Expiration-Time based upon Standards

set Alert-Type = DELETE

output Zone-ID and Alert-Expiration-Time and Alert-Type

set Message-Tailored TRUE

```
when Enable-Zone
    if Data-Quality = STANDARD-FORMAT
        set Refined-Zone-Location = Zone-Location
    else
        examine Standards
        convert Zone-Location to Refined-Zone-Location in standard format
    output Refined-Zone-Location
    set Location-Refined TRUE
```

```
when Disable-Zone
    clear Refined-Zone-Location
    output Refined-Zone-Location
    set Location-Refined TRUE
```

when AOC-Defined and Message-Tailored

if Alert-Type = ADVISORY or WARNING

output Alert

set Alert-Sent TRUE

add Alert to Alert-List

if Alert-Type = DELETE

if an Alert with this Zone-ID exists in Alert-List

change the stored Alert-Type to DELETE

copy new Alert-Expiration-Time to Alert-List

output Alert (i.e. “this zone no longer exists” message)

set Alert-Sent TRUE

---

do continuously

when other Alerts aren’t being sent

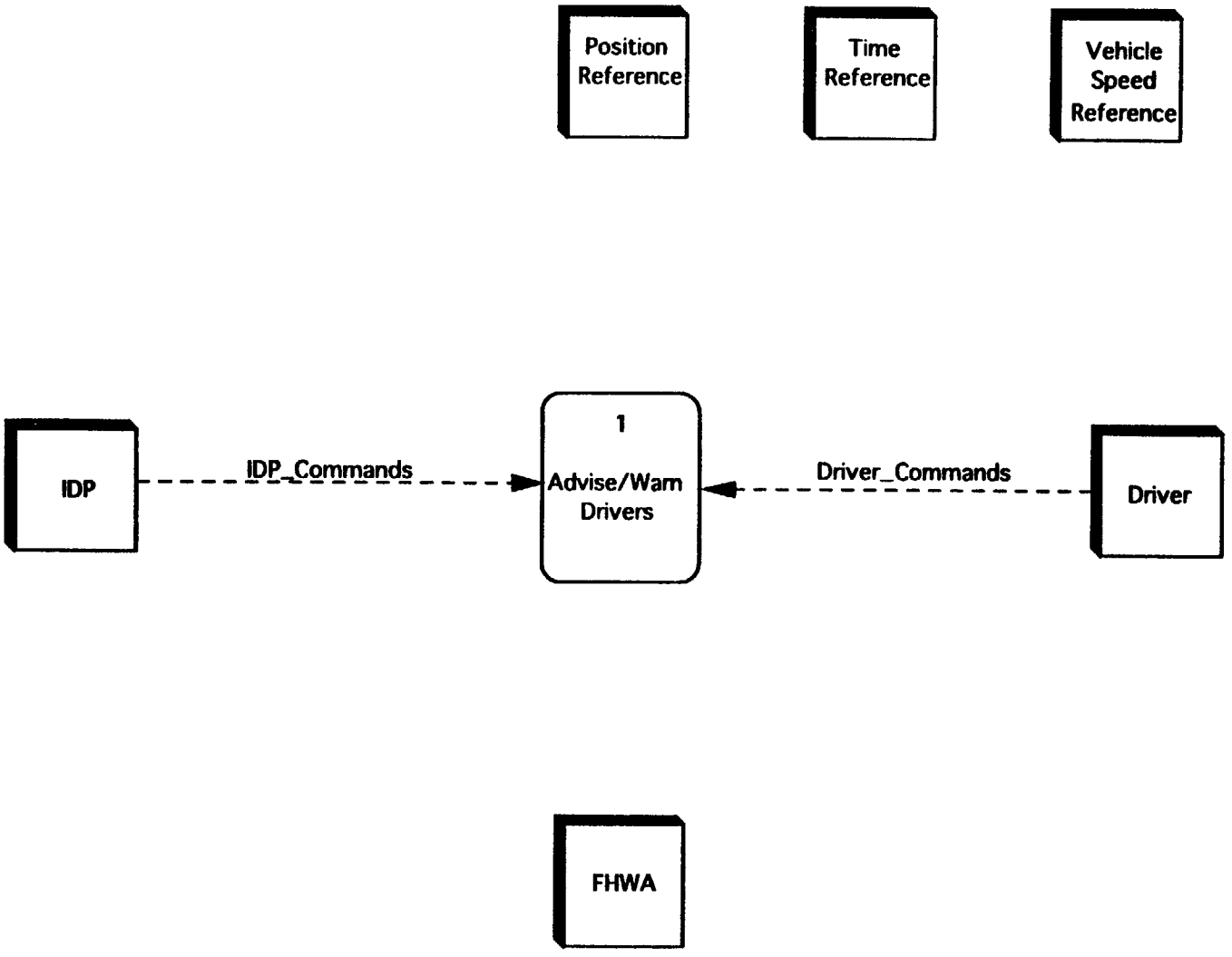
output Alerts from Alert-List (serially)

set Alert-Sent TRUE after each output

---

do continuously

remove Alerts from Alert-List when System-Time P Alert-Expiration-Time

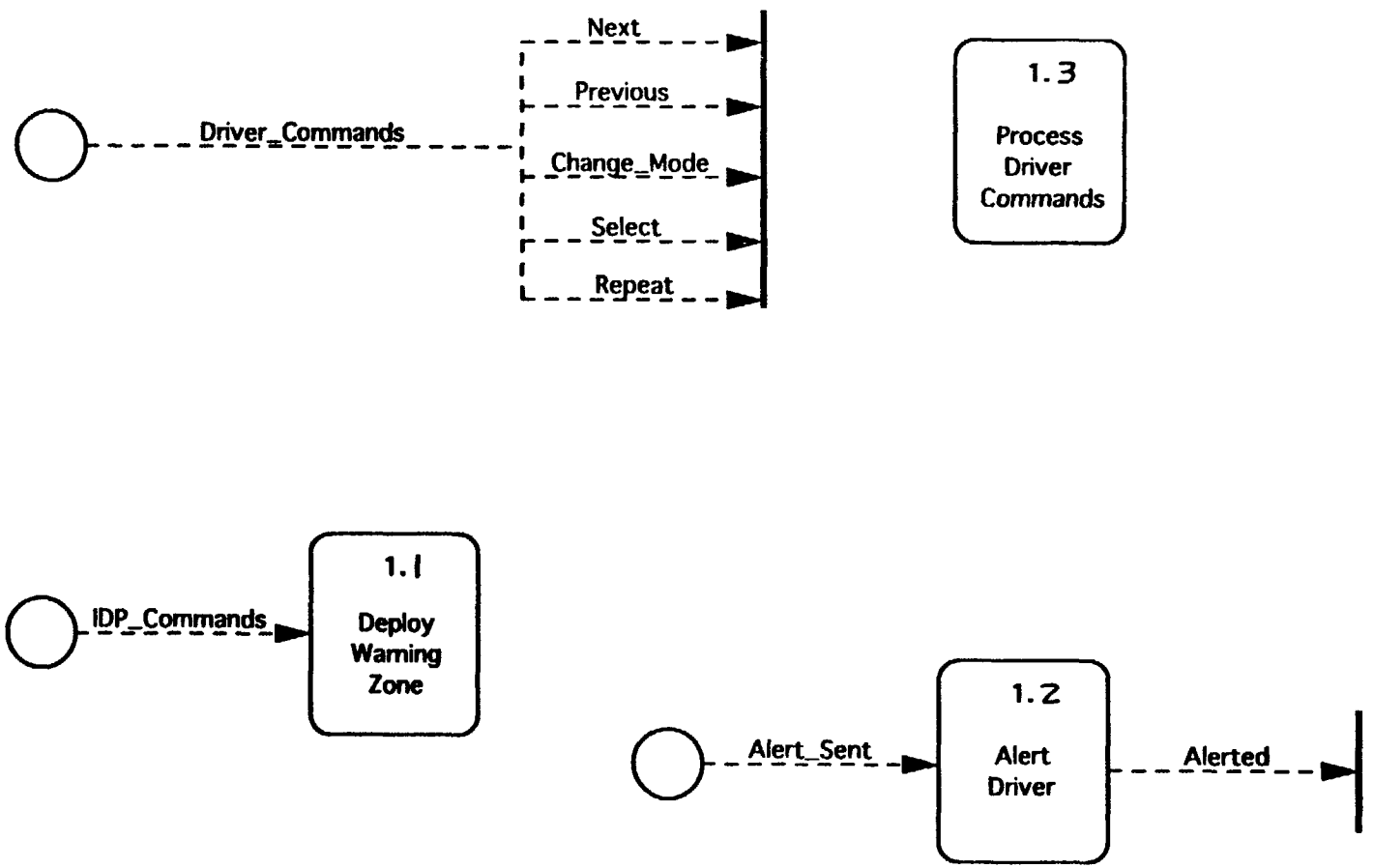


[FHWA N-37]

HUGHES

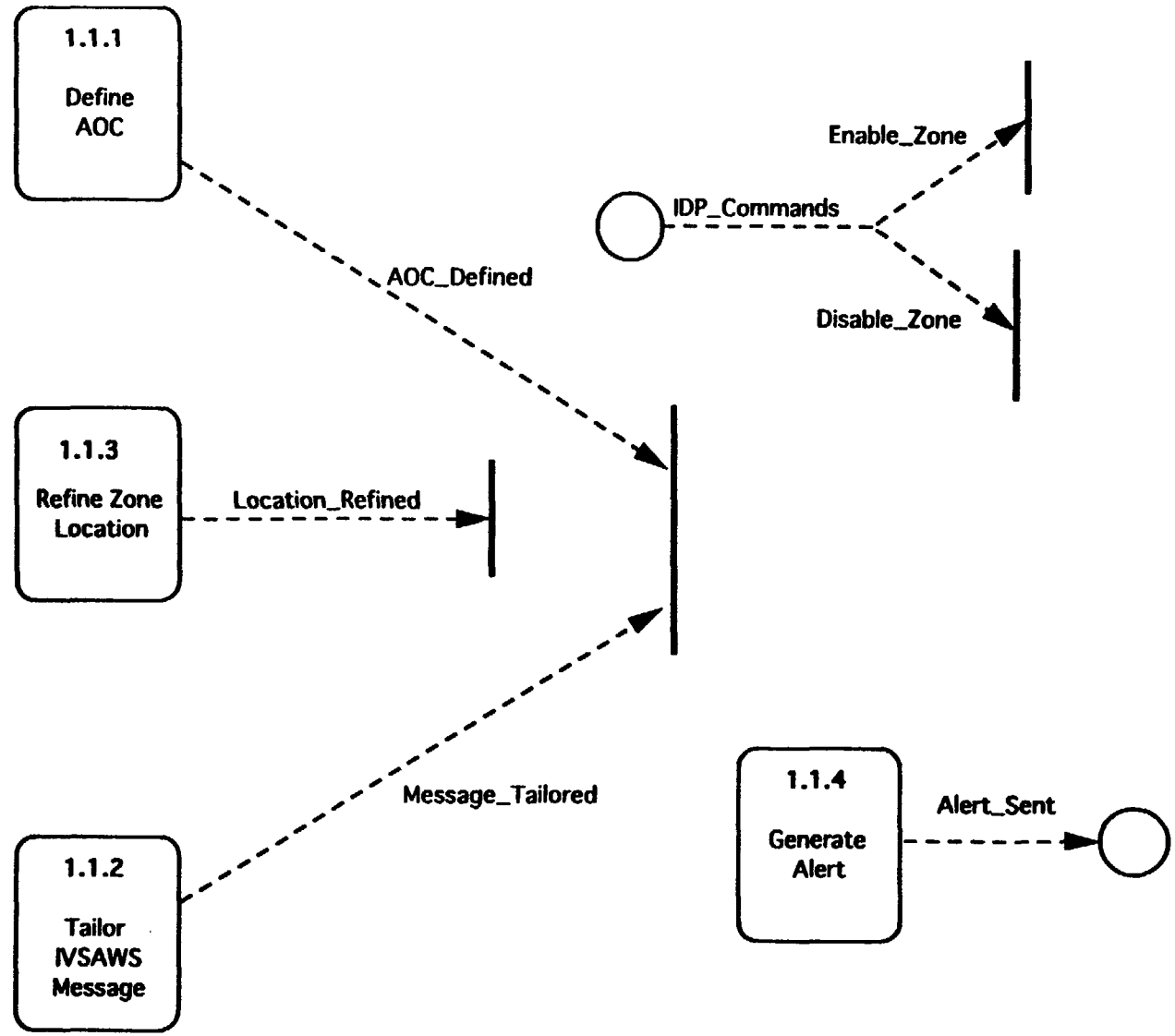
IVSAWS Requirements Model

Control Context Diagram | **#0**



[FHWA N-38]

HUGHES	IVSAWS Requirements Model	
		CFD
	Advise/Warn Drivers	#1



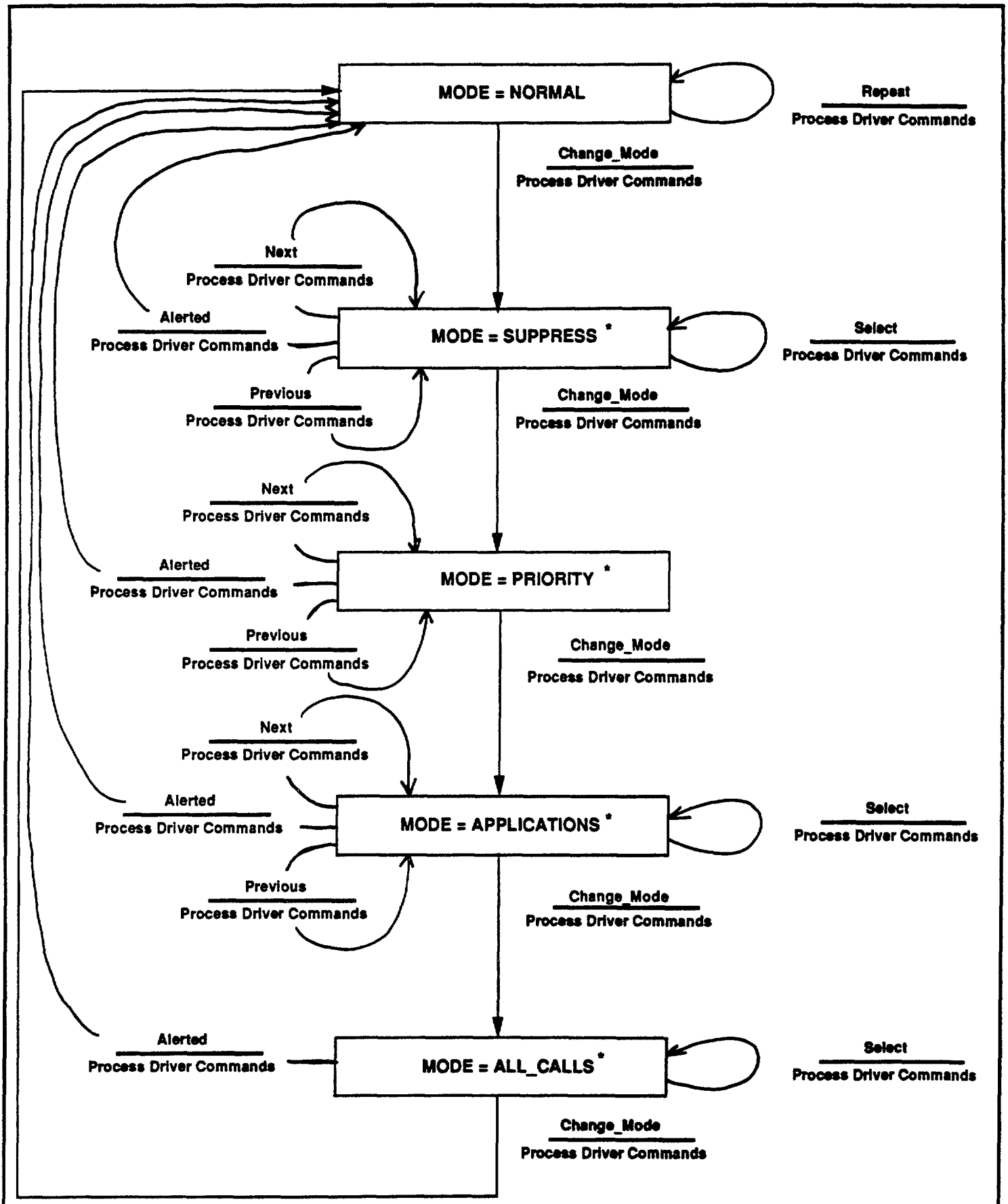
HUGHES

IVSAWS Requirements Model

CFD

Deploy Warning Zone

#1.1



* If no driver command
Is received for 6 seconds
MODE reverts to NORMAL

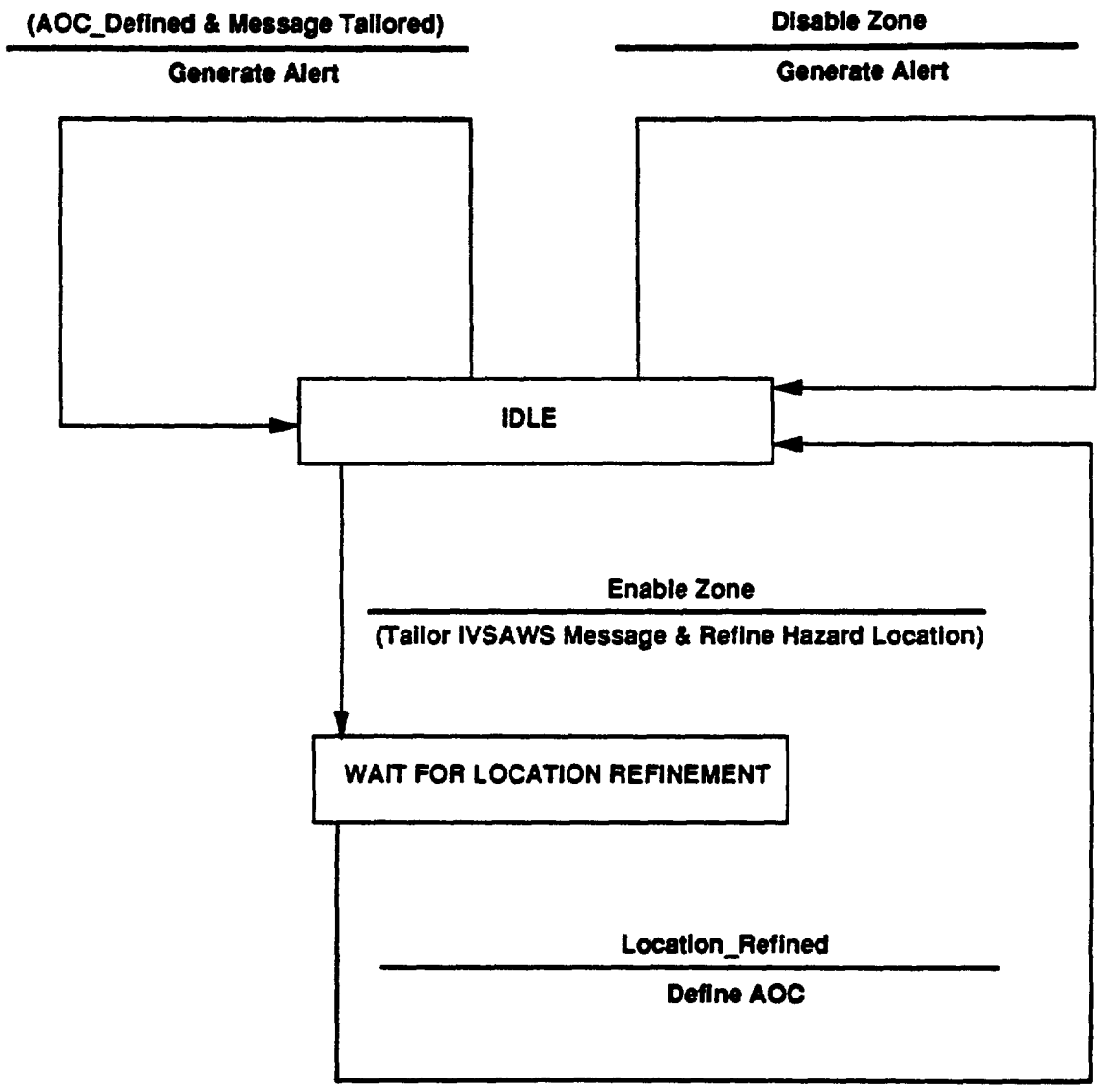
HUGHES

IVSAWS Requirements Model

Advise/Warn Drivers

[FHWA N-40]

CPEC 1


(AOC_Defined & Message Tailored)
Generate Alert
Disable Zone
Generate Alert
IDLE
Enable Zone
(Tailor IVSAWS Message & Refine Hazard Location)
WAIT FOR LOCATION REFINEMENT
Location_Refined
Define AOC

Alert

Type: Data Structure

Components :

+ Alert-ID
+ Alert-Type
+ Alert-Priority
+ Alert-Status
+ Alert-Expiration-Time
+ Standardized-Zone-Type
+ Refined-Zone-Location
+ AOC-Coordinates
+ Tailored-IVSAWS-Message

Remarks :

Alerts are stored in the Alert-Array for future processing by the Alert Driver function.

Alerted

Type: Basic Data

Discrete Values:

TRUE :
FALSE :

Remarks :

Alerted is a control flow. Each time a Driver-Alert is output, Alerted is set TRUE.

Alert-Array

Type: Data Structure

Components :

= Alert
+ Suppressed
+ Repeat

Remarks :

The components define a single record in the Alert-Array. There may be several records in the database. The Alert-Array identifies the set of warning and advisory zones currently being managed by the Alert Driver function.

Alert-Expiration-Time

Type: Basic Data

Values:

Min: present time

Max: some future time

Typ Val . :

Remarks :

Alert-Expiration-Time is the scheduled warning or advisory zone deactivation time as specified by the IDP or Standards. When System-Time exceeds an Alert-Expiration-Time, the corresponding Alert will be removed from the Alert-Array and Alert-List by the Alert Driver and Generate-Alert functions, respectively.

Alert-ID

Type: Basic Data

Values:

Min: 0

Max: a “large” integer

Typ Val . :

Remarks :

Alert-ID uniquely identifies an Alert. It is used as the index into the Alert-List and Alert-Array databases.

Alert-List

Type: Data Storage

Components :

Alert

Remarks :

The components define a single record in the Alert-List. There may be several records in the database. The Alert-List identifies the set of warning and advisory zones currently being managed by the Generate Alert function.

Alert-Priority
Type: Basic Data
Related Data :
Priority-Threshold
Discrete Values:
0 thru 7 :
Remarks :
An Alert_Priority is asigned to each Alert. Zero (0) corresponds to a low-level advisory alert. Seven (7) correspond6 to a high-level emergency alert.

Alert-Sent
Type: Basic Data
Discrete Values:
TRUE :
FALSE :
Remarks :
Alert-Sent is a control flow. Each time the Generate Alert process outputs an alert, Alert-Sent is set true (momentarily). Alert-sent is a process Activator.

Alert-Status
Type: Basic Data
Discrete Values:
CONFIRMED : Alert from PROFESSIONAL
UNCONFIRMED : Alert from PUBLIC
Remarks :
The driving public may initiate IVSAWS zones via cellular 911 calls or other communication systems (e.g., citizen's band radio). In such instances, the Alert-Status will be set to UNCONFIRMED in order to inform driver6 the Driver-Alert originate6 from an unskilled observer. Alerts originating or confirmed by a trained IDP are CONFIRMED.

Alert-Type
Type: Basic Data
Discrete Values:
ADVISORY : Alert is advisory
WARNING : Alert is a warning

AOC

Type: Basic Data

Related Data :

AOC_Coordinates

Data_Quality

Remarks :

Area of Coverage (AOC) is a description of the size and shape of an IVSAWS zone as provided by an IDP. If Data_Quality is STANDARD_FORMAT, AOC will be in AOC_Coordinates form. If not, AOC may be an approximation (e.g., verbal description) of the intended coverage area.

AOC_Coordinates

Type: Basic Data

Related Data :

AOC

Data_Quality

Remarks :

AOC_Coordinates define the area in which an IVSAWS Alert may be presented to a driver. The format is system-architecture-dependent and is TBD. The format will be standardized to allow for automated rejection of irrelevant alerts.

AOC_Defined

Type: Basic Data

Discrete Values:

TRUE :

FLASE :

Remarks :

AOC_Defined is a control flow. Each time the Define AOC process completes, AOC_Defined is set TRUE.

Change_Mode

Type: Basic Data

Discrete Values:

ON :

OFF :

Remarks :

Change_Mode is a control flow.

Current-Alert
Type: Data Structure
Components :
= Alert
Remarks :
Current-Alert is a copy of the Alert being processed by the Process Driver Command6 and Alert Driver functions.

Current-Application
Type: Basic Data
Remarks :
Current application is a pointer into the field6 of Enabled-Applications.

Data-Quality
Type: Basic Data
Related Data :
AOC
AOC-Coordinates
Zone-Location
Refined-Zone-Location
Zone-Type
Standardized-Zone-Type
IVSAWS-Message
Tailored-IVSAWS-Message
Discrete Values:
STANDARD : Data in standard format
NON-STANDARD : Data not standard format
Remarks :
AOC, Zone-Location, IVSAWS-Message, and Zone-Type may need to be converted to a standardized format in order to allow for an automated IVSAWS implementation, especially if the IDP provides these data via verbal desciptions. Data-Quality = STANDARD, no coversion is required. If Data-Ouality = NON-STANDARD, conversion is required.

DAWS-Status
Type: Data Storage
Component6 :
=Current-Alert
+ Current-Application
+ Enabled-Applications
+ Priority-Threshold
+ Mode
Remarks :
DAWS-Status is a scratchpad used to store the current state of the IVSAWS human-machine interface, the Driver Alert Warning Subsystem.

Disable-Zone
Type: Basic Data
Discrete Values:
ON :
OFF :
Remarks :
Disable-Zone is a control flow. It is a process activator.

Driver-Alert
Type: Data Structure
Components :
= Alert-Type
+ Alert-Status
+ Standardized-Zone-Type
+ Refined-Zone-Location
+ Tailored-IVSAWS-Message
Remarks :
Driver-Alerts are processed by a human-machine interface and presented to the driver.

Driver_Alert_Distance
Type: Basic Data
Related Data :
Zone_Location
Vehicle_Position
Vehicle_Type
Vehicle_Speed
Values:
Min: 0 meters
Max: 1200 meters
Typ Val . :
Remarks :
The Driver_Alert_Distance is the distance "in front" of the hazard or alert location (Zone_Location) at which an Alert is presented to the driver.

Driver_Commands
Type: Data Structure
Components :
= Next
+ Previous
+ Change_Mode
+ Select
+ Repeat
Remarks :
Driver_Commands is a control flow. Drivers issue the commands via the Driver Alert Warning Subsystem (DAWS).

Enabled_Applications
Type: Data Structure
Components :
= ~~?DELETED_DATA?~~ EVs
+ ~~?DELETED_DATA?~~ Workzones
+ ~~?DELETED_DATA?~~ Accidents
+ ~~?DELETED_DATA?~~ Lo-Vis
+ ~~?DELETED_DATA?~~ Trains
+ ~~?DELETED_DATA?~~ Infrastructure
+ ~~?DELETED_DATA?~~ Flooding
+ ~~?DELETED_DATA?~~ Traffic
+ ~~?DELETED_DATA?~~ Advisories

+ ~~?DELETED_DATA?~~ Hazard

Remarks :

Each component corresponds to a type of IVSAWS application. Each component can assume two discrete values, ENABLED or DISABLED, as set by the driver. Each Alert's Standardized_Zone_Type is compared against Enabled_Applications to see if the driver wants to be presented with Alerts of this type.

Enable_Zone

Type: Basic Data

Discrete Values:

ON :

OFF :

Remarks :

Enable_Zone is a control flow. It is a process activator.

IDP

Type: Basic Data

Aliases :

IVSAWS_Deployment_Personnel

IDP_Commands

Type: Data Structure

Components :

= Enable_Zone

+ Disable_Zone

Remarks :

IDP_Commands is a control flow

IDP_Community_Segment

Type: Basic Data

Discrete Values:

PUBLIC : ~ trained to deploy zones

PROFESSIONAL : Trained to deploy zones

IDP-Zone-ID
Type: Basic Data
Related Data :
Zone-ID
Values:
Min: 0
Max: some large integer
Typ Val . :
Remarks :
When an IDP wishes to modify or delete a zone, the Zone-ID generated by the Configure Warning Zone function should be referenced and provided as an input.

IVSAWS-Deployment-Personnel
Type: Alias
Main Name :
IDP

IVSAWS-Message
Type: Basic Data
Related Data :
Tailored-IVSAWS-Message
Remarks :
IVSAWS-Message is a description of any zone-specific information to be provided to drivers.

Location-Refined
Type: Basic Data
Discrete Values:
TRUE :
FALSE :
Remarks :
Location-Refined is a control flow. Each time the Refine Zone Location process completes, Location-Refined is set TRUE.

Message-Tailored
Type: Basic Data
Discrete Values:
TRUE :
FALSE :
Remark6 :
Message-Tailored is a control flow. Each time the Tailor IVSAWS Message process completes, Message-Tailored is set TRUE.

Mode
Type: Basic Data
Discrete Values:
NORMAL :
SUPPRESS :
PRIORITY :
APPLICATION :
ALL-CALLS :
Remarks :
Mode identifies the state of the DAWS human-machine interface.

Next
Type: Basic Data
Discrete Values:
ON :
OFF :
Remarks :
Next is a control flow.

Previous
Type: Basic Data
Discrete Values:
ON :
OFF :
Remarks :
Previous is a control flow.

Priority-Threshold
Type: Basic Data
Related Data :
Alert-Priority
Discrete Values:
0 thru 7 :
Remark6 :
A driver can select an alert Priority-Threshold. Alerts with Alert-Priority less than Priority-Threshold will not be presented to the driver.

Refined-Zone-Location
Type: Basic Data
Related Data :
Zone-Location
Data-Quality
Remarks :
Refined-Zone-Location identifies the position of a hazard or advisory situation. The format is system-architecture-dependent and is TBD. The format will be standardized to allow for automated timing of driver alerts based upon vehicle-situation separation and vehicle speed.

Repeat
Type: Basic Data
Discrete Values:
TRUE :
FALSE :
Remarks :
Drivers can have Alerts repeated by setting this bit TRUE via Driver-Commands. It is set TRUE via the Repeat control flow.

Select
Type: Basic Data
Discrete Values:
ON :
OFF :
Remarks :
Select is a control flow.

Standardized-Zone-Type
Type: Basic Data
Discrete Values:
EV : Emergency vehicle
WORKZONE : Roadway workzone
ACCIDENT : Accident site
LO-VISIBILITY : Lo visibility condition6
TRAIN : Train at/near crossing
ISTRUCTURE : Infrastructure hazard
FLOOD : Roadway flood
TRAFFIC : Traffic advisory
ADVISORY : General advisory
HAZARD : General hazard
Remarks :
The Standardized-Zone-Type can be used to select DAWS application-specific icons or enable the generation of canned application-specific aural and/or visual prompts.

Standards
Type: Basic Data
Remarks :
Any and all specifications that govern the sytax and semantics of IVSAWS operation.

Suppressed
Type: Basic Data
Discrete Values:
TRUE :
FALSE
Remarks :
Driver6 can selectively suppress individual Alerts by setting this bit TRUE via Driver-Commands.

System-Time
Type: Basic Data
Remarks :
Present time in system-specific format.

Tailored_IVSAWS_Message
Type: Basic Data
Related Data :
IVSAWS-Message
Data-Quality
Remarks :
Tailored_IVSAWS_Message is a description of any zone-specific information to be provided to drivers in STANDARD format.

Vehicle-Position
Type: Basic Data
Remarks :
The Vehicle-Position format will be standardized to allow for 1) automated rejection of irrelevant Alerts and 2) automated timing of driver alerts based upon vehicle-situation separation and vehicle speed.

Vehicle-Speed
Type: Basic Data
Values:
Min: 0 meters/second
Max: 63 meters/second
Typ Val . :

Vehicle-Type
Type: Basic Data
Related Data :
Driver-Alert-Distance
Discrete Values:
PASSENGER :
COMMERCIAL :
Remarks :
Vehicle-Type is used to compute the Driver-Alert-Distance. Typically, COMMERCIAL vehicles will have a longer Driver-Alert-Distance than PASSENGER vehicles.

Zone-ID
Type: Basic Data
Related Data :
IDP-Zone-ID
Values:
Min: 0
Max: some large integer
Typ Val . :
Remark6 :
The Zone-ID is uniquely identifies an IVSAWS hazard or advisory zone. A zone may have more than one Alert associated with it. The IDP reference the Zone-ID when modifying or deactivating a zone.

Zone-Location
Type: Basic Data
Related Data :
Refined-Zone-Location
Data-Quality
Remarks :
Zone-Location describes the position of a hazard or advisory situation.

Zone-Type
Type: Basic Data
Related Data :
Standardized-Zone-Type
Data-Quality
Remarks :
The Zone-Type is a description of an IVSAWS situation or application in STANDARD or NON-STANDARD format. In STANDARD format, it can be used to select DAWS application-specific icons or enable the generation of canned application-specific aural and/or visual prompts.