



How to Secure Your Data - Informix Column Encryption and Security

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Advanced DataTools

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Agenda

- Informix Column Encryption
- Demo – Implementing Encryption with Minimal Impact
- Managing Users with Roles

Requirements

- Need to Protect - "**Personally identifiable information**" (PII)
 - *Information which can be used to distinguish or trace an individual's identity, such as their name, social security number, biometric records, etc. alone, or when combined with other personal or identifying information which is linked or linkable to a specific individual, such as date and place of birth, mother's maiden name, etc.*
- Need to Secure Financial Data
- Many different rules (local, state, national, financial) - You need to find out what yours are!

Common Encryption Requirements

- Credit Card Info
- Bank Info
- Social Security Number

Problem

- How to you add encryption to an exiting database and application?
- With minimal change to the application
- With minimal impact to users?

IBM Knowledge Center on Column Encryption

The screenshot shows the IBM Knowledge Center interface. The browser address bar displays the URL: `www-01.ibm.com/support/knowledgecenter/#/SSGU8G_12.1.0/com.ibm.sec.doc/ids_ce_001.htm`. The page title is "IBM Knowledge Center - Column-level encryption". The navigation bar includes "Sign In" and "English". A search bar is present with a "Save Search" button. Below the search bar, search filters are shown: "Informix Servers 12.1" (selected), "Auto-select", "Clear All", and "Add Products...". The main content area is titled "Informix Servers 12.1 > Security > Security in IBM Informix > Securing data > Column-level encryption". The left sidebar contains a "Table of Contents" with links to "Back to all products", "Informix Servers", and "Informix Servers 12.1". Under "Informix Servers 12.1", there is a list of topics including "Informix V12.10 documentation", "Product overview", "Migrating and upgrading", "Installing", "Informix virtual images", "Designing databases", "Administering", "JSON compatibility", "SQL programming", "Client APIs and tools", "Embedding Informix", and "Extending Informix". The "Security" section is expanded, showing "Security in IBM Informix", "What's new for security in Informix, Version", "Prerequisites for a secure database server", "Securing data" (expanded), and "Column-level encryption" (selected). The main content area is titled "IBM® Informix® 12.10" and "Column-level encryption". It explains that column-level encryption is used to store sensitive data in an encrypted format. It lists the built-in encryption functions: ENCRYPT_AES() and ENCRYPT_TDES(). It also lists the character data types and smart large object data types that can be encrypted: CHAR, NCHAR, VARCHAR, NVARCHAR, LVARCHAR, BLOB, and CLOB. It mentions that the SET ENCRYPTION PASSWORD statement can be used to set an encryption password for a session. It also notes that the built-in ENCRYPT_AES(), ENCRYPT_TDES(), DECRYPT_CHAR(), and DECRYPT_BINARY() encryption and decryption functions can use the session-level password if the password is not explicitly specified. It states that after Informix® prepares a statement that contains a password (and, optionally, a hint), Informix keeps the password and hint in shared memory in an encrypted format. It also mentions that when you set encryption passwords for column data, you can specify these types of encryption: Column-level encryption and Cell-level encryption. It provides a tip: "If encryption functions are not used, users can enter unencrypted data into columns that are meant to contain encrypted data. To ensure that data entered into a field is always encrypted, use views and INSTEAD OF triggers." It also states that passwords and hints that you declare with SET ENCRYPTION PASSWORD are not stored as plain text in any table of the system catalog. The footer contains links for "Contact", "Privacy", "Terms of use", "Accessibility", and "Feedback".

Informix Encryption Functions

- SET ENCRYPTION PASSWORD to set an encryption password or encryption key for a session
- ENCRYPT_AES() and ENCRYPT_TDES() functions to encrypt data in columns
- DECRYPT_CHAR(), and DECRYPT_BINARY() decrypt functions

Encryption Data Types

- CHAR
- NCHAR
- VARCHAR
- NVARCHAR
- LVARCHAR
- BLOB
- CLOB

Encrypt Virtual Processor (oninit)

- Started at startup if defined in the ONCONFIG
 - VPCCLASS encrypt,num=1
- First time an encryption function is called if not defined in the ONCONFIG
- Start from the command line
 - onmode -p 1 encrypt

Encrypt Virtual Processor (oninit)

- Informix keeps the password and hint in shared memory in an encrypted format
- Informix uses a randomly generated session key to encrypt the password and hint in memory.
- **Not stored on disk or in plain text in memory or in AF dumps**

Encrypt Function

- **ENCRYPT_AES()**
 - Advanced Encryption Standard
- **ENCRYPT_TDES()**
 - Triple Data Encryption Standard, which is sometimes also called DES3 algorithm
 - Slower but considered more secure

Encrypt Function Arguments

- Data to be encrypted (required)
- Encryption password or Key (required when session password is not set)
- Encryption Hint (optional)
 - Use GETHINT to retrieve the Hint
- Example
 - set encryption password (abc)
 - encrypt_ssn = encrypt_tdes (ssn)

Encryption Column Size

- The encrypted data will be larger than the original unencrypted data
- The size of the encrypted column must be large enough to store the full encrypted data
- If column is too small, data will be truncated and cannot be decrypted

Determine Encryption Column Size

```
select length
```

```
  ( encrypt_tdes ("1234567890123456", "password", "hint"))
```

```
from sys tables where tabid = 1;
```

- Or without a hint

```
select length
```

```
  ( encrypt_tdes ("1234567890123456", "password",))
```

```
from sys tables where tabid = 1;
```

Manage Encryption Password

- The key to encrypt or decrypt data
- All data will be lost if key is lost
- Where do you keep your password?
 - Encrypted table in database which only the user Informix or designated user
 - Compiled in a C UDR

Demo and Examples

How to take an Informix database and change it to use encrypted columns with little impact to your front end applications using triggers, functions, and Informix encryption.

Example – Base Table

```
create table new_customer
(
  customer_num serial not null ,
  fname char(15),
  lname char(15),
  company char(20),
  address1 char(20),
  address2 char(20),
  city char(15),
  state char(2),
  zipcode char(5),
  phone char(18),
  ssn char(9),
  tin char(10),
  primary key (customer_num)
);
```

---- Load data into the New Customer table

```
insert into new_customer
select c.*,
       phone[1,3] || phone[5,6] || phone[9,12], -- Demo SSN
       zipcode || phone[10,12] || phone[2,3]   -- Demo TIN
from customer c
;
```

Example – Add Encrypted Fields

----- Add 2 fields to hold the Encrypted Data

```
alter table new_customer add ( encrypt_ssn varchar(50) before tin);
```

```
alter table new_customer add ( encrypt_tin varchar(50));
```

Example – Batch Encrypt Data

```
-- Mass Encrypt the SSN and TIN in the new customer table
set encryption password (( select trim(password) from
encrypt_key ));

update new_customer set encrypt_ssn = encrypt_tdes (ssn)
    where 1=1;
update new_customer set encrypt_tin = encrypt_tdes (tin)
    where 1=1;
-- hide old data
update new_customer set ssn = "*****" || ssn[6,9] where 1=1;
update new_customer set tin = "*****" || tin[7,10] where 1=1;
```

Example – Create Trigger to Encrypt New Rows

```
create trigger ins_cust insert on new_customer  
referencing new as post
```

```
for each row
```

```
(
```

```
    execute procedure sp_do_encryption('new_customer',  
    post.customer_num),
```

```
    execute function trunc_to_4('new_customer',  
    post.customer_num ) INTO ssn, tin
```

```
);
```

Example – Encryption SPL

--- Create a Procedure to Encrypt the SSN and TIN

```
CREATE PROCEDURE sp_do_encryption( tabname varchar(60), in_val integer)
```

```
  Define esql, eisam smallint;
```

```
  ON EXCEPTION SET esql, eisam
```

```
  END EXCEPTION
```

```
set lock mode to wait;
```

```
set encryption password (select password from encrypt_key);
```

```
if tabname = "new_customer" then
```

```
  update new_customer set
```

```
    encrypt_ssn = (case when ssn[1] != "*" then encrypt_tdes(trim(ssn)) else " end),
```

```
    encrypt_tin = (case when tin[1] != "*" then encrypt_tdes(trim(tin)) else "
```

```
end)
```

```
  where customer_num = in_val ;
```

```
end if
```

```
END PROCEDURE;
```

Example – Hide Old Data SPL

```
-- Create a Procedure to Hide the Old SSN and TIN
create function trunc_to_4( tabname char(60), in_val integer )
returning char(10), char(10);
Define ln1, ln2 smallint;
Define l_ssn, l_tin char(60);
Define val1, val2, val3 char(10);

if tabname = 'new_customer' then
  select length(ssn), ssn, length(tin), tin
  into ln1, l_ssn, ln2, l_tin from new_customer
  where customer_num = in_val;

      if l_ssn[1] != "*" then
          let val1 = "*****" || l_ssn[6,9];
      else
          let val1 = l_ssn;
      end if
      if l_tin[1] != "*" then
          let val2 = "*****" || l_tin[7,10];
      else
          let val2 = l_tin;
      end if

  end if
  return val1, val2;
end function;
```

Example – Decrypt Rows

```
select
    customer_num,
    lname,
    ssn,
    decrypt_ssn(customer_num) unencrypt_ssn,
    tin,
    decrypt_tin(customer_num) unencrypt_tin,
    encrypt_ssn,
    encrypt_tin
from new_customer;
```

Example – Decrypt SPL

```
create function decrypt_ssn ( in_val integer )
  returning char(10);
  Define val1 char(10);
    -- Check if user is allowed to see data
    if USER = "informix" then
      set encryption password (select password from encrypt_key);
      select ( decrypt_char(encrypt_ssn)::char(10) ) into val1
      from new_customer
      where customer_num = in_val;
    else
      let val1 = NULL;
    end if
  return val1;
end function;
```

To Add Encryption to an Existing Informix Database Application

Example Summary

Example Summary

1. Create the columns to hold the encrypted data
 - In separate shadow tables or
 - At the end of the current table
2. Create an SPL function to encrypt and hide the existing data
3. Create trigger to encrypt and hide all data on insert

Example Summary

4. Grant permissions on the SPL – allow everyone to encrypt the data
5. Create a function to decrypt the data
6. Grant permissions on the decrypt SPL – only authorized users can see the data
- 7. The only applications that need to change are the ones that need to show the decrypted data!***

Managing Users with Roles

- First article on Roles
 - **Roles - A New Security Feature in INFORMIX OnLine 7.10.UD1**
by Lester Knutsen
October 1995
- <http://advanceddatatools.com/TechInfo/WAIUG/iugnew54.htm#roles>

Roles

- Database privileges are granted to Roles, rather than individual users
- Users are added to Roles
- Roles can be set on login with the `sysdbopen()` function

Roles

- Reduce the complexity of managing thousands of users to:
 - Create and manage a few roles
 - Assign users to roles

Roles - Syntax

- Create Role statement
- Grant Role to User statement
- Grant Privileges to Role Statement
- Set Role statement

Questions?



Send follow-up questions to
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Informix Training in 2015

January 26-29, 2015 - Informix for Database Administrators

March 16-19, 2015 - Informix Enterprise Replication (New Course)

July 20-23, 2015 - Advanced Informix Performance Tuning

October 12-15, 2015 - Informix for Database Administrators

- All courses can be taken online over the web from your desk, or at our training center in Virginia.
- We guarantee to *NEVER* cancel a course and will teach a course as long as one student is registered!

Next Webcast

- Date: TBD January 2015
- Time: 2:00pm EST

- Fastest Informix DBA Contest 2015
- Informix and the Internet of Things:
 - Informix and embedded Devices/ARM and Informix – Tom Beebe
 - Connecting your database to the outside world – Mike Walker



Thank You

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