Lightweight Syntax Structure for Describe Data to Transfer over Internet of Things Devices

Ryan Donghan Kwon[O1], JunSeob Shin[2], Do Hyun Lim[2]
[1]Hana Academy Seoul, [2]Korea Science Academy of KAIST

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Abstract

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- 이기종 기기간 통신이 이루어지는 IoT 환경에서 데이터 교환을 위하여 내용과 구조를 정의
- 기존 ASN.1 표준은 데이터 구조의 표현에 초점이 맞추어져 있음
- 직관적이지 않고, 유연한 데이터 구조의 사용이 불가능하며 컴파일 단계를 거쳐야 함
- 데이터 구조가 유동적일 경우 컴파일 과정으로 인하여 통신 오버헤드가 발생

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On IoT Environment...
Internet of Things

- IoT - Internet of Things

Communication between Heterogeneous IoT Devices

Abstract Syntax Notation One

- ASN.1 - Abstract Syntax Notation One

```
Certificate  ::=  SEQUENCE  {
   tbsCertificate       TBSCertificate,
   signatureAlgorithm  AlgorithmIdentifier,
   signatureValue       BIT STRING  }

TBSCertificate  ::=  SEQUENCE  {
   version  [0] EXPLICIT Version DEFAULT v1,
   serialNumber CertificateSerialNumber,
   signature    AlgorithmIdentifier,
   issuer       Name,
   validity     Validity,
   subject      Name,
   (...)  }
```

표1. ASN.1을 통한 자료의 표현 예시

```
academy: dict = {
    name: TEXT = “Korea Science Academy”;
    foundation: TEXT = “09/06”;
    principal: TEXT = “Final Boat”;
    location: LIST = [INT: 00, INT: 21];
    float_number: REAL = 123.4;
};

developer: TEXT(3) = [
    “Ryan”, “JunSeob”, “Shio”,
];
```

표2. LSD를 사용한 데이터의 표현 예시

Definitions and Specifications of LSD

Lightweight Syntax Structure for Describe Data

- General Datatype
- `null, int8, int16, int32, int64, uint8, uint16, uint32, uint64, float16, float32, float64, bool, char, uchar, dict, list`
- Wrapped Datatype
- `INTEGER, REAL, TEXT, BLOB, REAL, DICT, LIST`

Grammatical Structure of LSD

Lightweight Syntax Structure for Describe Data

- `data_name: DATATYPE = data;`
- `list_name: DATATYPE(length) = [...];`
- string - `'~'`, Dict - `{~}`, List - `[~]`;
- space (except between `'~'`) can be ignored.

Mock of Data Transfer between Devices

Implementation of CANSAT for gathering information to assist artillery fire. KSAS, 2022.

- CANSAT Data

```
payload: dict = {
    ALTM: int4(10) = [
    64, 48, 46, 47, 44, 11, 21, 91, 74, 0x74
    ];
    DTLM4: bool(32) = [1,1,1,1,1,1,1,1,0,];
    CAN_TIME: TEXT = "15:28:07";
    RUN_TIME: TEXT = "00:00:09";
    IMU: REAL(3) = [-86.72, -44.99, 36.27];
    image: blob = (...);
};
cansat_detail: TEXT = "KSAT_포병";
```

표4. LSD를 통해 표현된 CANSAT-지상관제 통신 데이터

```
payload ::= SEQUENCE {
  ATLM     SEQUENCE OF INTEGER,
  DTLM4    BOOLEAN,
  CAN_TIME TIME-OF-DAY,
  RUN_TIME TIME-OF-DAY,
  IMU      SEQUENCE OF REAL,
  Image    OCTET STRING
}

Cansat_detail ::= UTF8String
```

```
data payload ::= {
  ALTM     {
    64, 48, 46, 47, 44, 11, 21, 91, 74, 0x74
    },
  DTLM4    {1,1,1,1,1,1,1,1,0,},
  CAN_TIME "15:28:07",
  RUN_TIME "00:00:09",
  IMU      {-86.72, -44.99, 36.27},
  Image    (...)
}
```

Mock of Data Transfer between Devices

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- CANSAT Data
- 위성 데이터 자료를 일관성 있게 통신 및 저장한다.
- 디코딩 및 Edge단 컴파일에서 발생하는 오버헤드를 절감한다.

Mock of Data Transfer between Devices

Implementation of CANSAT for gathering information to assist artillery fire. KSAS, 2022.

- CANSAT Data

```
Raspberry Pi 4 Model B
CPU – Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
MEM – 4GB LPDDR4-3200 SDRAM
```

표6. IoT Process를 모사한 기기 제원

Mock of Data Transfer between Devices

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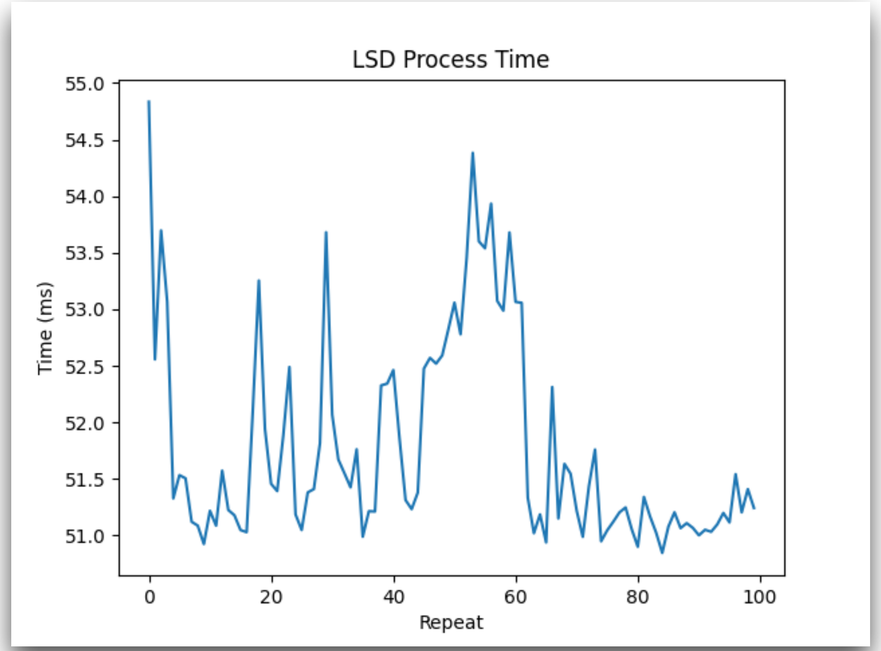
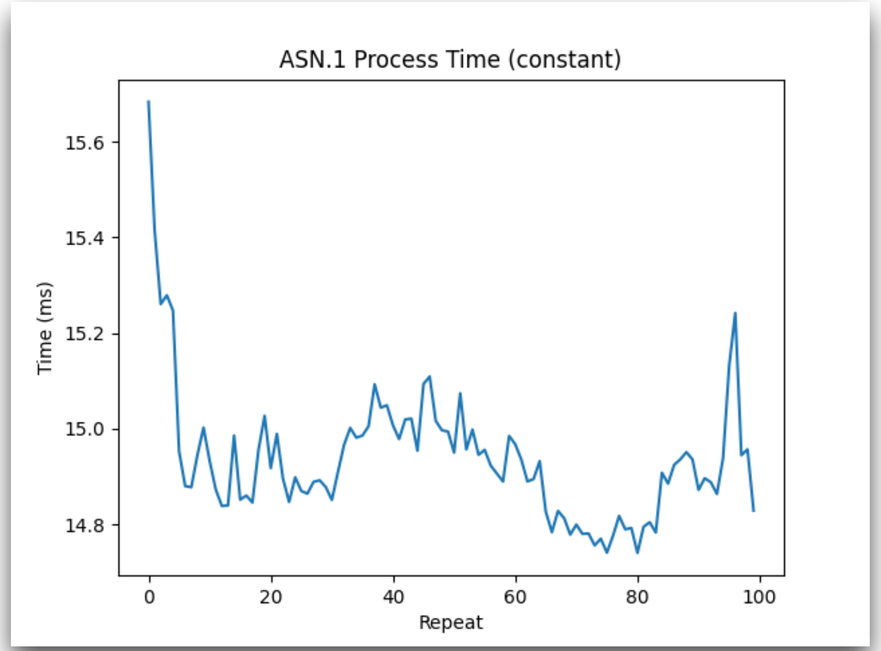
- LSD - ASN.1 Comparison in Data of Constant Structure





Mock of Data Transfer between Devices

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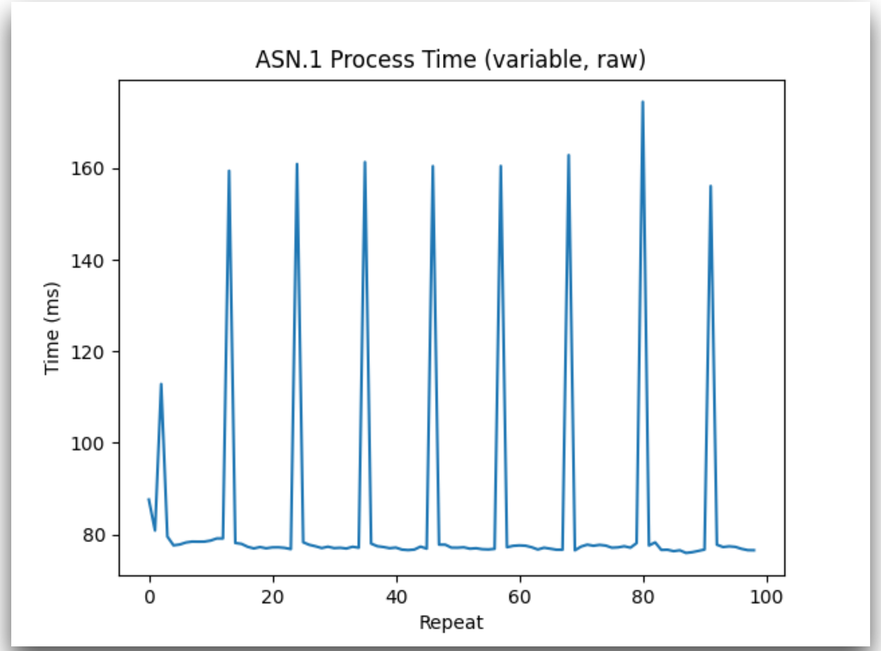
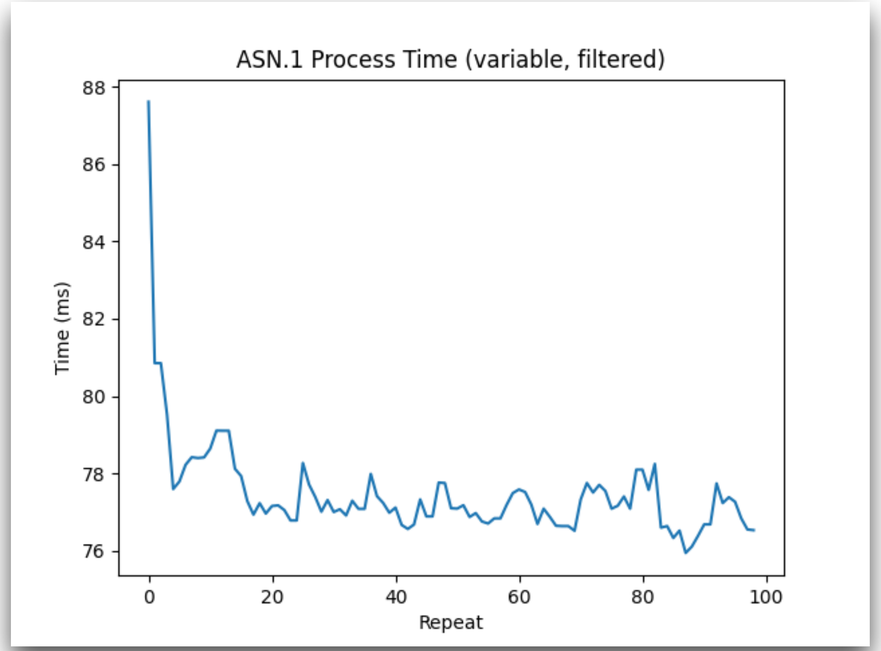
- ASN.1 Process Time in Data of Variable Structure





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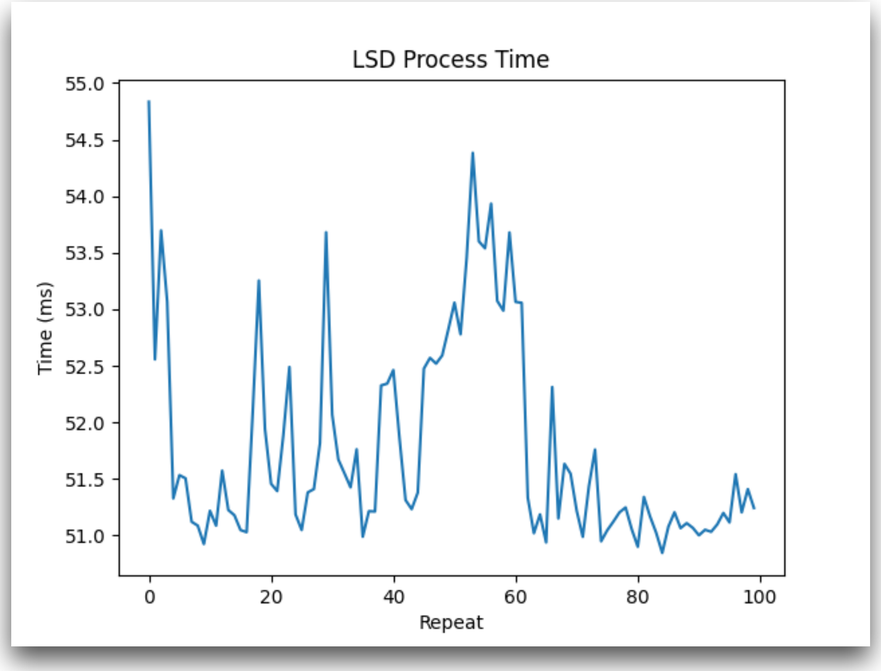
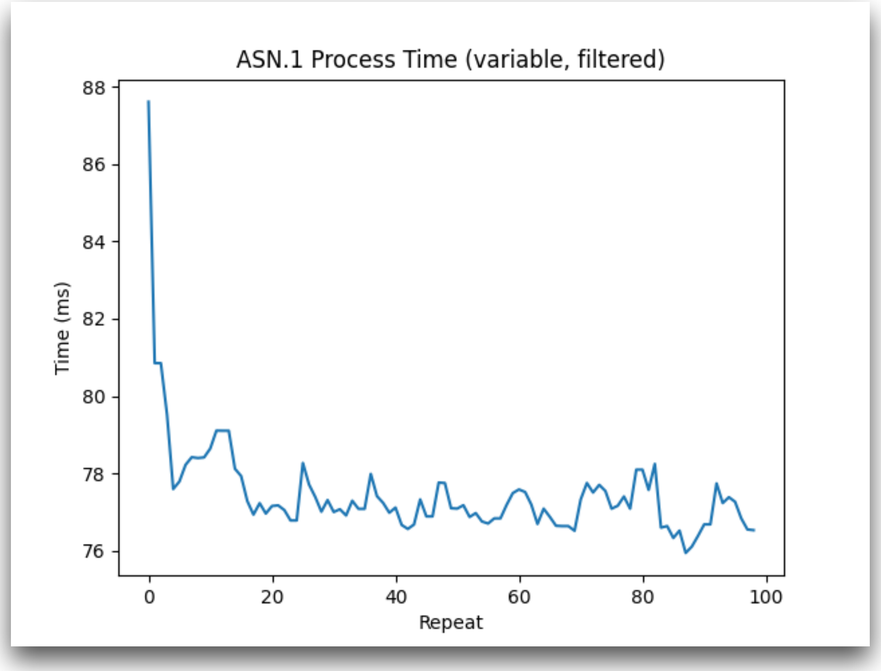
- LSD - ASN.1 Comparison in Data of Variable Structure





Conclusion

Lightweight Syntax Structure for Describe Data to Transfer over Internet of Things Devices

- 플랫폼 간 데이터 고정 자료형의 준수
- 데이터의 일관성 준수 및 가독성의 개선
- 이기종 IoT 통신 시 사용되는 프로토콜의 정립
- 유동적인 구조의 데이터 교환시 성능 개선

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