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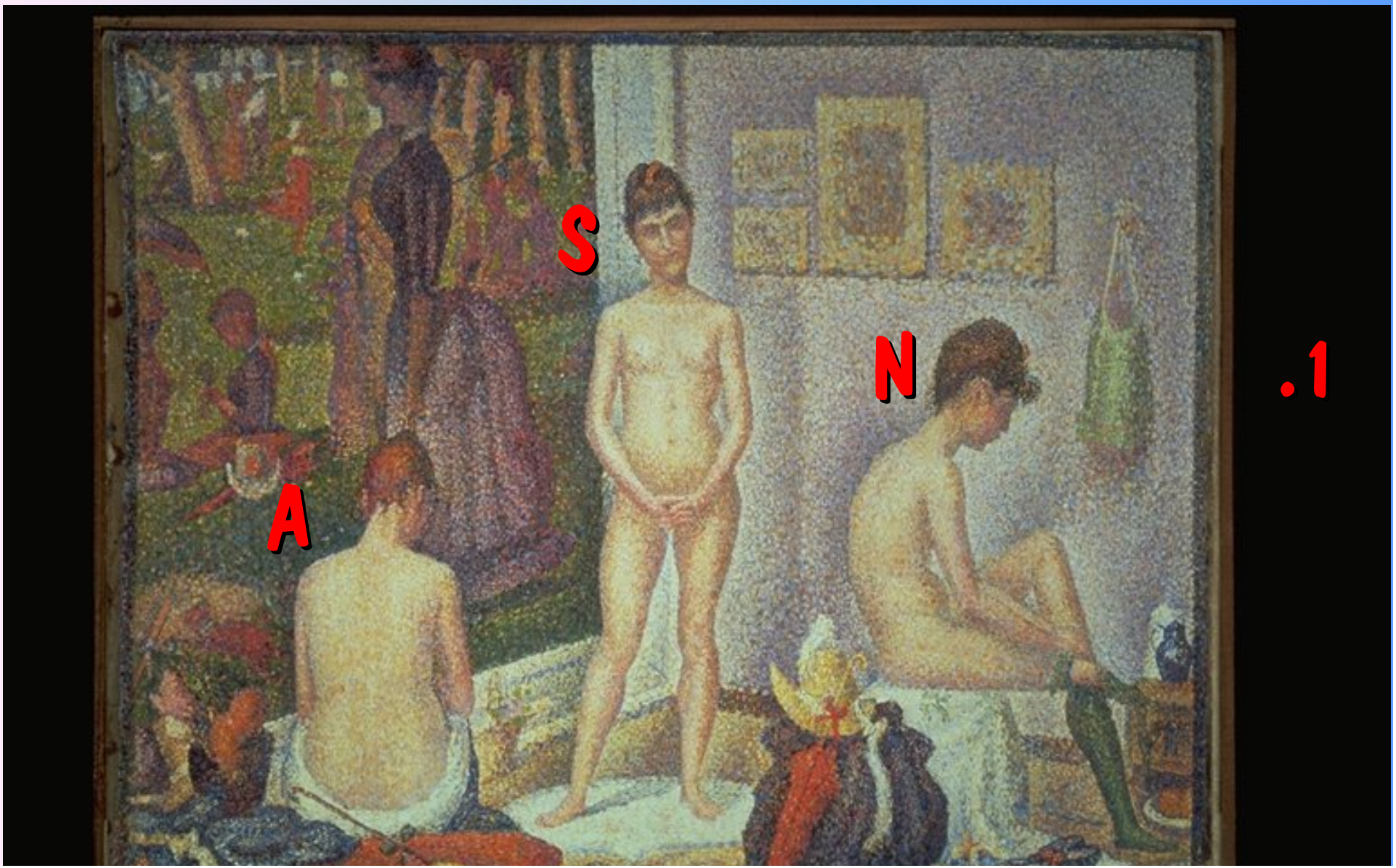
ASN.1 is getting sexy again!

or

ASN.1, XML, and Fast Web Services.

ASN.1 consortium

Whoops - did I mean that?



So – How Sexy?

- XML is sexy!
- Multiple layers of XML support in ASN.1
- Web Services is even more sexy!
- Fast Web Services are coming soon!

ASN.1 - lineage

- ASN.1 was borne around 1982 ish
- First ASN.1 Standard (CCITT X.409) in 1984
- Borne from X.400 (Mother with an early child, and the e-mail standard the world *should* have had!)
- Fathered by X.500 (Certified insane at birth, but totally secure)
- Grand-parents (OSI) died prematurely and are not discussed in polite conversation today
- Married XML, and begat Fast Web Services

A shorter history of protocol specification

The Montagues and the Capulets

(Contending Philosophies)

(With apologies to William Shakespeare)

Understanding of protocol specification techniques

- 1.5 billion seconds ago …..
  Computers started to communicate
- Major advances every 150 million seconds
- There was a need for
  - A means of syntax (data structure) specification
  - Procedure (sequence) specification
  - Test suite specification
  - Validation
- And tools to support rapid implementation!

The Montagues and Capulets

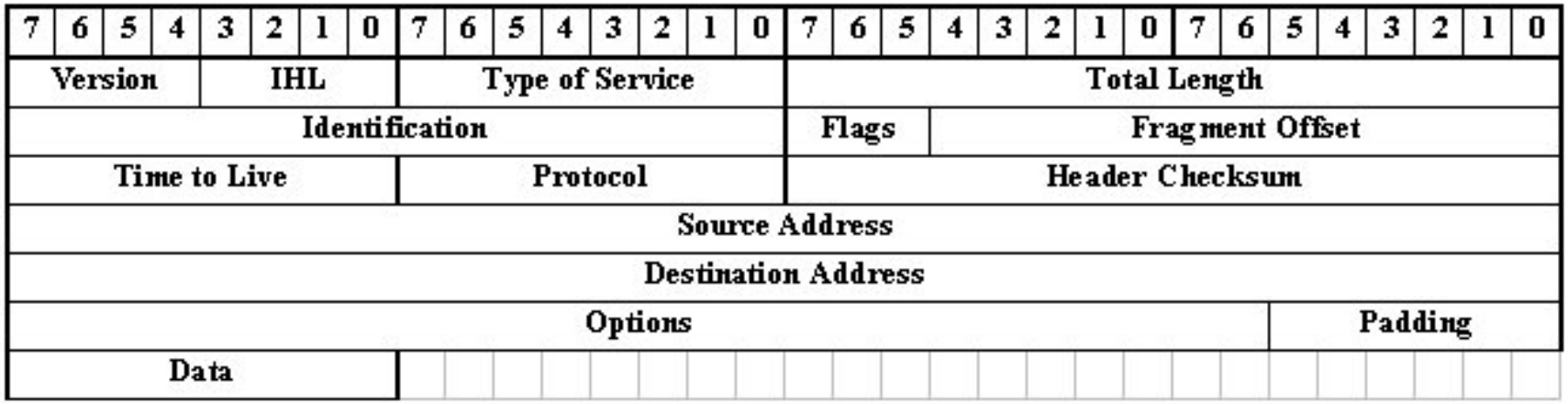
- **A long and on-going civil dispute**
- **Montagues =>**
  Binary-based specification
- **Capulets =>**
  Character-based specification

With apologies to William Shakespeare
and to those from a non-UK culture!

The stone-age Montagues

Diagrams of bits and bytes - e.g. IPv4

(The earliest approach, simple and clear, but focusing totally on the bits-on-the-line.)



Tool support not possible - but see ECN discussion.

Extensibility support crude - based on reserved fields.

The stone-age Capulets

- Simple “command lines” – in ASCII!
- Three character mnemonics and error codes (eg “200 OK”)
- Simple comma-separated parameters
- Good for simple dialogues
- Extensibility by adding commands in V2, with unknown commands ignored by V1 systems

The Bronze Age Montagues invent TLV and Tabular Notation

- Each PDU and each parameter has an ID (or Type), a Length, and a Value
- Tables list each parameter: Tabular Notation

Connect Message format

Parameter ID	Length	Optionality	Semantics
Version	1 octet	Mandatory	See para 14.2
Priority	1 octet	Optional (default 0)	See para 14.3
Called address	Variable	Mandatory	See para 14.4
Calling address	Variable	Mandatory	See para 14.5
Additional information	Variable	Optional	See para 14.6

And Yuck – we are still going this route in 2003!

Tabular Notation and TLV was a break-through – should have been patented!

- **Extensibility was EXCELLENT.**
- **Version 1 systems just skipped (using TLV) anything they did not know.**
- **Tool-support, however, not possible.**
- **But it was verbose!**

But not as verbose as the character-based encoding used by the Capulets!

The Bronze Age Capulets invent BNF

- The Capulets' main concern was with precise specification of correct syntax
- This was the dawning of Backus Naur Form (BNF).
- This potentially allowed more complex information to be specified in a "command".
- But it never really made it to the modern era of **automatic** mapping to Java, C++ etc.

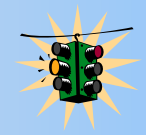
150 Million seconds after the Bronze Age

- **Recognition of:**
  - **Separation of abstract and transfer syntax**
  - **(This is jargon for "content definition" and "encoding" or "syntax")**
  - **Encoding rules**
- **ASN.1 specs define a de facto API (message content)**
- **Tools emerge to support the transformation of ASN.1 to an API, and the encoding of data across that API**
- **Profits for all! ASN.1 gets really Sexy!**

ASN.1 deployment

- **Wide use in a large range of industries:**
  - **Keeping the lights burning**
  - **Portable phones – we need them**
  - **Birthday presents on time**
  - **Traffic lights**
  - **Aircraft fly safely**
  - **Multimedia standards**
- **Many other industrial sectors**
  - **Most recently, biometrics**



Without ASN.1:

- The lights go out!
- Portable phones don't work!
- Parcels get lost!
- Traffic lights fail!
- Aircraft fall from the sky!
- Your impending marriage suffers as NetMeeting fails!






On second thoughts – it might be a better world?

The emergence of ECN

- Ambitious
- Use ASN.1 with a formal encoding notation to define any (binary) protocol
- ETSI-funded
- Took off slowly
- But very much still of interest
- Not the subject for today, but gives transition from ad hoc binary to XML encoding

300 Million seconds later, the Capulets develop XML

- Focus still on what is correct syntax, not content
- (This is still bad. What is syntax variation and what is a difference in the message? Covert channels.)
- Came out of SGML and HTML
- The “X” does not mean eXtensibility”
- Essentially a TLV style of encoding, but with human readable “<Start>….</End>” wrappers
- Rapidly gained popularity! Idiots can understand it! Oh dear!

And finally, after another Million seconds

- ASN.1 develops XML Encoding Rules
- “Coloring” added to allow control of (for example) attributes v elements

Romeo and Juliet marry!

EXAMPLES

(If you can't understand the examples at first glance, something is wrong!)

A simple invoice

```
Invoice ::= SEQUENCE {
        number          INTEGER,
        name            UTF8String,
        details         SEQUENCE OF
                          line-item  LineItemPair,
        charge          REAL,
        authenticator   BIT STRING}

LineItemPair ::= SEQUENCE {
        part-no         INTEGER,
        quantity        INTEGER }
```

LineItemPair in XSD!

```
<xsd:complexType  name="LineItemPair">
   <xsd:sequence>
      <xsd:element
            name="part-no"  type="xsd:number"/>
      <xsd:element
            name="quantity" type="xsd:number"/>
    </xsd:sequence>
</xsd:complexType>
```

Compare:

```
LineItemPair ::= SEQUENCE {
        part-no          INTEGER,
        quantity         INTEGER }
```

How sexy is that – half the size!

ASN.1 consortium

An example Invoice (1)

```
<Invoice>
        <number>32950</number>
        <name>funny-name with &lt;</name>
        <details>
                <line-item>
                        <part-no>296</part-no>
                        <quantity>2</quantity>
                </line-item>
```

Cont

An example Invoice (2)

Continuation

```
                    <line-item>
                        <part-no>4793</part-no>
                        <quantity>74</quantity>
                    </line-item>
                </details>
                <charge>397.65</charge>
                <authenticator>
                    EFF8 E976 5403 629F
                </authenticator>
            </Invoice>
```

A base-ball card defined

```
BBCard ::= SEQUENCE {
    name          IA5String (SIZE (1..60)),
    team          IA5String (SIZE (1..60)),
    age           INTEGER (1..100),
    position      IA5String (SIZE (1..60)),
    handedness ENUMERATED {
                      left-handed (0),
                      right-handed (1),
                      ambidextrous (2) },
    batting-average REAL }
```

A base-ball card value in XML syntax

```
<BBCard>
        <name>Jorge Posada</name>
        <team>New York Yankees</team>
        <age>29</age>
        <position>C</position>
        <handedness><right-handed/></handedness>
        <batting-average>0.277</batting-average>
</BBCard>
```

"Coloring" for different XML syntax

```
BBCard ::= SEQUENCE {
    name          [ATTRIBUTE] IA5String (SIZE (1..60)),
    team          [ATTRIBUTE] IA5String (SIZE (1..60)),
    age           INTEGER (1..100),
    position      IA5String (SIZE (1..60)),
    handedness [TEXT] ENUMERATED {
                  left-handed (0),
                  right-handed (1),
                  ambidextrous (2) },
    batting-average REAL }
```

The new XML syntax

```
<BBCard
        name = “Jorge Posada”
        team = “New York Yankees” >
        <age>29</age>
        <position>C</position>
        <handedness>right-handed</handedness>
        <batting-average>0.277</batting-average>
</BBCard>
```

The C data-structure for the base-ball card

```
typedef struct BBCard {
        char name [61] ;
        char team [61] ;
        short age ;
        char position [61] ;
        enum {
                left_handed = 0,
                right_handed = 1,
                ambidextrous = 2,
                } handedness ;
        float batting_average ;
} BBCard ;
```

A personnel-record defined (1)

```
PersonnelRecord ::= SEQUENCE {
    name            Name,
    title           VisibleString,
    number          EmployeeNumber,
    dateOfHire      Date,
    nameOfSpouse    Name,
    children        SEQUENCE OF
                        child    ChildInformation
                        DEFAULT {} }
```

A personnel-record defined (2)

```
ChildInformation ::= SEQUENCE {
                name        Name,
                dateOfBirth Date}
Name ::= SEQUENCE {
                givenName   VisibleString,
                initial     VisibleString,
                familyName  VisibleString}
EmployeeNumber ::= INTEGER
Date ::= VisibleString -- YYYYMMDD
```

An example personnel-record (1)

```
<PersonnelRecord>
    <name>
        <givenName>John</givenName>
        <initial>P</initial>
        <familyName>Smith</familyName>
    </name>
    <title>Director</title>
    <number>51</number>
    <dateOfHire>19710917</dateOfHire>
    <nameOfSpouse>
        <givenName>Mary</givenName>
        <initial>T</initial>
        <familyName>Smith</familyName>
    </nameOfSpouse
```


Cont

An example personnel-record (2)

```
<children>
   <child>
        <name>
              <givenName>Ralph</givenName>
              <initial>T</initial>
              <familyName>Smith</familyName>
        </name>
        <dateOfBirth>19571111</dateOfBirth>
   </child>
   <child>
        <name>
              <givenName>Susan</givenName>
              <initial>B</initial>
              <familyName>Jones</familyName>
        </name>
        <dateOfBirth>19590717</dateOfBirth>
   </child>
</children>
</PersonnelRecord>
```

A count of octets for the personnel-record value

- With white-space omitted, 653 octets
- Fully human-readable with white-space, can be double that! (Who cares?)
- BER 136 octets
- PER 94 octets (An unfriendly example?)
- ZIP compression …..
- But does size matter anyway? (Or transaction processing speed?)

ASN.1 support for XML – Basic and simple

- XML Encoding Rules
- A simple, fixed, encoding in XML for any type defined using ASN.1
- No use of attributes
- No use of Lists
- No use of xsi:type or xsi:nil
- No support for namespaces
- Simple and easy

Add XML Encoding Instructions

- Do not confuse with ECN – a similar but different concept
- Allows use of XML ATTRIBUTES
- Allows use of LIST for SEQUENCE OF
- Either a prefixed encoding instruction (like a TAG), or an encoding control section in the module
- Provides anything a right-minded person might want!

Now add MODIFIED-ENCODINGS

- Causes the ASN.1 XML encodings to be the same as XSD encodings for the same type
- For example, the BOOLEAN type encodes as
  - true or false
- And not as
  - <true/> or <false/>

Now add more encoding instructions

- Full support for anything you can do with XSD
- Yuck!
- Mapping from XSD to ASN.1 (X.694)
- Reverse not provided – politics!

ASN.1 is an XML Schema notation

- **MoU (ISO, IEC, ITU-T, UN/ECE and others) MG recommendation:**

  E-business standards should use both XSD and ASN.1 as XML Schema notations

- **OASIS UBL uses both XSD and ASN.1**
- **OASIS XCBF uses only ASN.1 as the Schema notation**

Web Services

- Machine-to-machine using Web protocols (SOAP wrappers)
- Flexible publishing of services (parameters etc) with WSDL
- Mapping into Java etc code
- XML encoded transfers

And now the REALLY sexy stuff

- *Fast* Web Services = ASN.1 and PER!
- Being promoted by SUN
- Progressing as ITU-T X.695 | ISO 8825-6
- Linked to binary encoding of XML data
- ASN.1 SOAP, ASN.1 encoding of the XML Infoset
- A new lease of life for ASN.1? Watch this space!

Binary XML – marriages again!

- Schema driven
- Schema-less
- Importance of the XML Infoset
- Simple compression
- Many options
- XSD -> ASN.1 -> PER

PER extensions

- Several aims – not yet mature
- Simplified ECN for common cases
- Better support for Binary XML:
  - Support for message fragments
  - Support for partial messages
  - Variable and partial compression
  - Namespace support
  - Added element support
- A further marriage – XML text goes into PER binary encodings

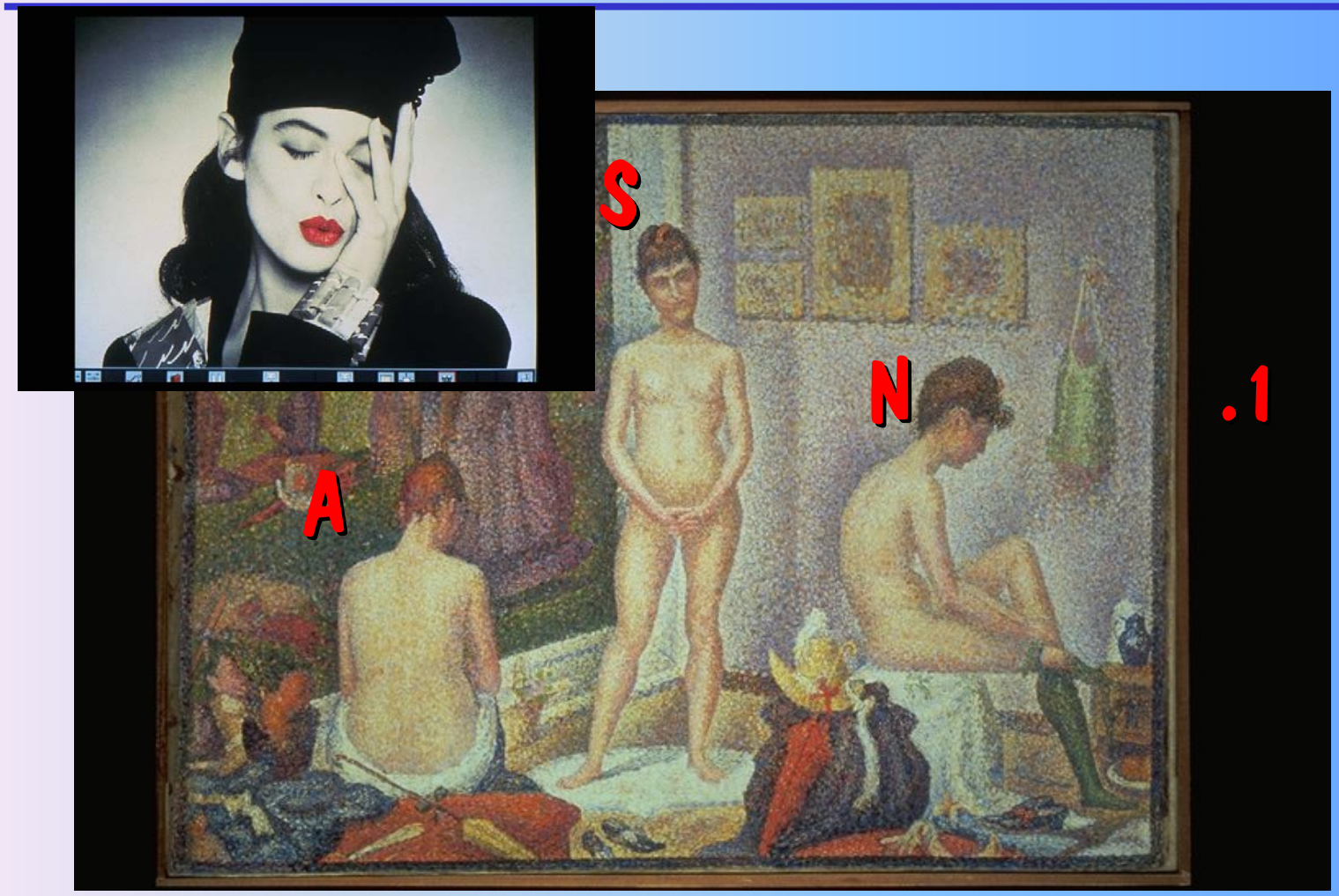
Syntax for specification

- Relax NG compact syntax – ASN.1-like
- Compact syntax for XSD under discussion
- XML syntax for ASN.1 under discussion
- UML class diagram syntax for ASN.1 – a UML profile – beginning (how sexy is UML?)
- So what are the differences? Why does the spec language matter?
  - A variety of encoding rules
  - Mappings to C, C++ Java
  - Efficient processing of messages
  - The language you love or hate!

In conclusion

- ASN.1 made major break-throughs in each of the last few decades
- The abstract syntax concept
- The Information Object concept (not discussed in this presentation)
- Embracing XML encodings
- ECN and then Encoding Instructions
- And now Fast Web Services
- How much more sexy (and useful!) can you get?

Whoops - not that again!



Finito!