Data packets

Module Description

In this module, we will learn about the Data packet. What are the main fields inside the Data packet, how it is communicated in the NDN network, and how it is handled by the NDN forwarder.

Procedure

What is a Data packet?

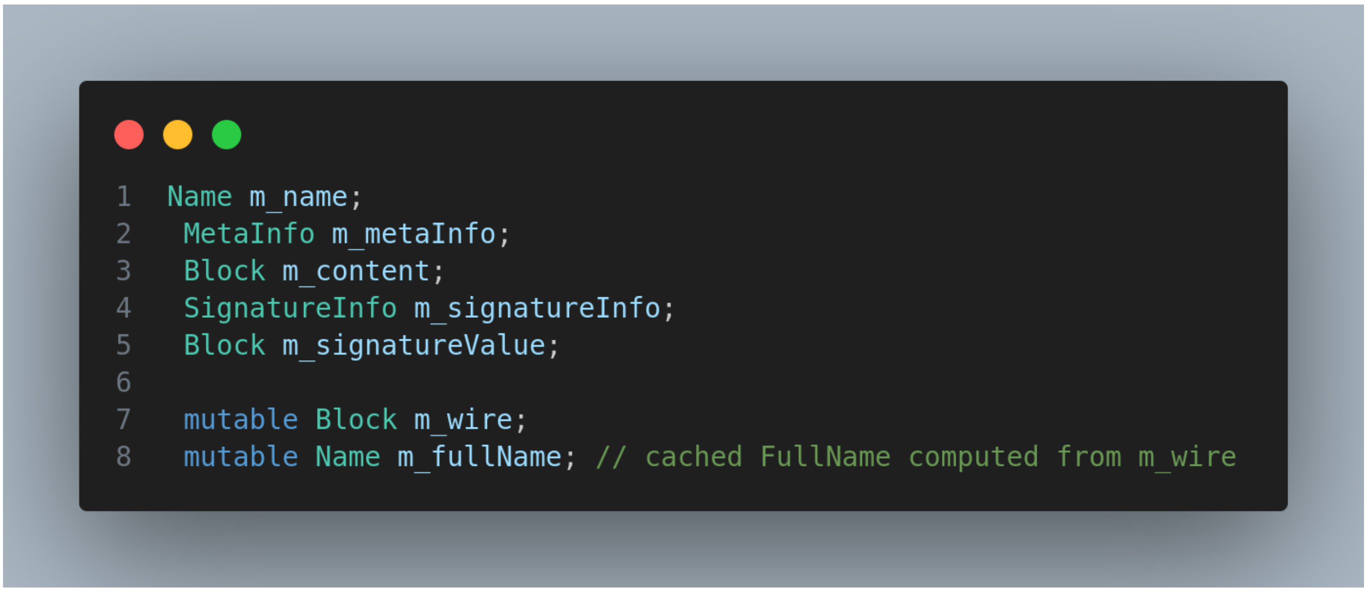
A Data packet is a packet that is used by the producer to send data to the consumer. It can of any type, it can be a video, audio, text, etc. and of any size.

Data packet is implemented by `Data` class in data.hpp

What are the main fields inside the Data packet?

The main fields inside the Data packet are:

1. Name
2. Meta Info
3. Content
4. Signature



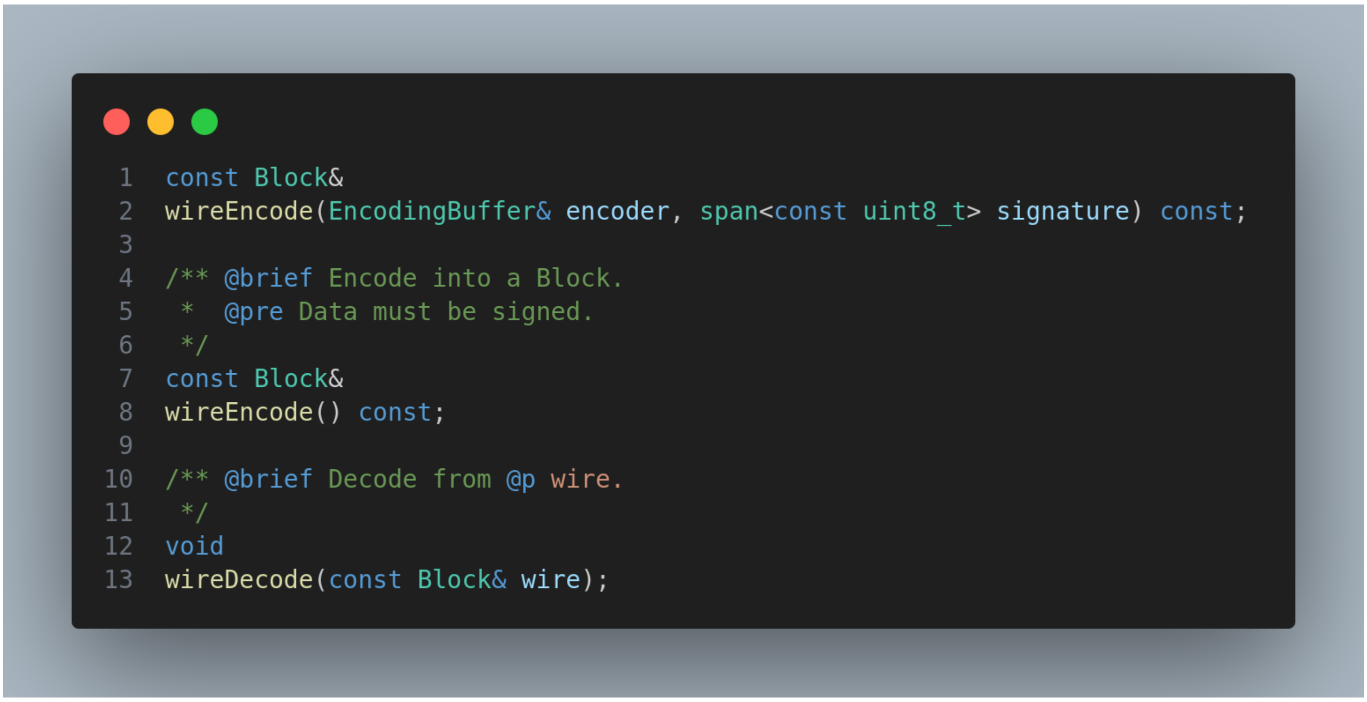
```
Name m_name;
 MetaInfo m_metaInfo;
 Block m_content;
 SignatureInfo m_signatureInfo;
 Block m_signatureValue;

 mutable Block m_wire;
 mutable Name m_fullName; // cached FullName computed from m_wire
```

Taken from the private field section of the Data class.

The keyword `mutable` is used to specify that the field can be changed by const methods.

To understand the use, we must understand the use of constant function in c++.

We will understand this concept using an example from this class. `Data` class has many fields and we don't want some function (i.e `wireEncode`) to change the values of user set variables. But when encoding the private variables set by the user, we use `wireEncode` function which shouldn't change the value of user set variables. But the output of encoding is itself a member variable. Thus we want to change only that particular variable and not the user set variables. Thus we use `mutable` keyword.



```
const Block&
wireEncode(EncodingBuffer& encoder, span<const uint8_t> signature) const;

/** @brief Encode into a Block.
 *  @pre Data must be signed.
 */
const Block&
wireEncode() const;

/** @brief Decode from @p wire.
 */
void
wireDecode(const Block& wire);
```

See the constant keyword used in the `wireEncode` function. Also notice the absence of constant keyword in the `wireEncode` function of `Interest` class of signature

```
void wireEncode(const Block& wire);
```

Here, we didn't use the const keyword because we want to change the value of the user set variables by decoding the wire format of the Data packet.

How is Data packet communicated in the NDN network?

Data packet is processed in the same way as the Interest packet. The only difference is that the Data packet is sent by the producer to the consumer.

The Data packet is converted into `Block` format which defines ndn specific TLV format and then it is sent to the network using the `Face` class.

The `Forwarder` uses different set of methods to handle the incoming Data packet. The methods are:

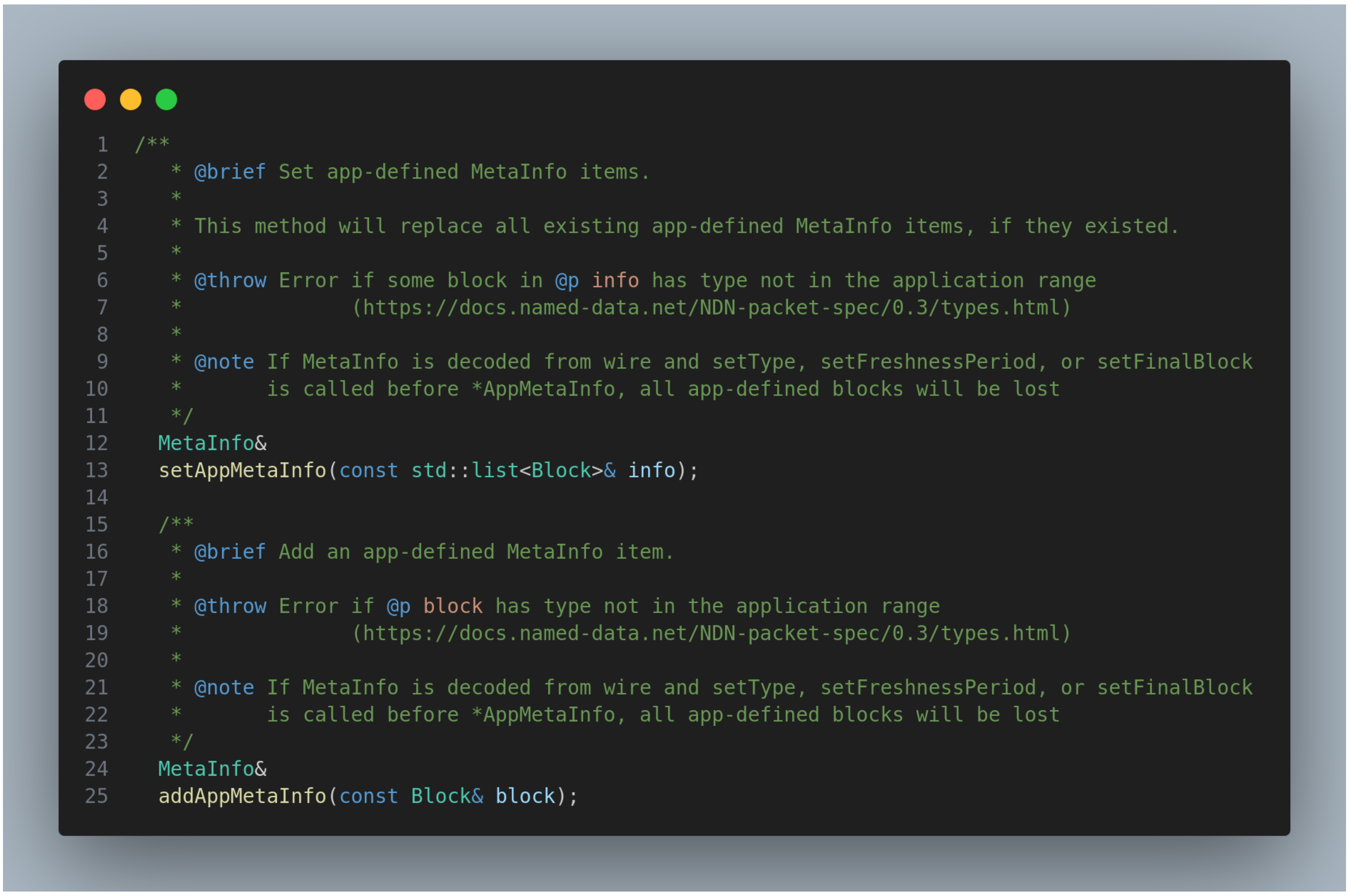
```
void
   onIncomingData(const Data& data, const FaceEndpoint& ingress);

void
    onOutgoingData(const Data& data, const FaceEndpoint& egress);
```

The use of the methods can be understood from the name itself.

The Data class also contains MetaInfo class which contains the meta information about the Data packet content. The MetaInfo class contains the following fields:

1. ContentType
2. FreshnessPeriod
3. FinalBlockId
4. OtherTypeCode

To set the value of the MetaInfo class, we use the setAppMetaInfo method and addAppMetaInfo of the Data class.



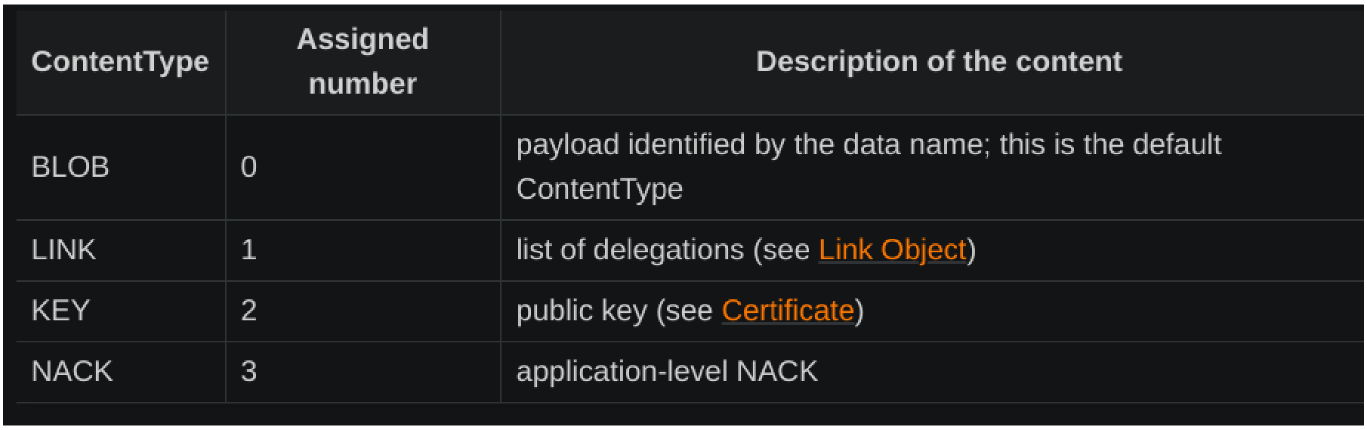
```
/**
   * @brief Set app-defined MetaInfo items.
   *
   * This method will replace all existing app-defined MetaInfo items, if they existed.
   *
   * @throw Error if some block in @p info has type not in the application range
   *              (https://docs.named-data.net/NDN-packet-spec/0.3/types.html)
   *
   * @note If MetaInfo is decoded from wire and setType, setFreshnessPeriod, or setFinalBlock
   *       is called before *AppMetaInfo, all app-defined blocks will be lost
   */
  MetaInfo&
  setAppMetaInfo(const std::list<Block>& info);

  /**
   * @brief Add an app-defined MetaInfo item.
   *
   * @throw Error if @p block has type not in the application range
   *              (https://docs.named-data.net/NDN-packet-spec/0.3/types.html)
   *
   * @note If MetaInfo is decoded from wire and setType, setFreshnessPeriod, or setFinalBlock
   *       is called before *AppMetaInfo, all app-defined blocks will be lost
   */
  MetaInfo&
  addAppMetaInfo(const Block& block);
```

Each component of the MetaInfo class is considered as separate TLV field. The ContentType is of type uint32_t and is represented by the TLV type 0x18. The FreshnessPeriod is of type uint64_t and is represented by the TLV type 0x19. The FinalBlockId is of type Name and is represented by the TLV type 0x1a. The OtherTypeCode is of type Block and is represented by the TLV type 0x1b.

Thus we were able to add new field in the MetaInfo of the Data packet.

Types of Data packets

There are not theoretically different but technically same. The types of Data packets are:



ContentType	Assigned number	Description of the content
BLOB	0	payload identified by the data name; this is the default ContentType
LINK	1	list of delegations (see Link Object)
KEY	2	public key (see Certificate)
NACK	3	application-level NACK

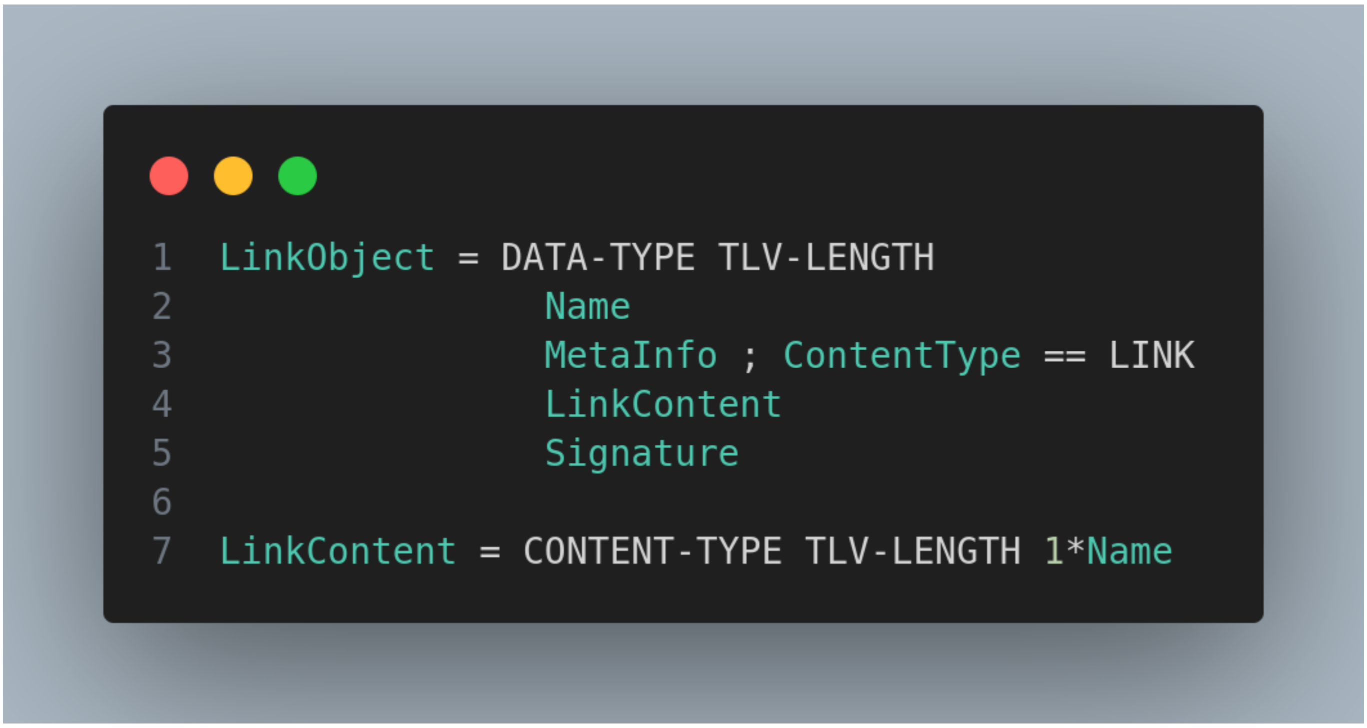
source: NDN packet specification

Normal Data packet

Normal Data packet is the Data packet that is sent by the producer to the consumer. It contains the content requested by the consumer.

Link Object

Link object doesn't carry any content to the user.It carries a list of one or more names (formerly known as “delegations”). These delegations are name of the ISP that host the data content required. SO, assume a case where the data producer is not able to announce globally their presence but the consumer is aware of it. So in this case, the consumer shall add the ISP name in the `Interest` packet that can be used by the intermediate routers to forward the Interest packet to the corresponding ISP who host the data content.



```
LinkObject = DATA-TYPE TLV-LENGTH
               Name
               MetaInfo ; ContentType == LINK
               LinkContent
               Signature

LinkContent = CONTENT-TYPE TLV-LENGTH 1*Name
```

See the TLV format of the Link Object.

Key

Key is the public key of the producer. It is used to verify the signature of the Data packet.

NACK

NACK is the negative acknowledgement. It is used to inform the consumer that the requested content is not available or when hop limit is exceeded.