

Use of Error Codes in TCIP Data Elements

1. Problem Statement

The TWG expressed a need to include a way to provide error processing related to data exchange. The question was posed to the TWG to eliminate the error codes (codes 245-255) from NTCIP 1401 (CPT), 1403 (PI), 1404 (SCH), and 1405 (SP), as the working groups for NTCIP 1402 and 106-1408 did. The argument for eliminating them came from anticipating that the TCIP Dialogs would replace the need for the internal error codes. Further, the error codes only applied to data elements that were represented as codes, and not all data elements.

This white paper explores the issues related to replacing the error codes within the data elements represented as codes by something else (in the absence of a TCIP Dialog standard).

2. Background

During the development of TCIP data dictionary, one of the participants recommended error codes be included in data elements that were represented as “codes”. This suggestion was adopted by the general TWG at the Orange County meeting (1998). Later, the Onboard/Control Center, Fare Collection and Incident Management Working Groups made the case that the codes only related to one class of data elements and not all. They surmised that the TCIP Dialogs effort would deal with Error Codes.

In the Dialogs Phase 1 effort, the TCIP Dialogs working group proposed four categories of Dialogs, “error processing” was one of them. The Error Processing dialog requirement included codes for data elements, messages and general/specific dialogs. The numbering scheme that classifies the types of errors as stated in the [Dialogs] is included below. The errors for data element errors were derived from the list in the TCIP standards NTCIP 1401 and 1403-1405.

Code	Category
0-49	Message Errors
50-99	General Dialog Error
100-199	Specific Dialog Errors
100-124	• Event Processing Errors
125-149	• Data Provision Errors
150-159	• Journal Provision Errors
200-255	Data Element Errors

The Error Processing dialog could be executed within any dialog if an “error” was detected. The error “message template” would be executed instead of, or in addition to an expected API/template, message or data element.

3. Requirements

The requirements as stated by the TWG are as follows:

- Provide error processing/informational message related to all TCIP objects, including data element, message and data elements inside of messages. (In the absence of dialogs, dialogs is currently not included in the requirement)
- Provide information on the type of error; minimally, incorporate the list of ten (10) from the original TCIP error list:
 - Null (data is null)
 - Intentionally left blank (not used)
 - Deleted by device (reset to null)
 - Data unavailable
 - Illegal calculation (e.g., divide by zero)
 - Value out of range
 - Device malfunction (no value returned)
 - Data expired (data deleted, no longer available)
 - Data suppressed for security or privacy
 - Unspecified

4. Issues and Alternatives

Alternative 1: Do nothing.

Description -- Leave the business area code numbers as is.

Logic – The fewer changes to the existing standard the better.

Deficiency -- Does not meet requirements of TWG.

Alternative 2: Take all the codes out.

Description – Take out all the error codes in TCIP data elements represented as codes in 1401, 1403-1405.

Logic – Makes all TCIP data elements consistent.

Deficiency -- Does not meet requirements of TWG.

Alternative 3: Create a message that alerts target system that an error has occurred.

Description – Alternative 2, and create a new message and data element that may be used for identifying errors in exchanging (all types of) TCIP objects.

Logic – Good programming practice includes an error processing function within a module to handle potential or expected errors, e.g., divide by zero, invalid data. This description implies “behavior” of an application. By definition, a data interface standard codifies the data, not the behavior. The function of a Dialog is to standardize the behavior of exchange. So by scope, the Dialogs standard should be responsible for how and when an error processing message is sent. However, the message and/or template for an error processing message may fall under the general TCIP data dictionary umbrella and be included in the Common Public Transportation (CPT) data dictionary/message set.

Deficiency -- Effort is not coordinated with Dialogs since the Dialogs standard effort is on hold.

Proposed Message –

The message “scope of operations” would work as follows:

A response or event is expected from a target system. The target system determines that it cannot respond as expected because of an error. The error message should contain the following fields:

- Request or event that was expected such as reference to get, request, event-subscribe
- TCIP object reference that was expected (may be embedded object such as a data element within a message)
- Reason for not responding

The message may be described as follows:

Message Identifier: cpt xx
Metadata Source: DIRECT
Descriptive Name: CptErrorTemplate_message
Descriptive Name Context: Manage Transit
Definition: Describes the error that occurred in responding to TCIP interchange
Source: TCIP
Class Name: CPT
Classification scheme name: TCIP
Classification scheme version: NTCIP 1400
Data concept type: Message
Keyword:
Related data concept:
Relationship type:
Remarks:
Symbolic name:
Symbolic name usage:
ASN.1 name: CptErrorTemplate
Constraints:
Synonymous descriptive name:
Synonymous descriptive name context:
Priority: Priority
Frequency/Message Mode: as needed -- Map to Dialog Requirement
Delivery Verification: none -- Map to Dialog Requirement
Message body:

```
CptErrorTemplate ::= SEQUENCE {
    address OBJECT IDENTIFIER OPTIONAL, -- source device
    reference OBJECT IDENTIFIER, -- reference to TCIP object
    sub-reference UTF8String (1..25) OPTIONAL,
```

```
-- reference to field within message or message within dialog
error-code      CPT-ErrorType,
footnote        CPT-Footnote  OPTIONAL }
```

Just one data element is associated with the new message, and that is the CPT-ErrorType. It is described below:

Descriptive Name CPT_ErrorType_cd
Descriptive Name Context: Manage Transit
Definition: Indicates the type of error that occurred in response to a request or event.
Formula:
Source: TCIP
Class Name: CPT
Classification scheme name: TCIP
Classification scheme version: NTCIP 1400
Data concept type: Data Element
Keyword:
Related data concept:
Relationship type:
Remarks:
Symbolic name: cptdd xxx
Symbolic name usage: TCIP Classification Tree for CPT Data Dictionary
ASN.1 name: CPT-ErrorType
Representation layout: INTEGER (0..255)
Constraints:

Value Domain: UBYTE

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200-255	Data Element Errors

```
200 data-null --null (data is null)
201 data-blank --intentionally left blank (not used)
202 data-deleted -- deleted by device (reset to null)
203 data-unavailable-- data unavailable
204 data-illegal
    -- illegal calculation (e.g., divide by zero)
205 data-out-of-range --value out of range
206 data-malfunction--device malfunction (no value returned)
207 data-expired
    -- data expired (data deleted, no longer available)
208 data-suppressed -- data suppressed for security or privacy
```

209 data-unspecified -- unspecified

Data type: UNIVERSAL 2 – Integer Type

Representation class term: code

Valid value rule:

```
CPT-ErrorType ::= INTEGER {
  -- 0 to 49 are reserved for message errors
  -- 50 to 99 are reserved for general dialog errors
  -- 100 to 199 are reserved for specific dialog errors
  -- 200 to 255 are reserved for data element errors
  data-null (200),
  data-blank (201),
  data-deleted (202),
  data-unavailable (203),
  data-illegal (204),
  data-out-of-range (205),
  data-malfunction (206),
  data-expired (207),
  data-suppressed (208),
  data-unspecified (209)
  -- 210 to 255 are reserved for data element errors
} (0..255)
```

For more information about this paper contact:

Paula Okunieff
TCIP TWG Consultant
okunieff@theworld.com
