Time Stamping Preprint and Electronic Journal Server Environment

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Towards a Digital Mathematics Library 2011

Backgrounds

- While many universities operate local preprint and journal servers, the security of these digital documents may be at risk.
- Cracking, disasters and careless operations cause the serious problem.
- Full text file may be diffused hands by hands with annotations or comments.
- Currently, most articles still have the printed issue in addition to digital file distribution.
- In this dual publication scheme, the printed issue is regarded as the trusted original version.

Backgrounds

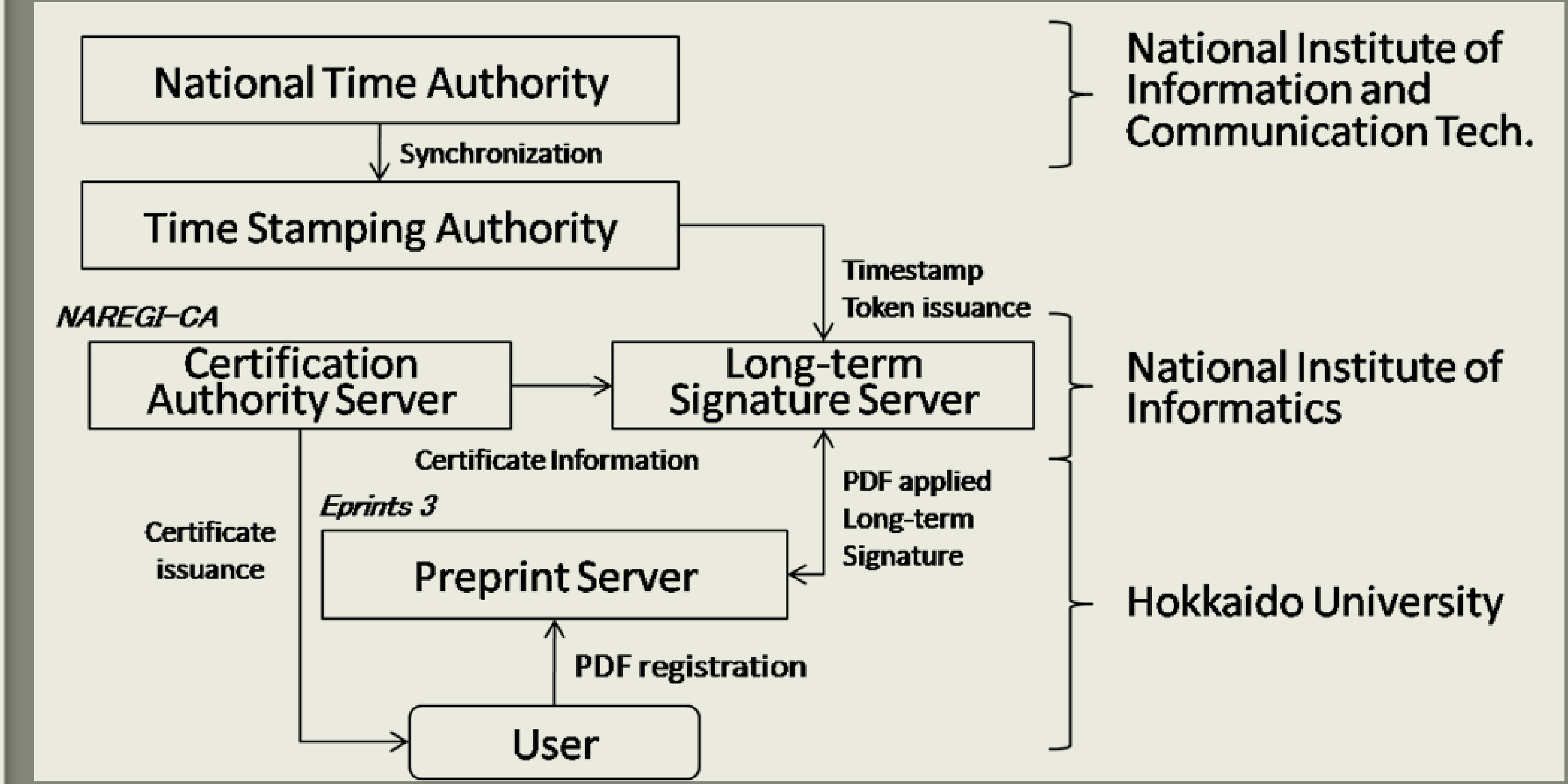
- However, in paperless publication, it is difficult to distinguish a copy from the original. That is, the security level of the preprint files has to be raised in order to protect the research results.
- In the field of business, the security of digital documents containing patentable ideas and intellectual property are guaranteed by means of an electronic signature and timestamp technique.
- These technologies can be applied to academic publishing to ensure reliable digital content.
- This study proposes a secured preprint server environment and describes its application to the mathematical e-journal and preprint service at Hokkaido University.

Possible Solutions

- Mirroring and backup
- Hash/Checksum
- Read only full text file
- Password protection
- There is no guarantee that nobody have changed the created time information of full text file.
- Cracking, disasters and careless operations will cause unrecoverable problem.

Overview of our Solution

- System architecture



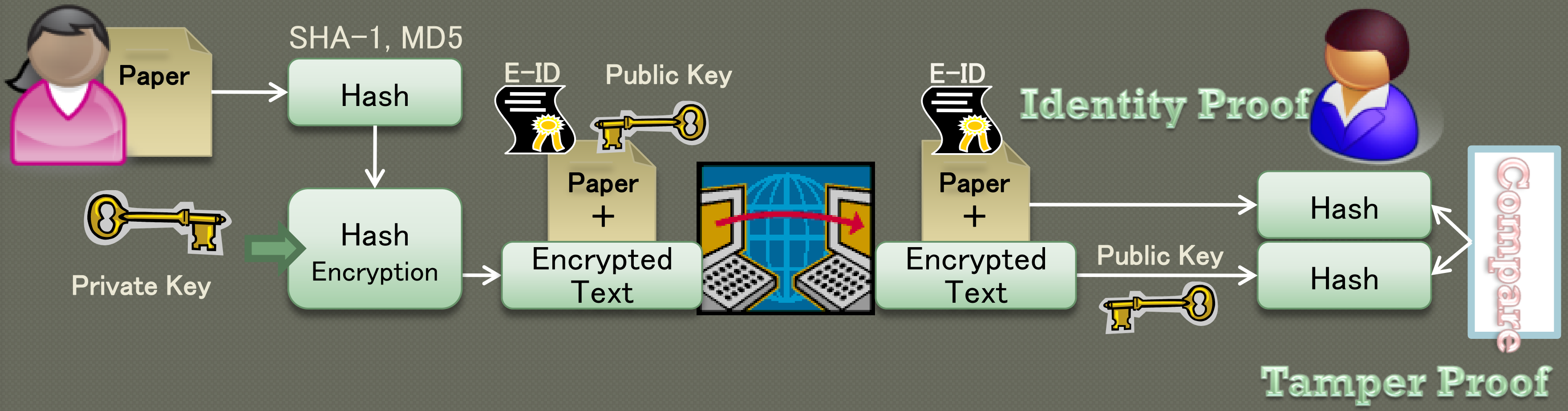
Electronic Signature

- One solution is Long-term Signature.
- The electronic signature (ES) ensures integrity and signer of a document.
- The digital signature is created from an encrypted hash value of a digital document.
- The recipient (client application) can detect a falsification of the document by comparing hash values calculated from the original document and decrypted from the digital signature

Electronic Signature

Electronic signature ensures integrity and signer of a document

ES by PKI (Public Key Infrastructure)



- Application of the ES to Article
  - Author (Editor)
  - Contents

can be certified

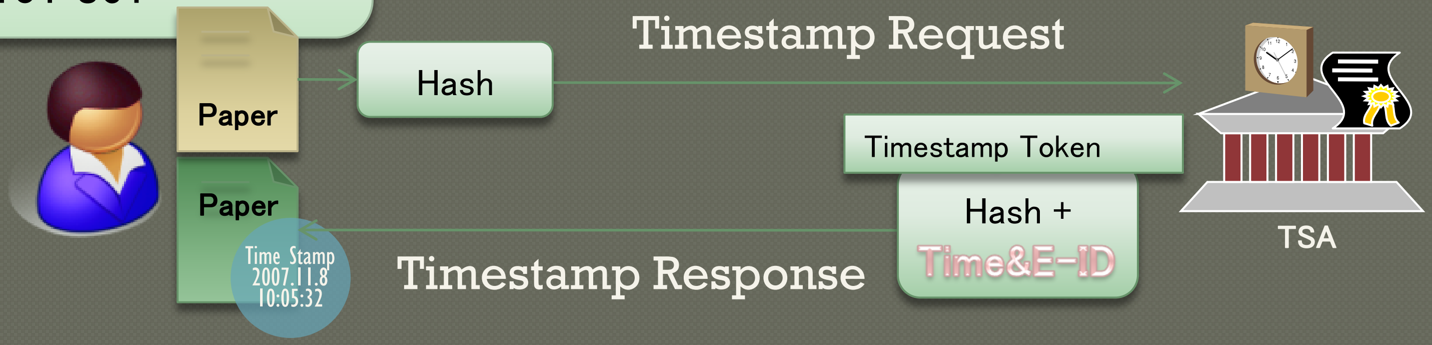
Timestamp

- The timestamp (TS) technology guarantees existential evidence of digital documents.
- The combination of ES and TS, as indicated by ES-T in Figure, ensures the authenticity of the digital documents.

Timestamp

Timestamp technology guarantees existential evidence of the digital documens

International Standard
- RFC 3161
- ETSI TS 101 861



Paper

Hash

Timestamp Request

TSA

Timestamp Token

Hash +
Time&E-ID

Timestamp Response

Paper

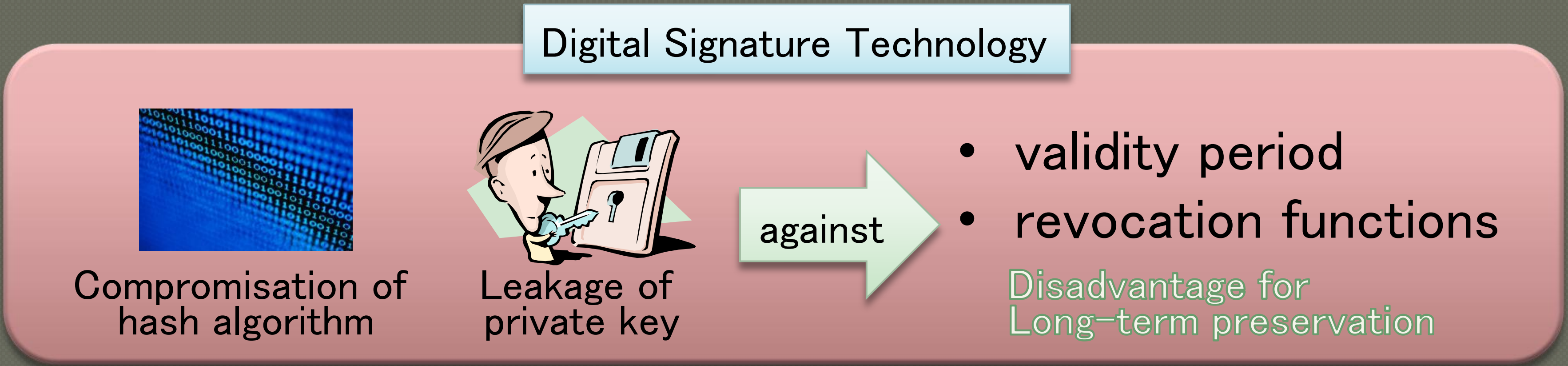
Time Stamp
2007.11.8
10:05:32

- Application of the TS to Research Paper
  - Publication Date
  - Contents

} can be certified

Disadvantage of ES&TS

Electronic signature and timestamp are useful technology however…



Digital Signature Technology

Compromisation of hash algorithm

Leakage of private key

against

- validity period
- revocation functions

Disadvantage for Long-term preservation

Long-term signature

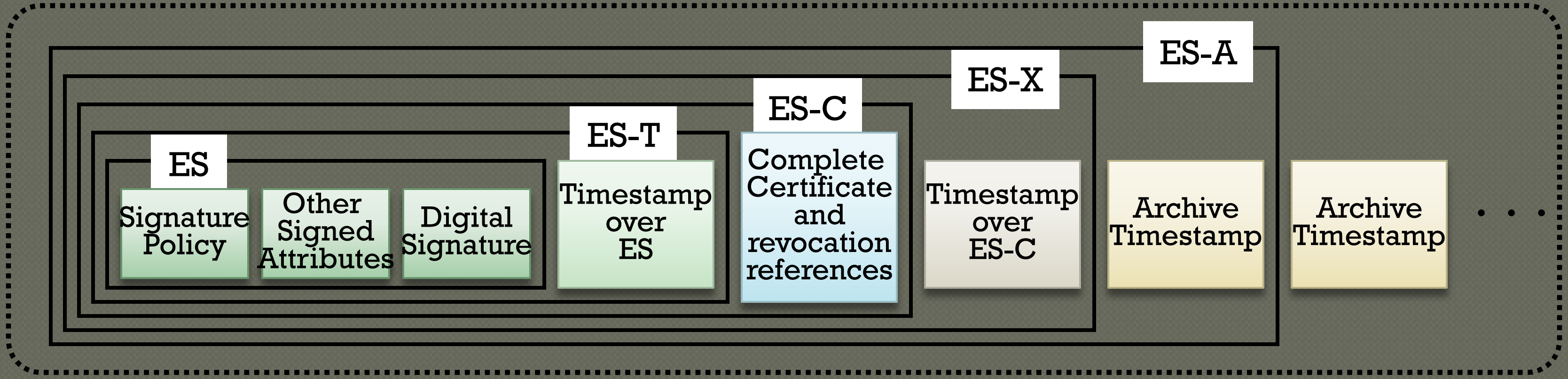
- solves disadvantage of ES and TS above
- embeds a complete certificate and revocation reference
- International standard RFC 3126

Long-Term Signature

- The ES and TS have a validity period and revocation functions. However, the temporary nature of these functions causes a problem for long-term preservation.
- To solve this problem, a long-term signature has been proposed.
- This signature format embeds a complete certificate and revocation references shown as ES-C.
- Therefore, ES and TS can be verified even after the signature expires.
- This study employed international standard RFC3126 as a long-term signature format and applied it to the article PDF documents.

Long-Term Signature

Long-term Signature Format(RFC3126)

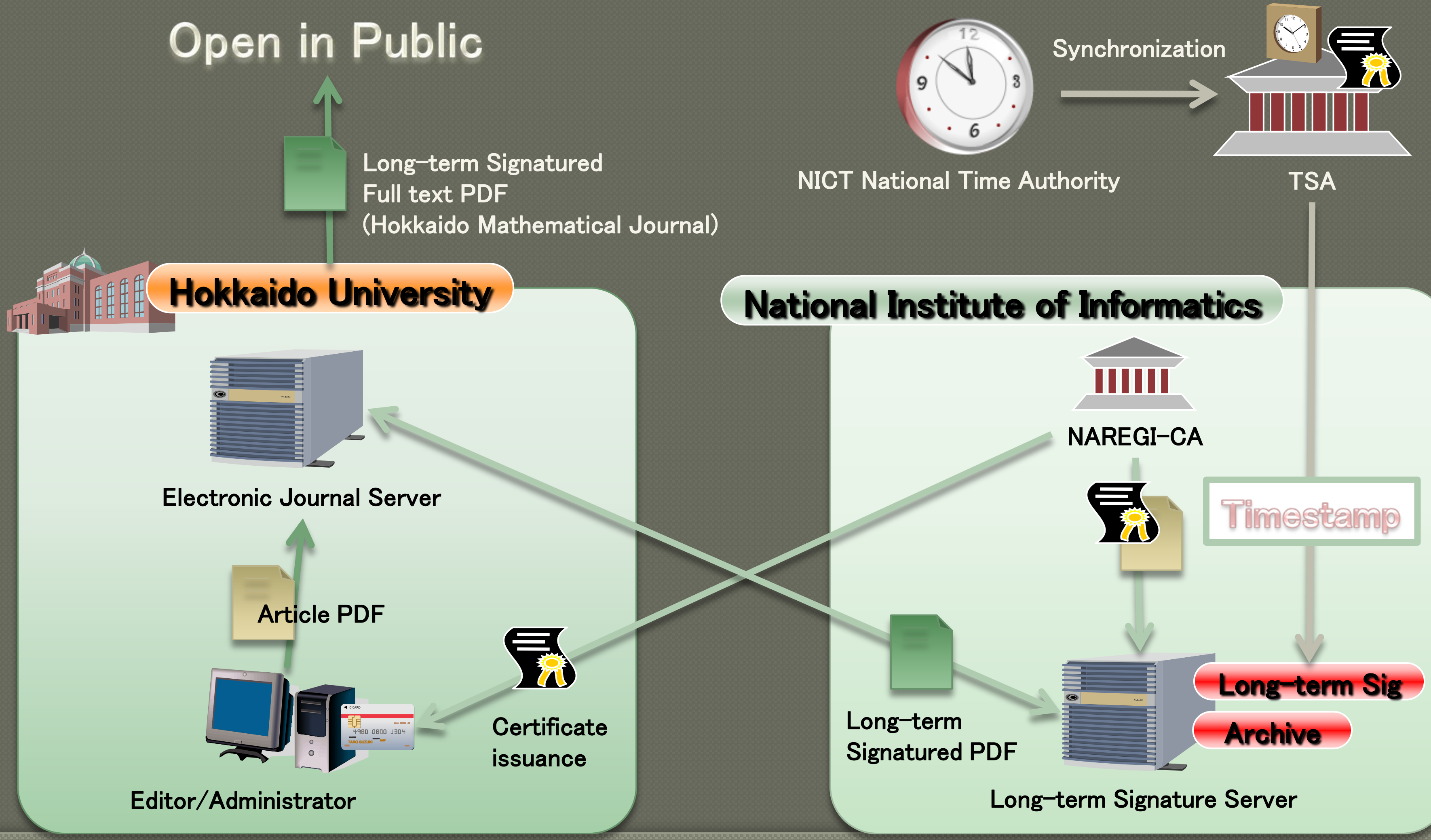


Application of LTS to Full text PDF

System Environment

- Application of the long-term signature requires a certification authority (CA) server and long-term signature server. The CA issues a digital certificate to a user who would like to register a document on the server.
- CA was established by NAREGI-CA which is an open source software originally developed for grid computing .
- The long-term signature server obtains a timestamp token from the time stamping authority managed by a trusted third party.

System Archtecture



Open in Public

Long-term Signatured
Full text PDF
(Hokkaido Mathematical Journal)

NICT National Time Authority

Synchronization

TSA

Hokkaido University

Electronic Journal Server

Article PDF

Editor/Administrator

Certificate
issuance

National Institute of Informatics

NAREGI-CA

Timestamp

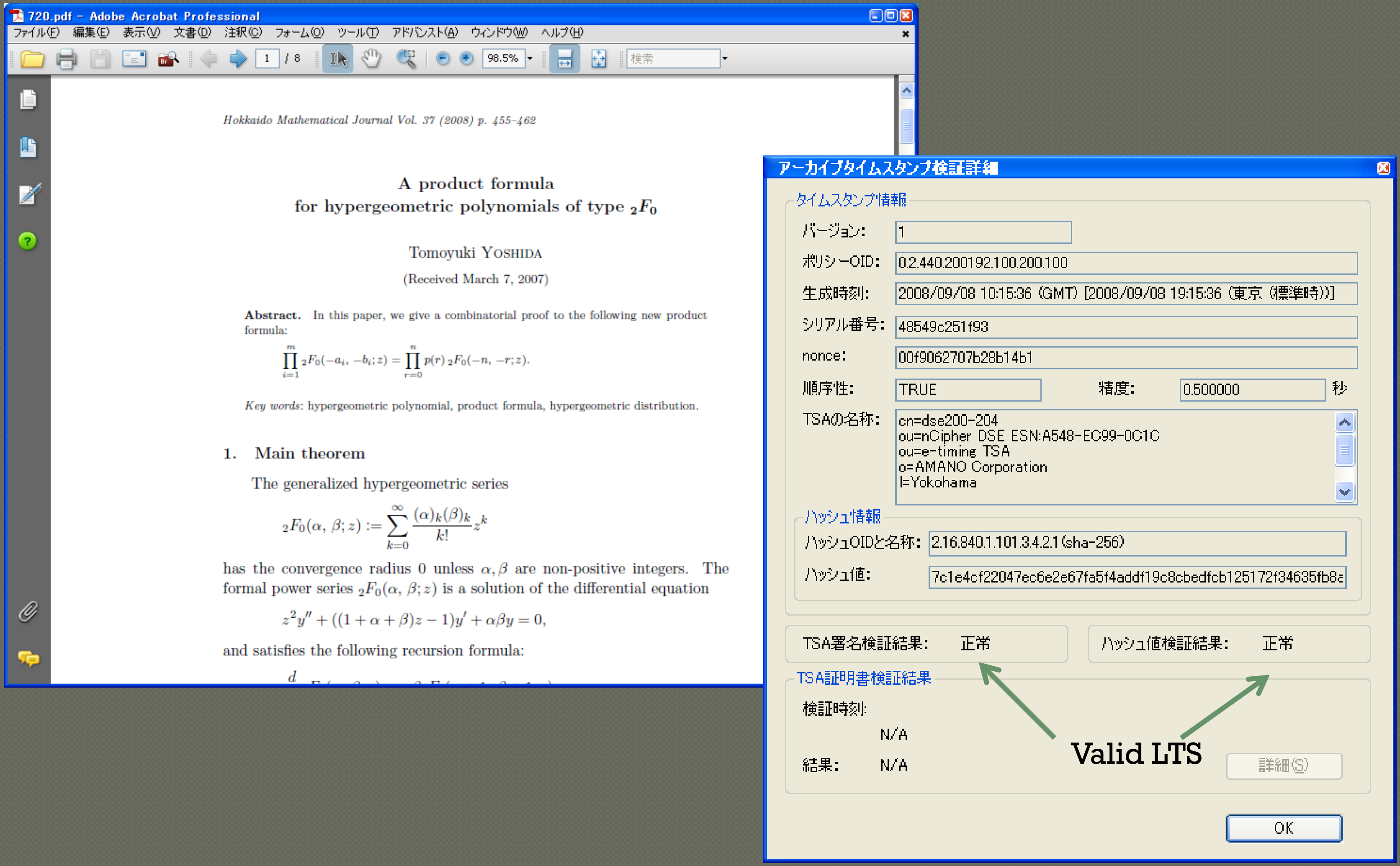
Long-term
Signatured PDF

Long-term Sig

Archive

Long-term Signature Server

LTSed Fulltext PDF Sample


720.pdf - Adobe Acrobat Professional
ファイル(F) 編集(E) 表示(V) 文書(D) 注釈(C) フォーム(O) ツール(T) アドバンスト(A) ウィンドウ(W) ヘルプ(H)
1 / 8
98.5%
検索
アーカイブタイムスタンプ検証詳細
詳細(S)
OK

Hokkaido Mathematical Journal Vol. 37 (2008) p. 455–462

A product formula for hypergeometric polynomials of type $_2F_0$

Tomoyuki YOSHIDA

(Received March 7, 2007)

Abstract. In this paper, we give a combinatorial proof to the following new product formula:

$$\prod_{i=1}^{m} {}_2F_0(-a_i,\ -b_i; z) = \prod_{r=0}^{n} p(r)\, {}_2F_0(-n,\ -r; z).$$

Key words: hypergeometric polynomial, product formula, hypergeometric distribution.

1. Main theorem

The generalized hypergeometric series

$$ {}_2F_0(\alpha,\ \beta; z) := \sum_{k=0}^{\infty} \frac{(\alpha)_k(\beta)_k}{k!} z^k $$

has the convergence radius 0 unless α, β are non-positive integers. The formal power series $_2F_0(\alpha,\ \beta; z)$ is a solution of the differential equation

$$ z^2y'' + ((1+\alpha+\beta)z - 1)y' + \alpha\beta y = 0, $$

and satisfies the following recursion formula:

タイムスタンプ情報

バージョン: 1
ポリシーOID: 0.2.440.200192.100.200.100
生成時刻: 2008/09/08 10:15:36 (GMT) [2008/09/08 19:15:36 (東京 (標準時))]
シリアル番号: 48549c251f93
nonce: 00f9062707b28b14b1
順序性: TRUE 精度: 0.500000 秒
TSAの名称: cn=dse200-204
ou=nCipher DSE ESN:A548-EC99-0C1C
ou=e-timing TSA
o=AMANO Corporation
l=Yokohama

ハッシュ情報

ハッシュOIDと名称: 2.16.840.1.101.3.4.2.1 (sha-256)
ハッシュ値: 7c1e4cf22047ec6e2e67fa5f4addf19c8cbedfcb125172f34635fb8a

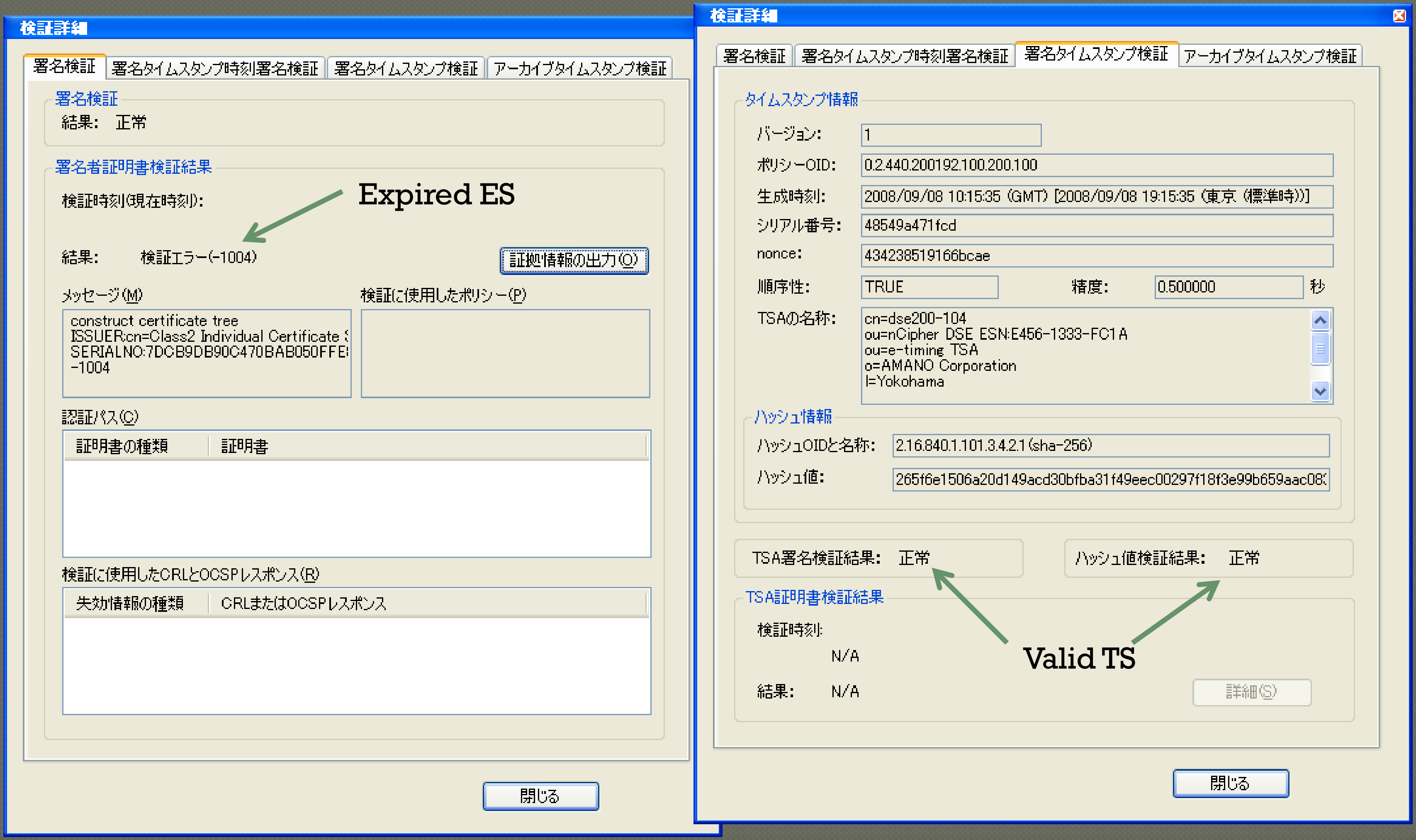
TSA署名検証結果: 正常
ハッシュ値検証結果: 正常

TSA証明書検証結果

検証時刻: N/A
結果: N/A

Valid LTS

Validation Example



検証詳細

署名検証 | 署名タイムスタンプ時刻署名検証 | 署名タイムスタンプ検証 | アーカイブタイムスタンプ検証

署名検証

結果:　正常

署名者証明書検証結果

検証時刻(現在時刻):

結果:　検証エラー(-1004)

Expired ES

証拠情報の出力(O)

メッセージ(M)

```
construct certificate tree
ISSUER:cn=Class2 Individual Certificate :
SERIALNO:7DCB9DB90C470BAB050FFE
-1004
```

検証に使用したポリシー(P)

認証パス(C)

証明書の種類	証明書

検証に使用したCRLとOCSPレスポンス(R)

失効情報の種類	CRLまたはOCSPレスポンス

閉じる

検証詳細

署名検証 | 署名タイムスタンプ時刻署名検証 | 署名タイムスタンプ検証 | アーカイブタイムスタンプ検証

タイムスタンプ情報

バージョン: 1

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生成時刻: 2008/09/08 10:15:35 (GMT) [2008/09/08 19:15:35 (東京 (標準時))]

シリアル番号: 48549a471fcd

nonce: 434238519166bcae

順序性: TRUE　精度: 0.500000 秒

TSAの名称:
cn=dse200-104
ou=nCipher DSE ESN:E456-1333-FC1A
ou=e-timing TSA
o=AMANO Corporation
l=Yokohama

ハッシュ情報

ハッシュOIDと名称: 2.16.840.1.101.3.4.2.1 (sha-256)

ハッシュ値: 265f6e1506a20d149acd30bfba31f49eec00297f18f3e99b659aac08

TSA署名検証結果:　正常

ハッシュ値検証結果:　正常

Valid TS

TSA証明書検証結果

検証時刻:
N/A

結果:　N/A

詳細(S)

閉じる

Discussion

- Using Long-Term Signature technology published date and contents of full text PDF for electronic journal articles are certified.
- It works well even after embedded ES was expired.