WEB SERVICES FOR NETWORK MANAGEMENT

INTENAL DACS PRESENTATION
DECEMBER 1, 2004

BASED ON:

- "*COMPARING THE PERFORMANCE OF SNMP AND WEB SERVICES BASED MANAGEMENT*",
eTNSM, Vol.1 No.2 November 2004 (accepted for publication)

- "*WEB SERVICES FOR MANAGEMENT - HOW IS PERFORMANCE?*",
Presentation at the 17th IRTF-NMRG Meeting, November 14, 2004, Davis, USA

- "*WEB SERVICES FOR MANAGEMENT - A PERSONAL VIEW?*",
Tutorial at NOMS 2004, April 19, 2004, Seoul, Korea

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OVERVIEW

BACKGROUND

WHAT IS SNMP?

WHAT ARE WEB SERVICES?

PERFORMANCE

CONCLUSIONS

BACKGROUND

EXISTING MANAGEMENT PROTOCOLS:

- CLI (Command Line Interface) / TELNET - SSH
- SNMP / SMI / MIBS
- COPS-PR / SPPI / PIBs
- CIM / MOF / UML / PCIM
- HTTP / HTML
- XML

SNMP WIDELY USED FOR MONITORING

SNMP HARDLY USED FOR CONFIGURATION MANAGEMENT

BACKGROUND - 2

WEB SERVICES ARE THE MOST IMPORTANT MIDDLEWARE TECHNOLOGY

COULD IT BE USED FOR MANAGEMENT?

IF WEB SERVICES GET USED FOR MANAGEMENT
MANAGERS CAN CONCENTRATE ON MANAGEMENT APPLICATIONS

DISCUSSIONS ON THIS AT:
IAB WORKSHOP
VARIOUS IRTF-NMRG MEETINGS

MANY PEOPLE ASSUMED WEB-SERVICES PERFORMANCE
WOULD BE PROBLEMATIC

IETF DECIDED TO DEVELOP NETCONF

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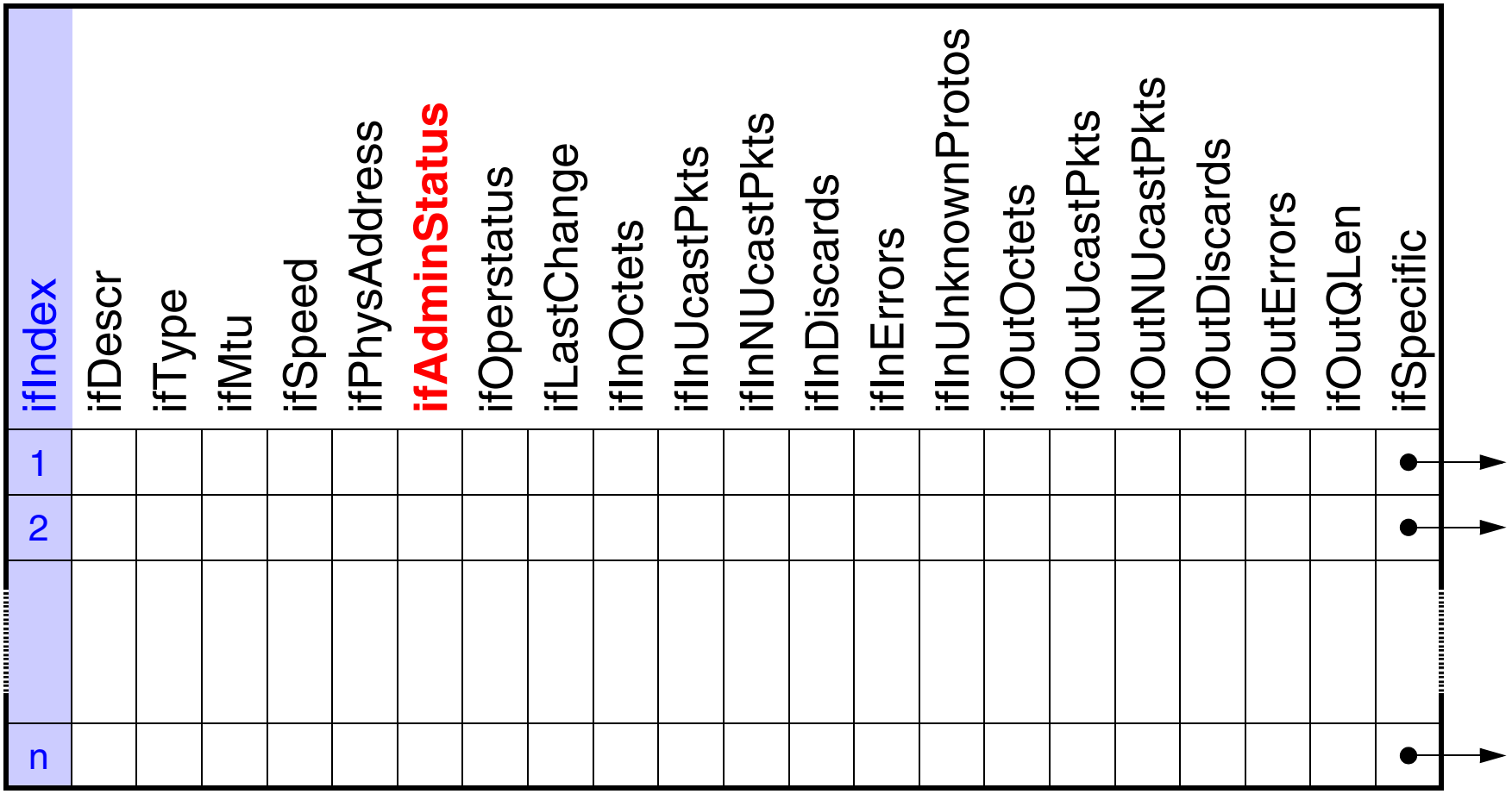
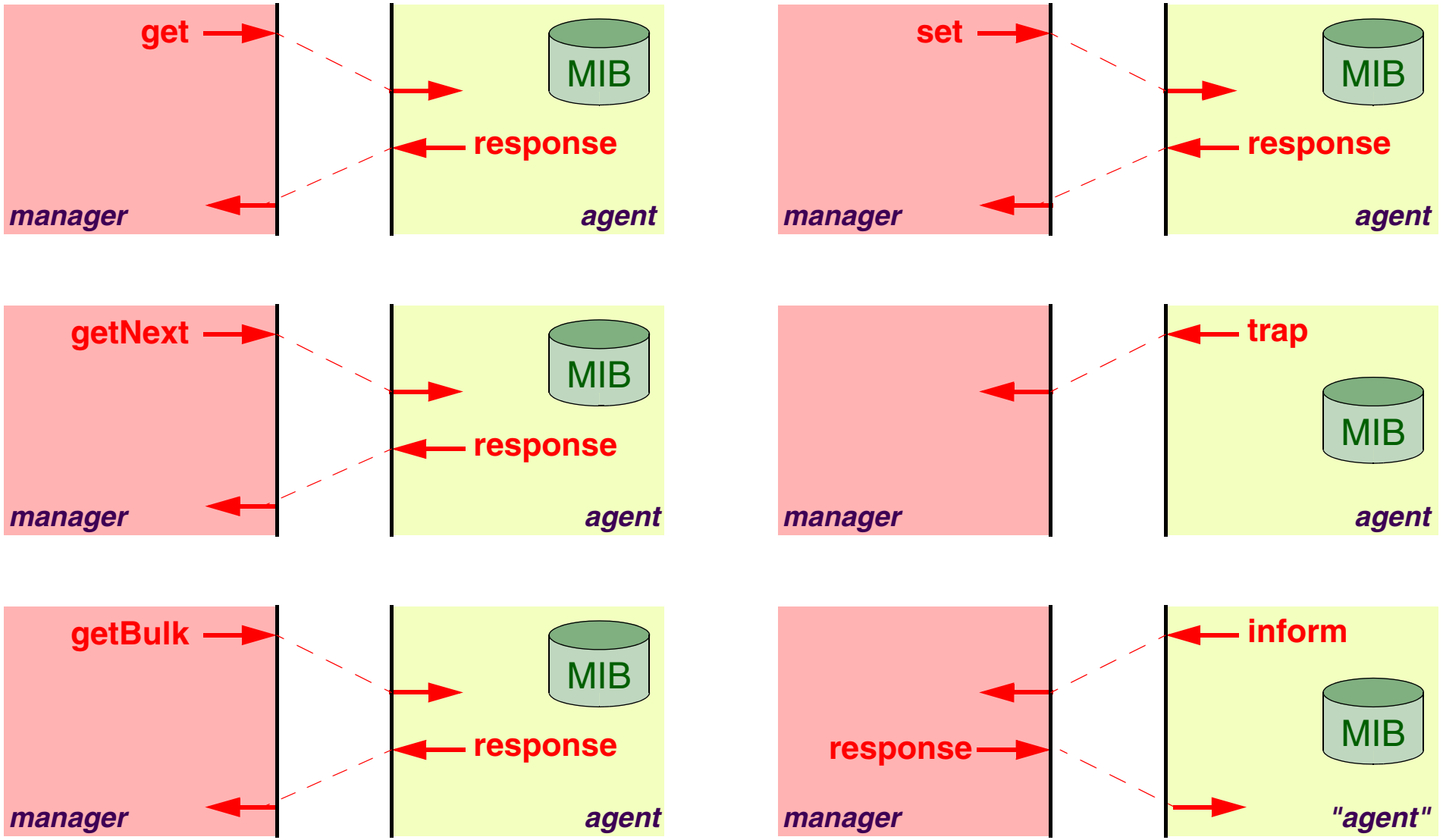
WHAT IS SNMP

example: ifTable OF MIB-II



WHAT IS SNMP - 2?



WHAT IS SNMP - 3?

variable bindings:

NAME *1*	VALUE *1*	NAME *2*	VALUE *2*	•••	•••	NAME *n*	VALUE *n*

SNMP PDU:

PDU TYPE*	REQUEST ID	ERROR STATUS	ERROR INDEX	VARIABLE BINDINGS

SNMP message:

VERSION	COMMUNITY	SNMP PDU

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WHAT ARE WEB SERVICES?

WEB SERVICES COMPONENTS

PROTOCOL STACK

MAIN W3C SPECIFICATIONS

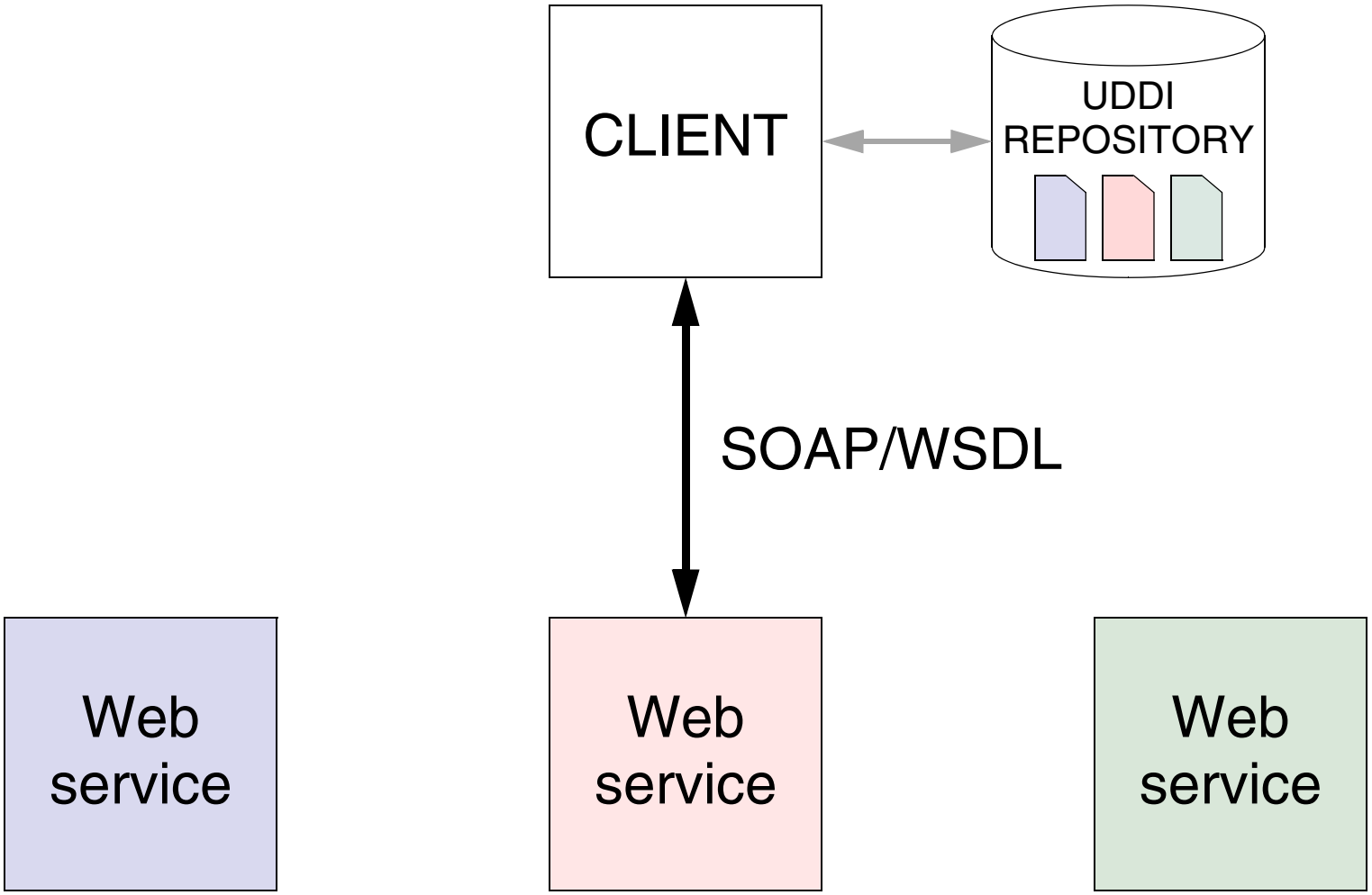
STRUCTURE WSDL DEFINITION

MESSAGE STRUCTURES

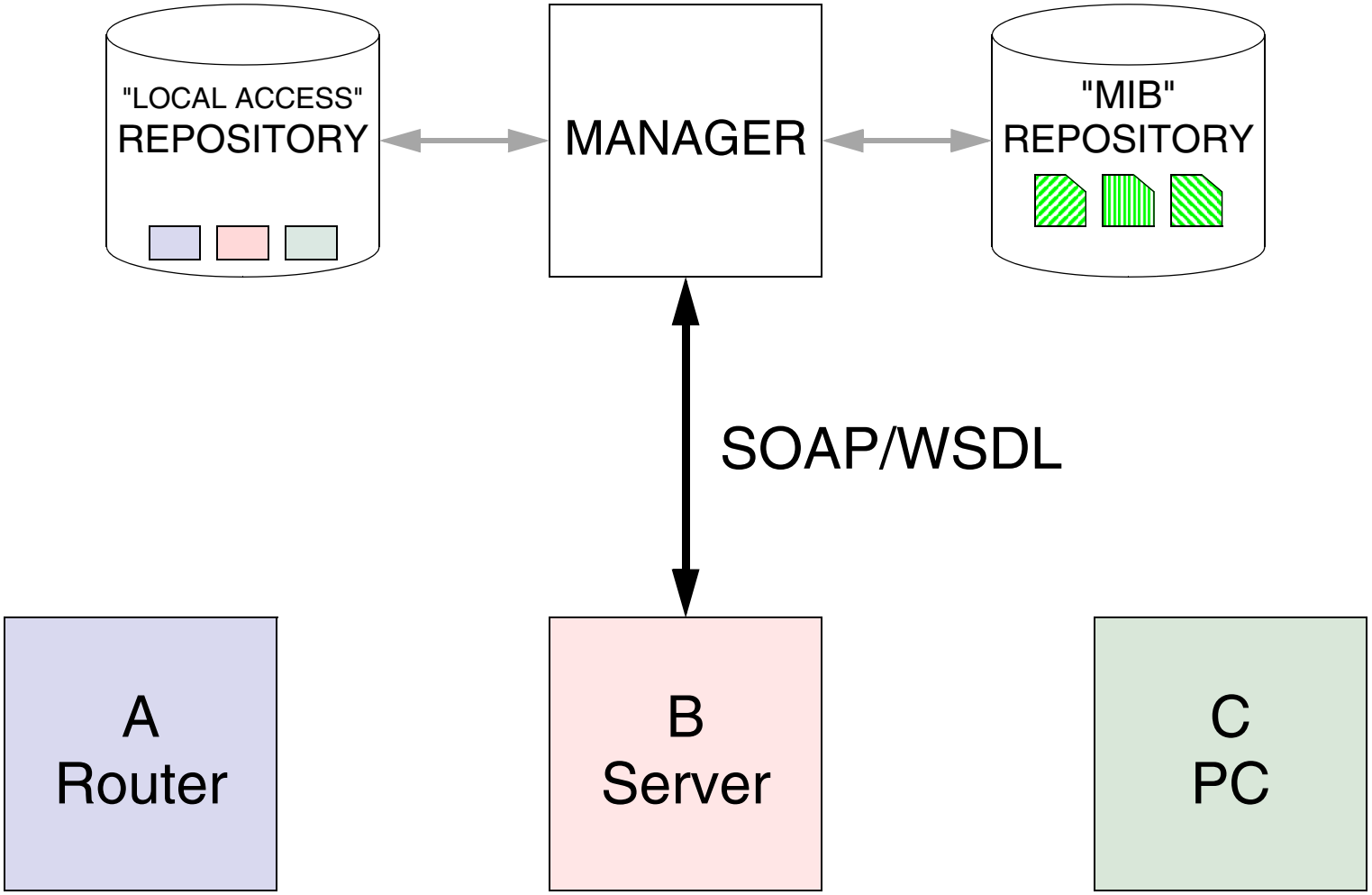
DATA TYPES

ADVANCED FEATURES

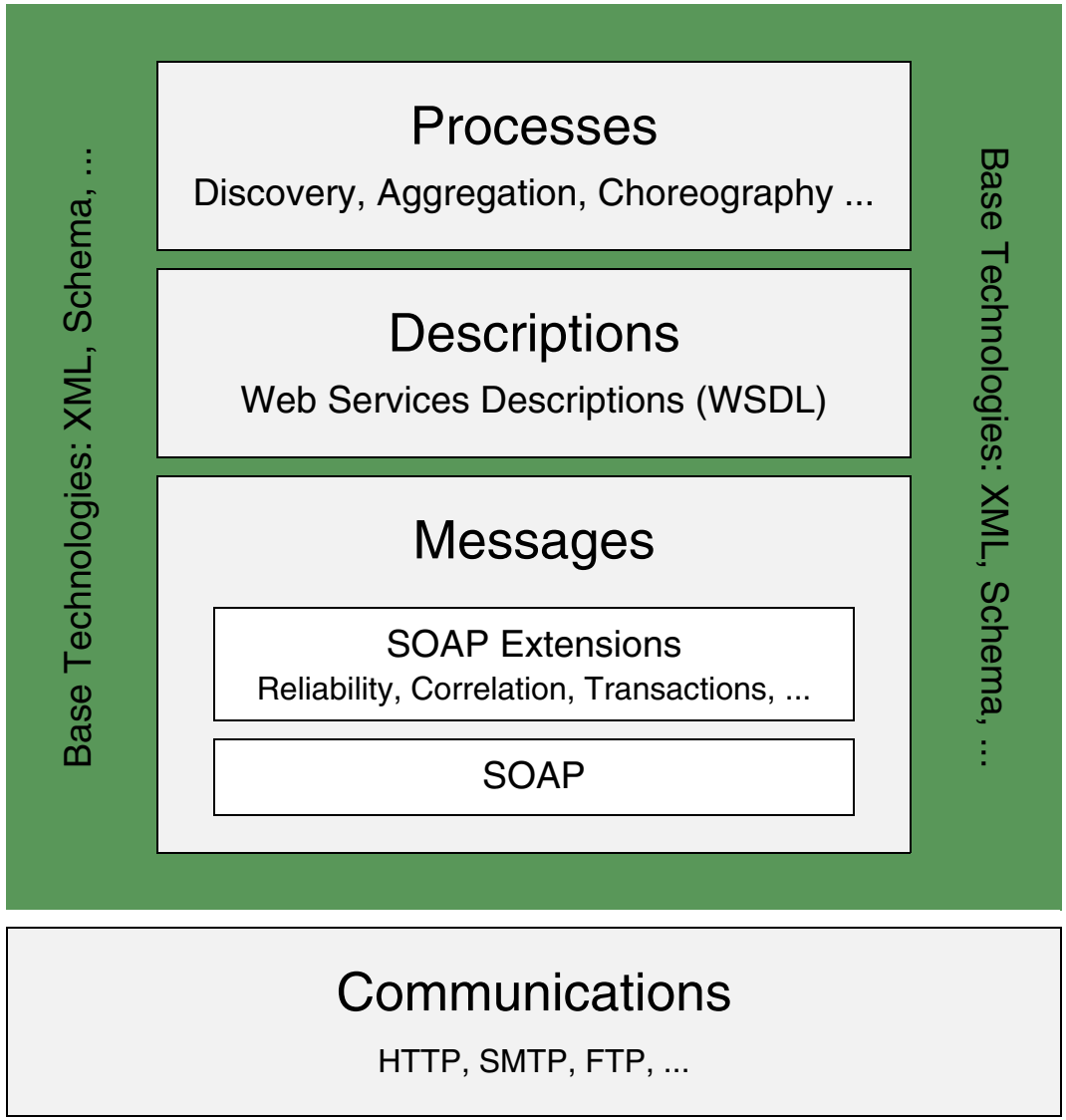
WEB SERVICES COMPONENTS



WEB SERVICES COMPONENTS FOR MANAGEMENT



STACK DIAGRAM



MAIN W3C DOCUMENTS

Web Services Description Language (WSDL)

Working Drafts - Version 2.0 - 2003

- Core Language
- Message Patterns
- Bindings
- Requirements
- Usage Scenarios

SOAP

Version 1.2 - W3C Recommendation - June 2003

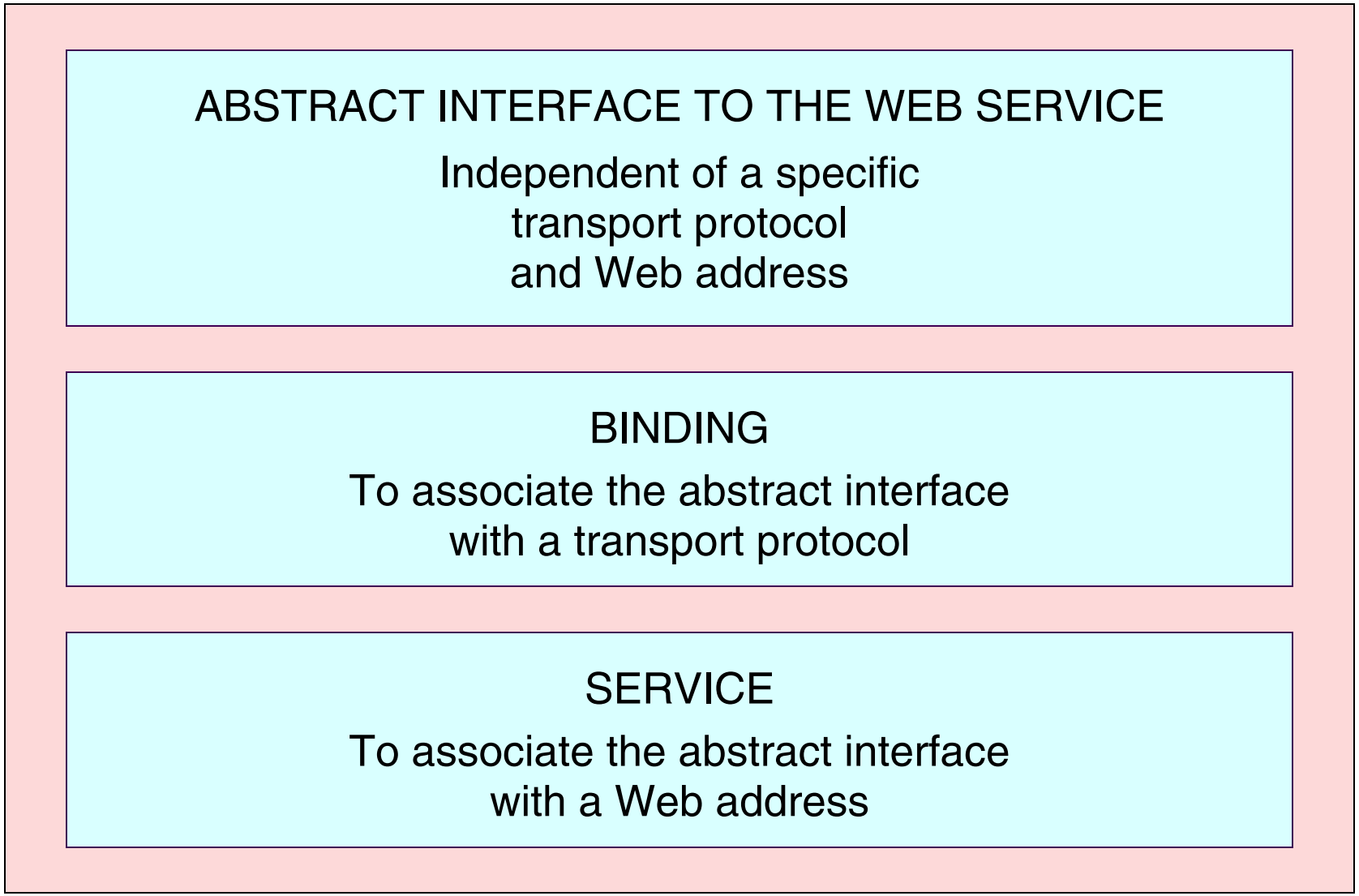
- Part 0: Primer
- Part 1: Messaging Framework
- Part 2: Adjuncts

XML Schema

W3C Recommendation - May 2001

- Part 0: Primer
- Part 1: Structures
- Part 2: Datatypes

STRUCTURE WSDL DEFINITION



STRUCTURE WSDL DEFINITION

ABSTRACT INTERFACE - EXAMPLE

```
<message name="getIfInOctetsRequest">
    <part name="community" type="xsd:string"/>
    <part name="index" type="xsd:unsignedInt"/>
</message>

<message name="getIfInOctetsResponse">
    <part name="ifInOctets" type="xsd:unsignedInt"/>
</message>


<interface name="IfDataServiceInterface">
    <operation name="getIfInOctets">
        <input message="myns:getIfInOctetsRequest"/>
        <output message="myns:getIfInOctetsResponse"/>
    </operation>
</interface>
```

STRUCTURE WSDL DEFINITION

BINDING TO A PROTOCOL - EXAMPLE

```
<binding name="ifDataServiceBinding"
        interface="myns:IfDataServiceInterface">

    <soap:binding style="rpc" transport="http://schemas.xmlsoap.org/soap/http"/>

    <operation  name="getIfInOctets">

        <soap:operation soapAction=""/>

        <input>
            <soap:body use="encoded" namespace="urn:..."
              encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"/>
        </input>

        <output>
            <soap:body use="encoded" namespace="urn:..."
              encodingStyle="http://schemas.xmlsoap.org/soap/encoding/"/>
        </output>

    <operation>
</binding>
```

STRUCTURE WSDL DEFINITION

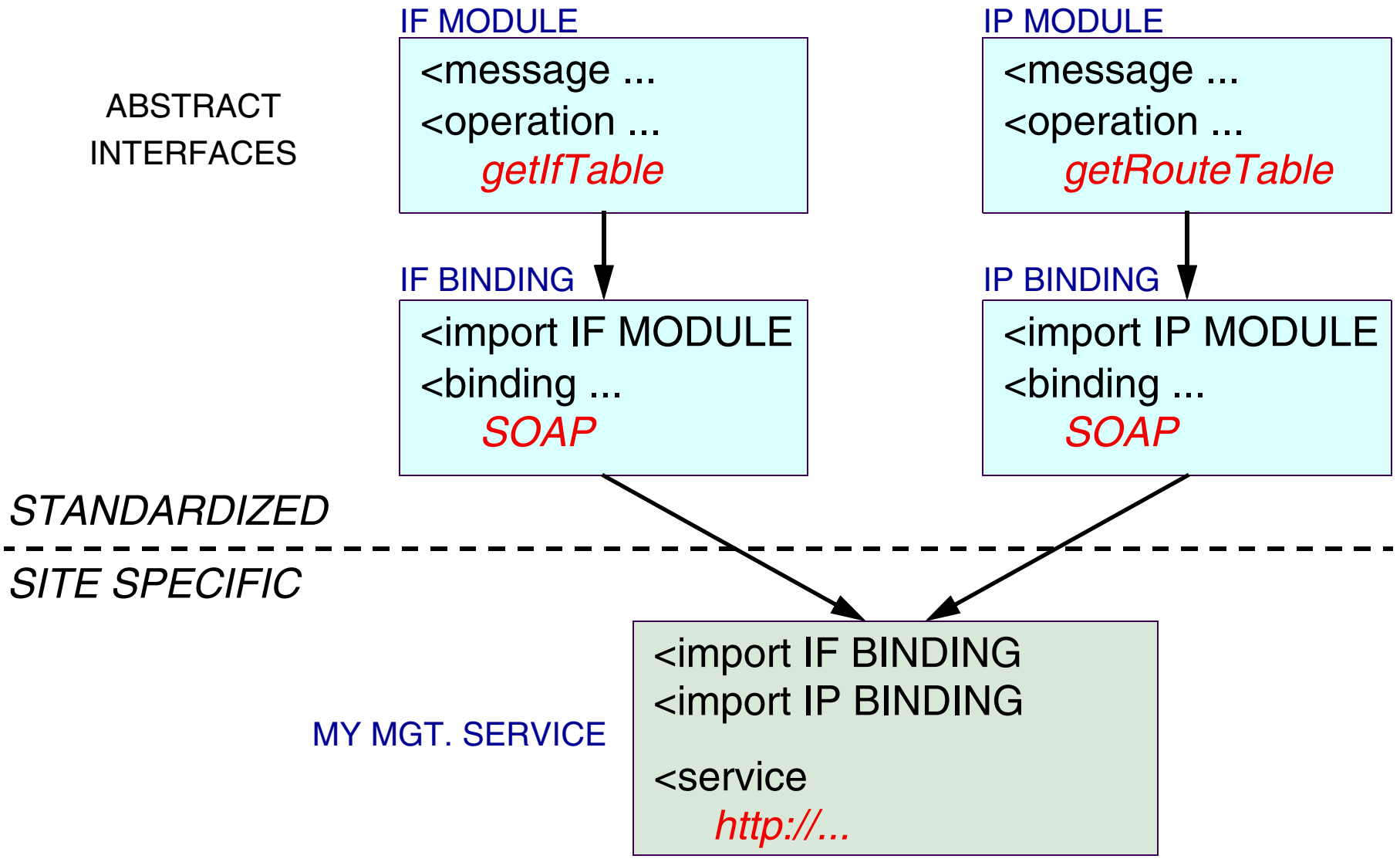
SERVICE AT A WEB ADDRESS - EXAMPLE

```
<service name="ifDataService" interface="myns:IfDataServiceInterface">

    <endpoint name="ifDataServiceEndpoint"
                binding="myns:ifDataServiceBinding"
        <soap:address location="http://my.webservice.com/ifData/"/>
    </endpoint>

</service>
```

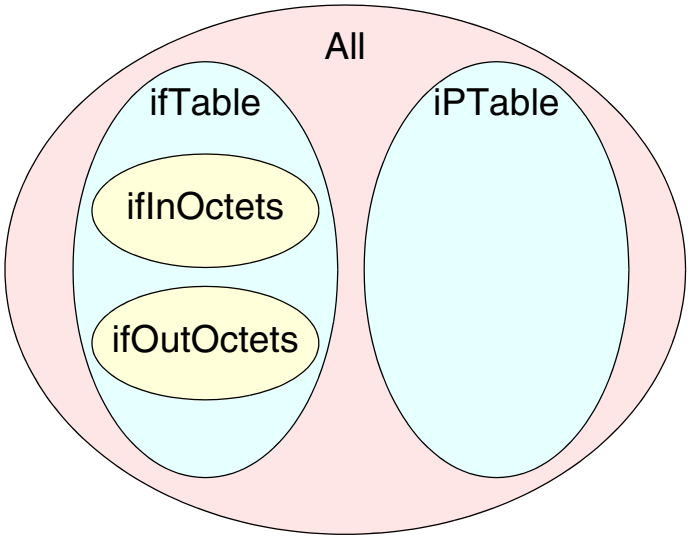
MODULAR WSDL STRUCTURE



POSSIBLE MESSAGE STRUCTURE

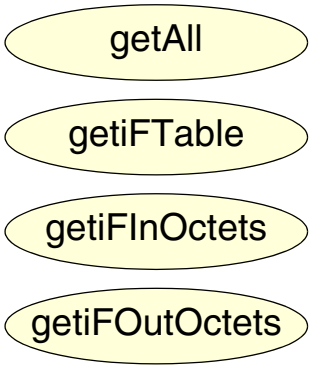
COARSE

- get(OID, instance, ...)
- set (OID, instance, ...)
- ...



FINE

- getAll(...)
- getIfTable(...)
- getIfInOctets(index, ...)
- getIfOutOctets(index, ...)
- ...



POSSIBLE MESSAGE PARAMETERS

NON-TRANSPARENT

getIfInOctets(index, amount)

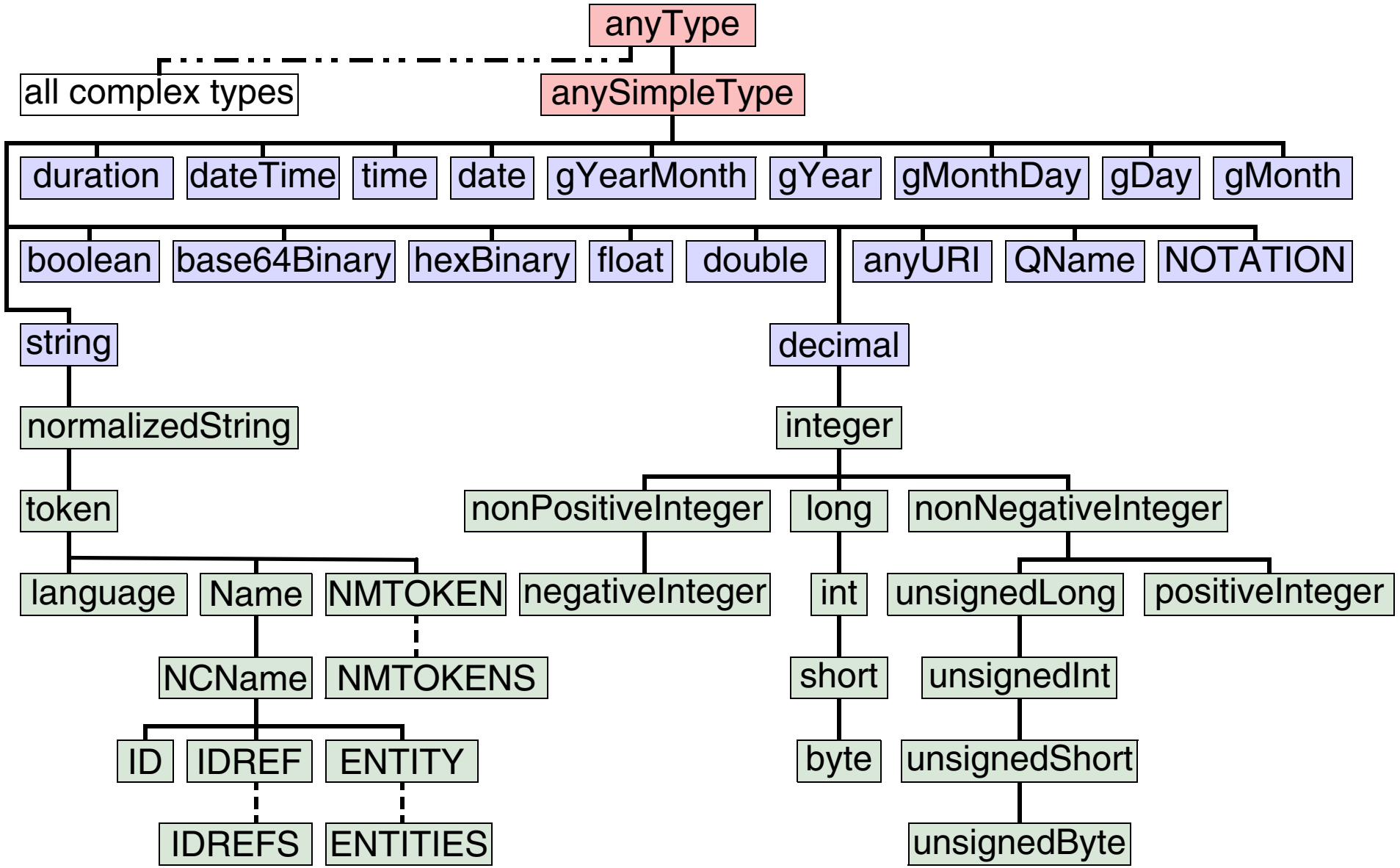
- Data parsed at WSDL level
- One level of standards: WSDL
- Less flexible
- Easy integration with standard applications
- Simple users (home environments)

TRANSPARENT

getIfInOctets(string)

- Data parsed by higher level application
- Data could be XML encoded
- Two levels of standards: WSDL operation & XML data
- Powerful (e.g. XPATH / XQUERY)
- Harder to use (professional operators)

DATA TYPES


anyType
all complex types
anySimpleType
duration
dateTime
time
date
gYearMonth
gYear
gMonthDay
gDay
gMonth
boolean
base64Binary
hexBinary
float
double
anyURI
QName
NOTATION
string
decimal
normalizedString
integer
token
nonPositiveInteger
long
nonNegativeInteger
language
Name
NMTOKEN
negativeInteger
int
unsignedLong
positiveInteger
NCName
NMTOKENS
short
unsignedInt
ID
IDREF
ENTITY
byte
unsignedShort
IDREFS
ENTITIES
unsignedByte

ADVANCED FEATURES

TRANSACTIONS

- Business Transaction Protocol (OASIS)
- WS-Coordination + WS-Transaction (BEA, IBM, MS)
- WS-Composite Application Framework (Arjuna, Fujitsu, IONA, Oracle, Sun)

SECURITY

- WS-Security (IBM, OASIS)

CHOREOGRAPHY / ORCHESTRATION

- XLANG (MS), WSFL (IBM)
- BPEL4WS (IBM, MS, BEA)
- WSCI (SUN, ...)
- W3C

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PERFORMANCE

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PERFORMANCE

WEB SERVICES COMPARED TO SNMP

- BANDWIDTH
- CPU TIME
- MEMORY USAGE
- RESPONSE TIME

MEASUREMENTS HAVE BEEN PERFORMED ON:

- FOUR WEB SERVICES PROTOTYPES DEVELOPED BY US
- ALL SNMP AGENTS THAT WE COULD TEST

WEB SERVICES PROTOTYPES

PROTOTYPE

- ifTable

GetIfCell
GetIfColumn
GetIfRow
GetIfTable

- gSOAP (2.3.8)

- Net-SNMP (V5.0.x) Data retrieval functions

- Debian Linux, kernel v2.4.22, 800 Mhz Pentium

WEB SERVICES PROTOTYPES - 2

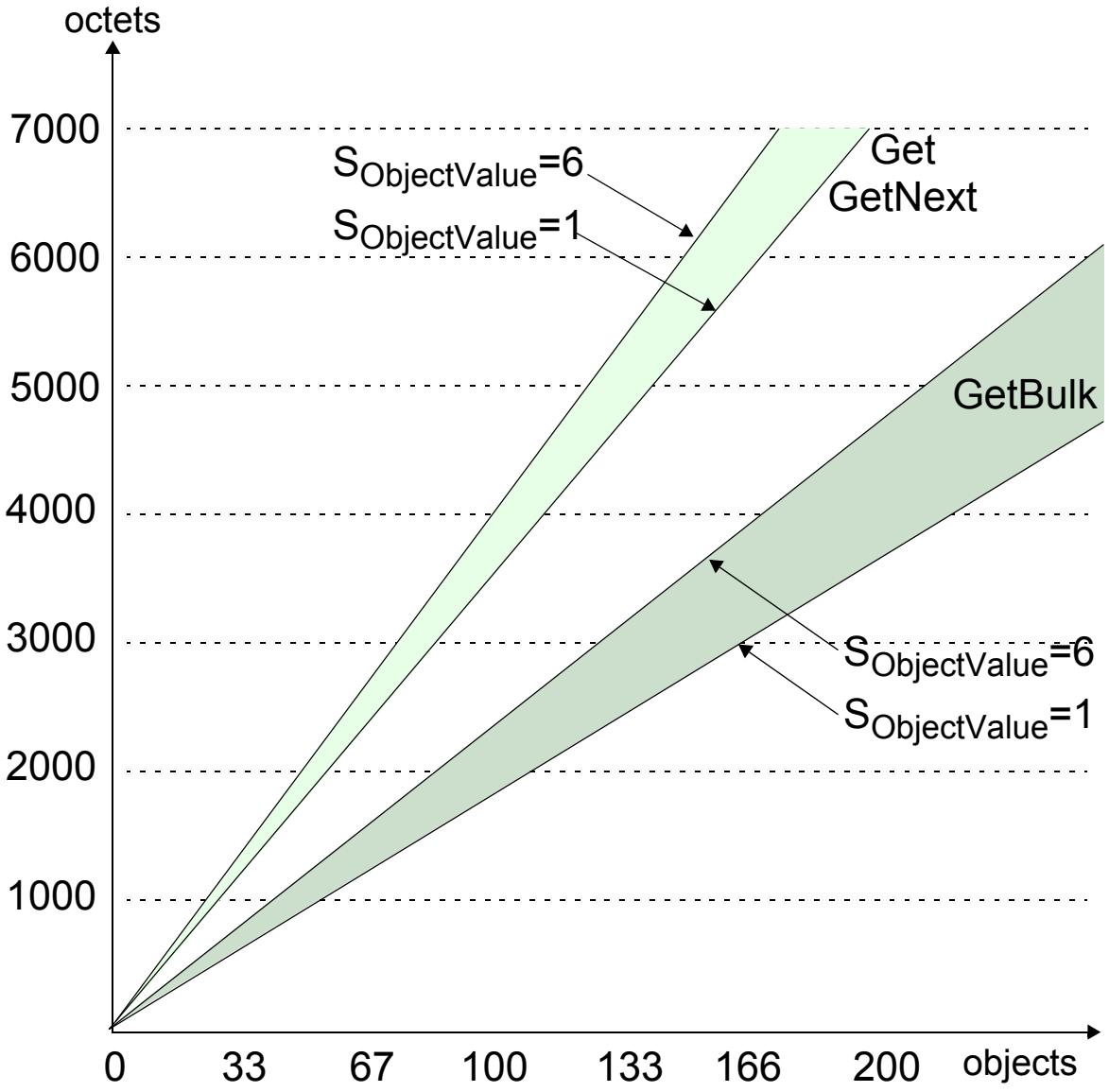
```
<complexType name="GetIfTableResponse">
  <sequence>
    <element name="ifEntry" type="utMon:ifEntry" minOccurs="1" maxOccurs="unbounded"/>
  </sequence>
 </complexType>

<message name="GetIfTableRequest">
  <part name="commuity" type="xsd:string"/>
</message>

<message name="GetIfTableResponse">
  <part name="-sizeTable" type="xsd:int"/>
  <part name="ifEntry" type="utMon:ifEntry"/>
</message>

<portType name="GetIfTableServicePortType">
 <operation name="GetIfTable">
   <documentation>Service definition of function utMon__GetIfTable</documentation>
   <input message="tns:GetIfTableRequest"/>
   <output message="tns:GetIfTableResponse"/>
 </operation>
</portType>
```

WEB SERVICES PROTOTYPES - 3

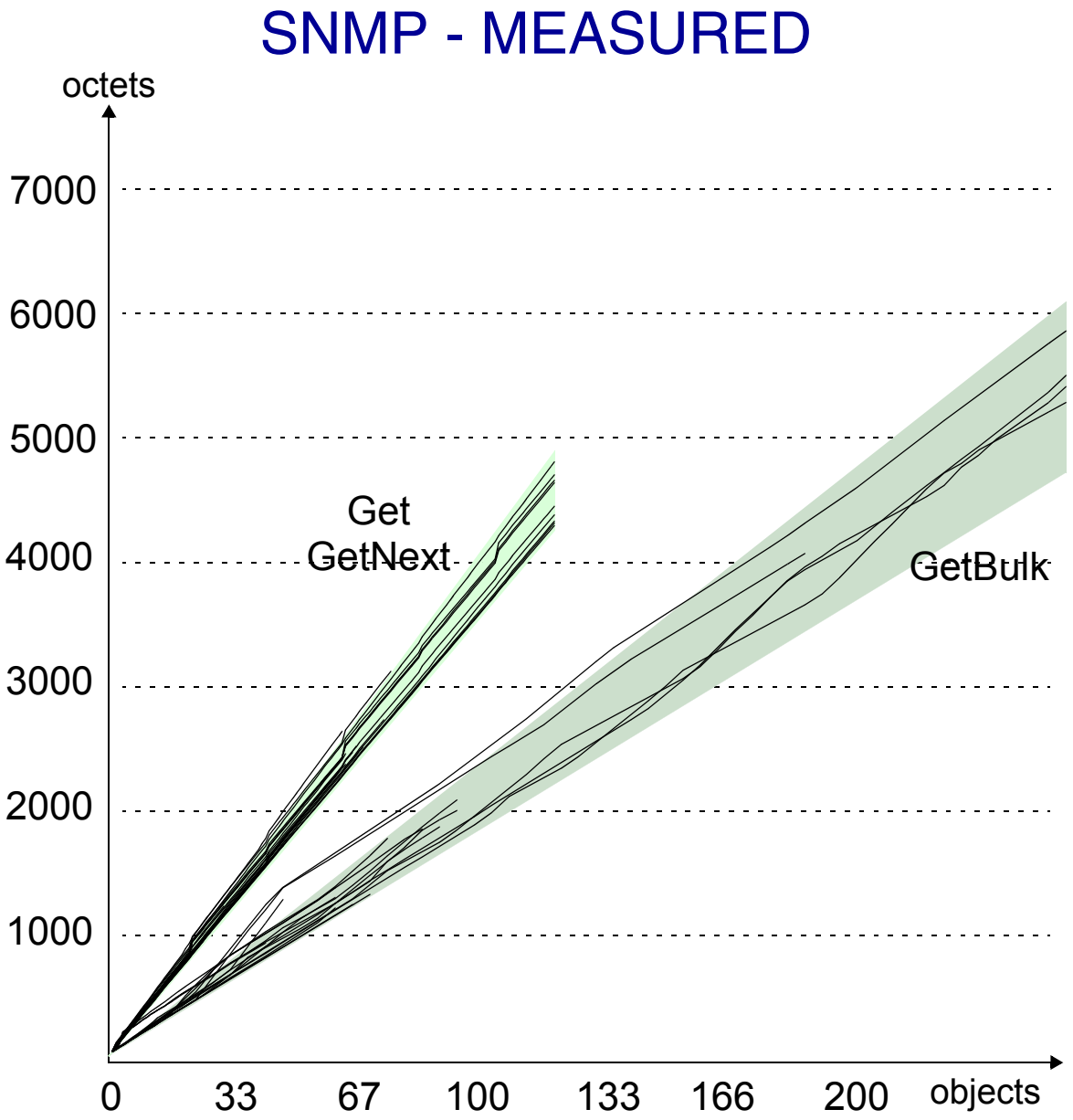
```
<complexType name="ifEntry">
  <sequence>
   <element name="ifIndex" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifDescr" type="xsd:string" minOccurs="1" maxOccurs="1" nillable="true"/>
   <element name="ifType" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifMtu" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifSpeed" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifPhysAddress" type="xsd:string" minOccurs="1" maxOccurs="1" nillable="true"/>
   <element name="ifAdminStatus" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifOperStatus" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifLastChange" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifInOctets" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifInUcastPkts" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifInDiscards" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifInErrors" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifInUnknownProtos" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifOutOctets" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifOutUcastPkts" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
   <element name="ifOutErrors" type="xsd:unsignedInt" minOccurs="1" maxOccurs="1"/>
  </sequence>
</complexType>
```

BANDWIDTH

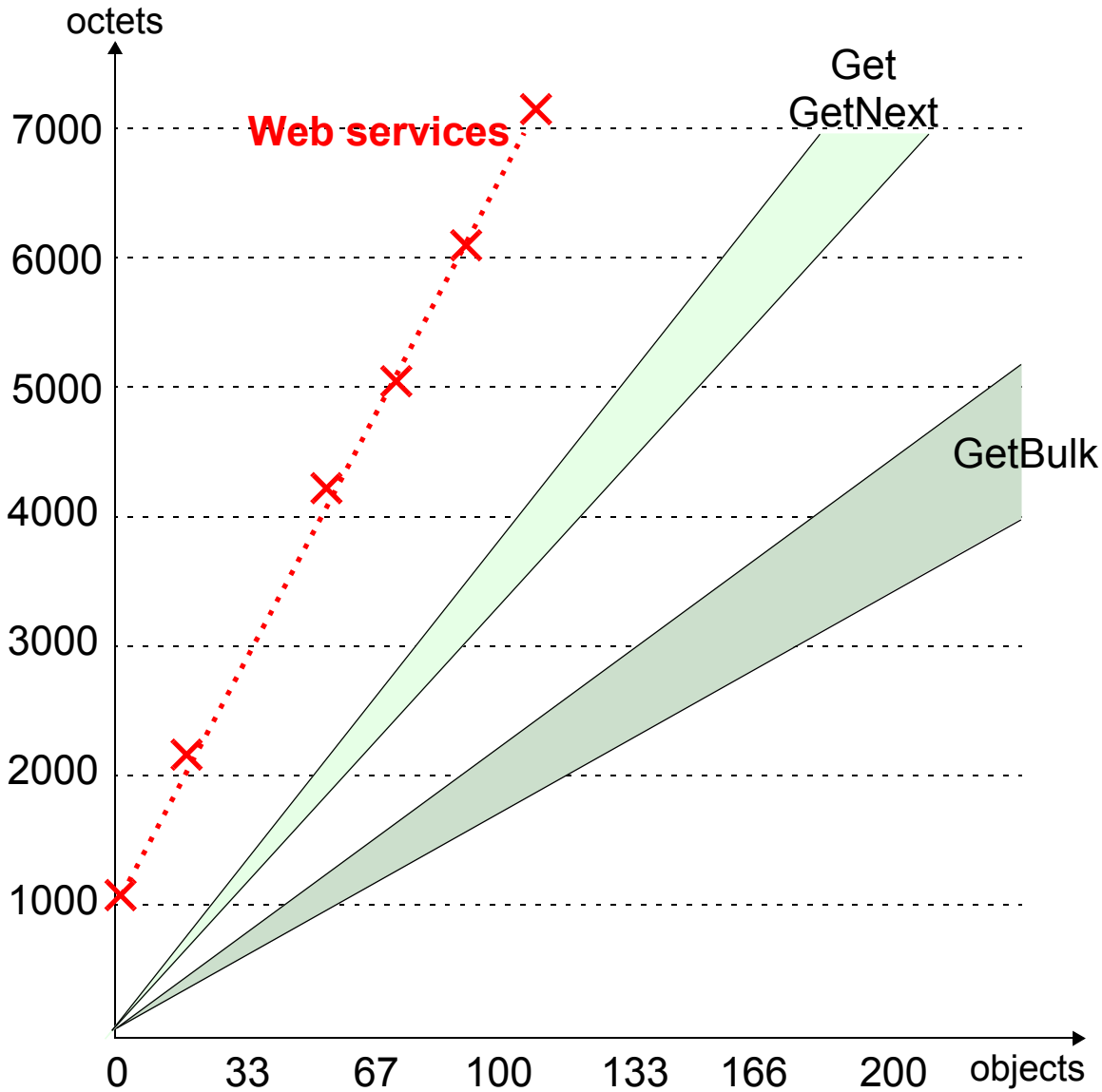
SNMP - THEORY



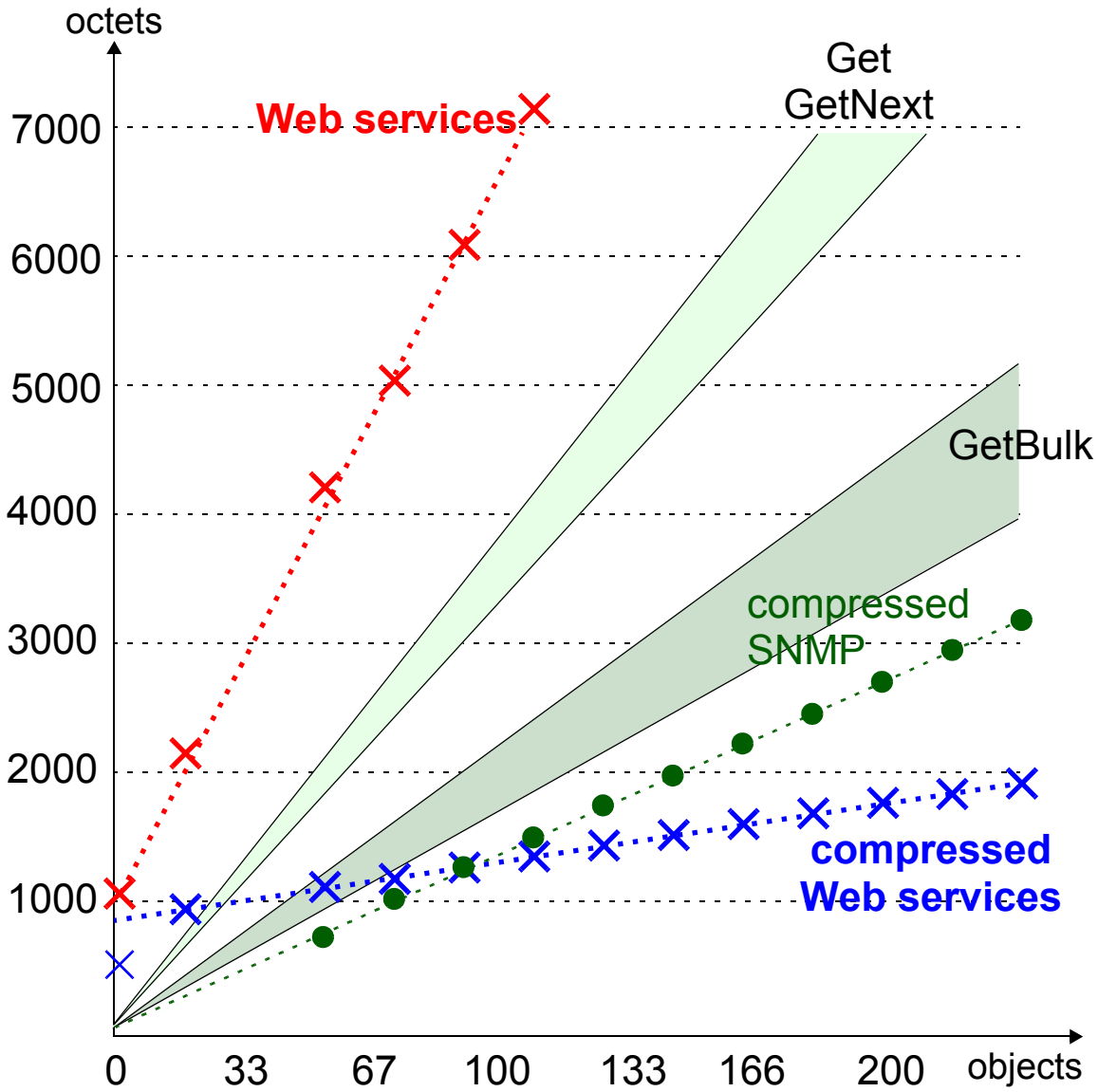
SNMP BANDWIDTH - 2



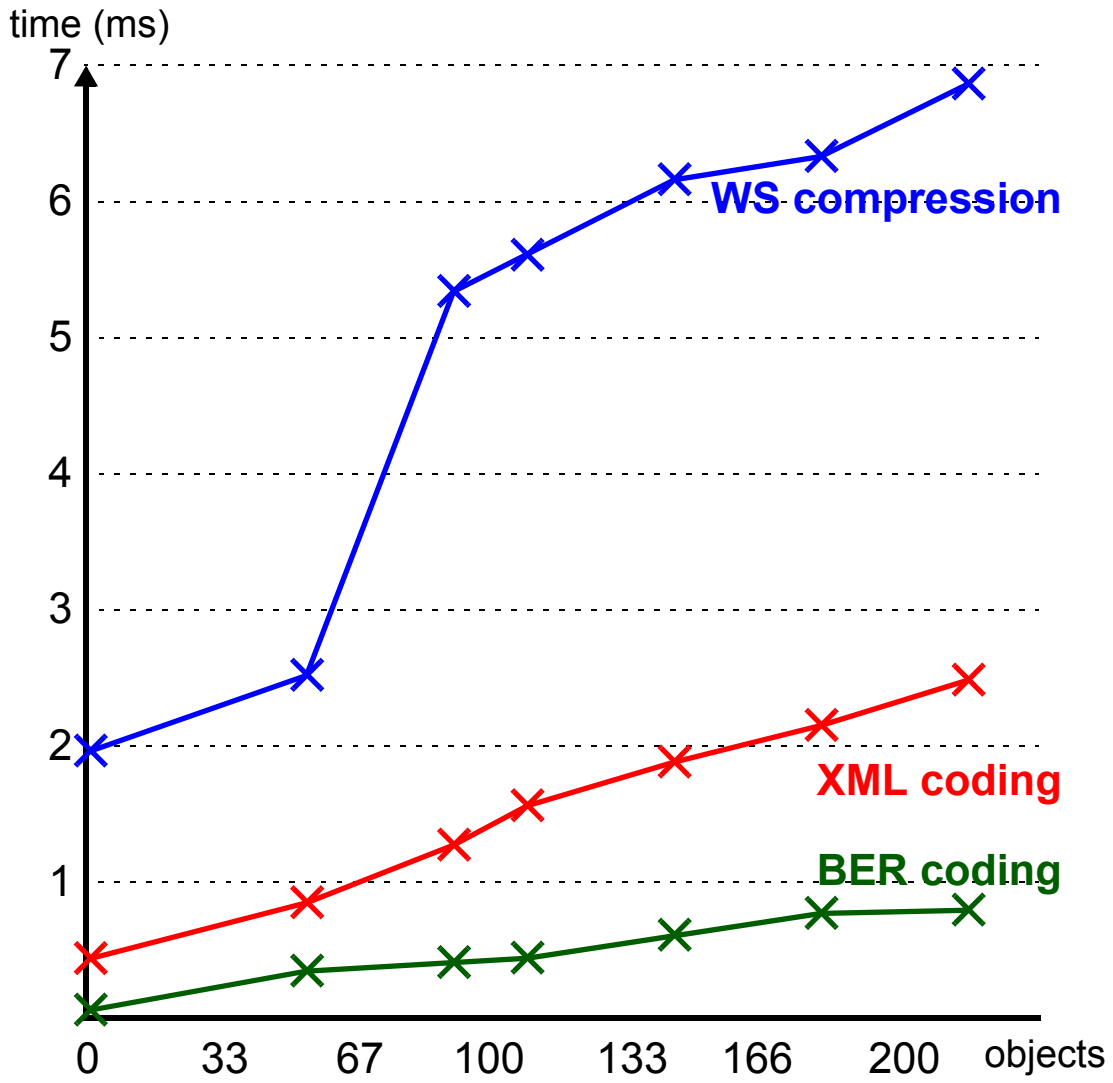
BANDWIDTH - 3


octets
7000
6000
5000
4000
3000
2000
1000
Web services
Get
GetNext
GetBulk
0
33
67
100
133
166
200
objects

BANDWIDTH - 4

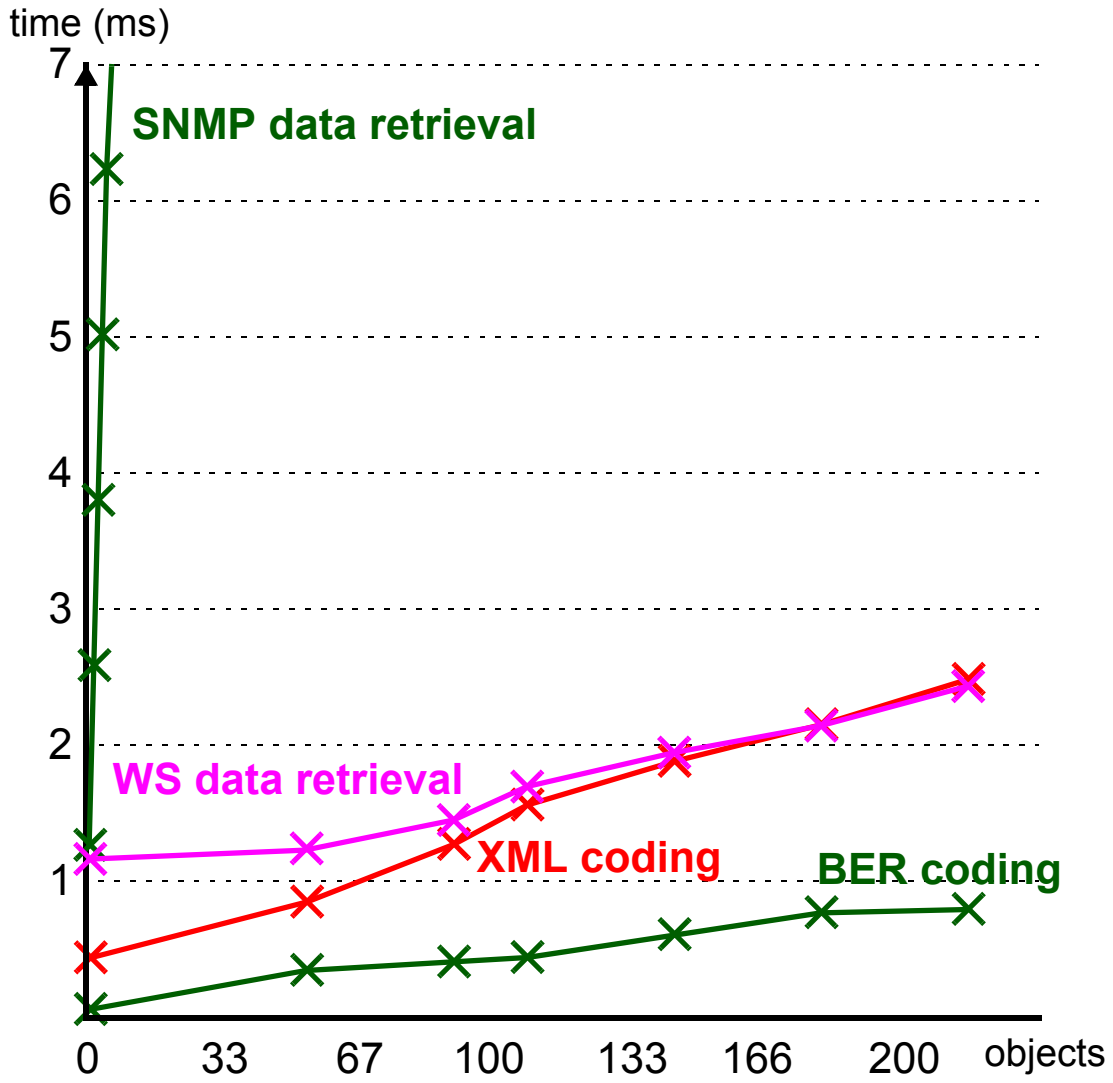

octets
7000
6000
5000
4000
3000
2000
1000
Web services
Get
GetNext
GetBulk
compressed
SNMP
compressed
Web services
0
33
67
100
133
166
200
objects

CPU TIME



zlib / gSOAP (V2.3.8) / Net-SNMP (5.0.9)

CPU TIME - 2



zlib / gSOAP (V2.3.8) / Net-SNMP (5.0.9)

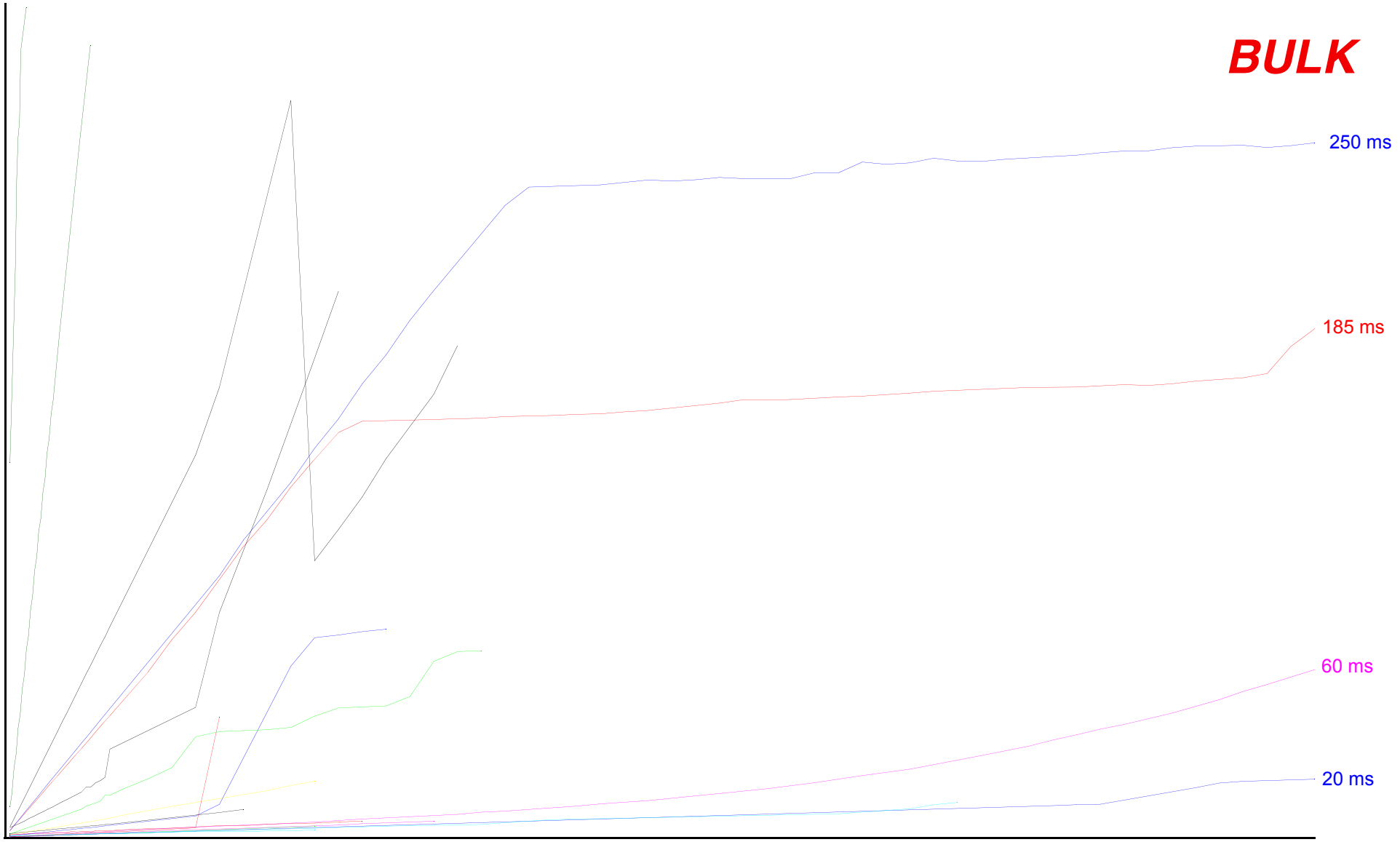
MEMORY USAGE

	instructions	data	
		static	dynamic
SNMP	1972 KB	128 KB	70 - 160 KB
Web services	580 KB	470 B	4 KB

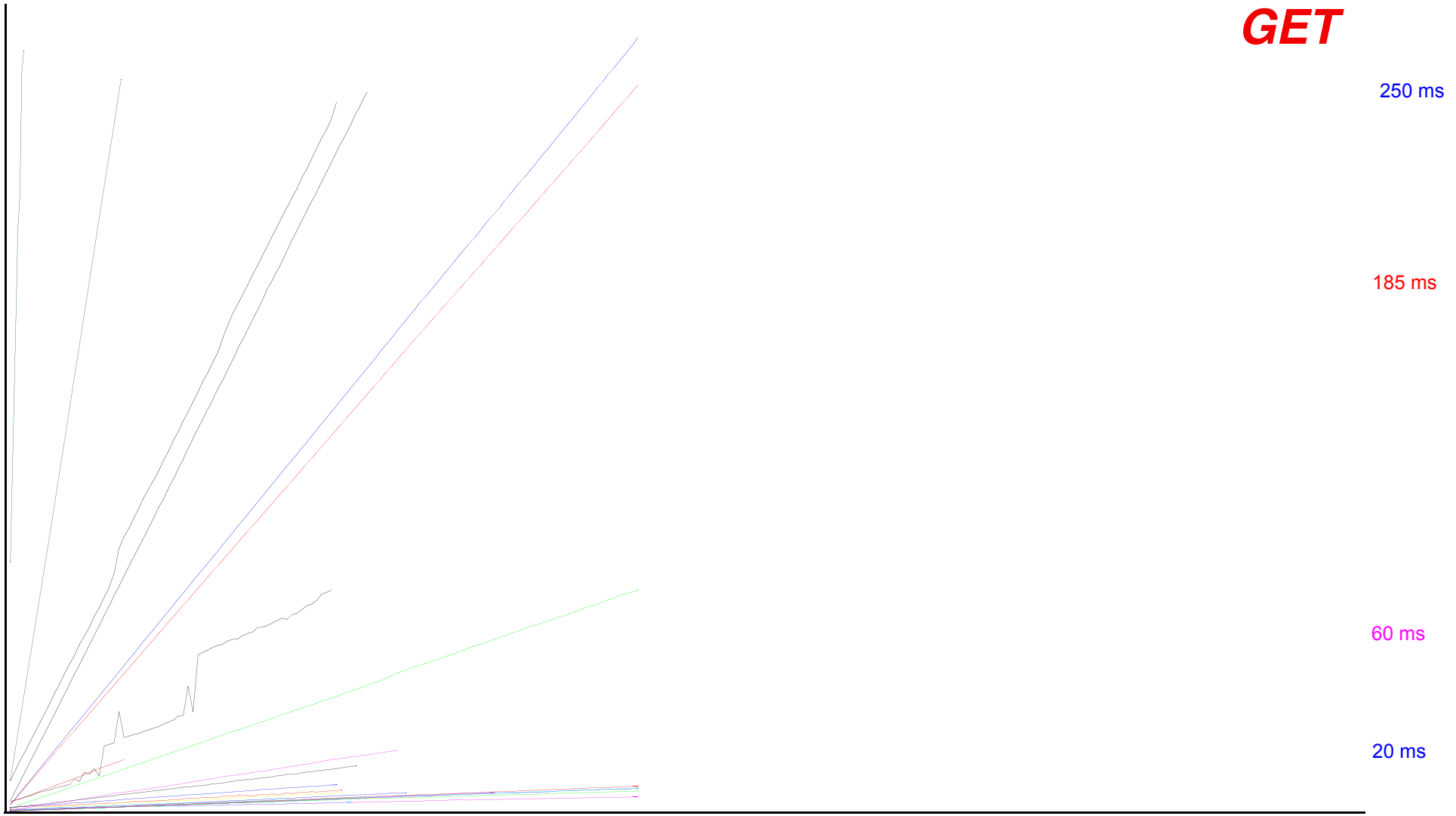
RESPONSE TIME

	1	22	66	270
WS	1,7	2,6	10,3	36,5
WS-Comp	3,3	4,3	5,6	11,8
SNMP-1	0,4	1,6	3,9	21,1
SNMP-2	0,4	1,9	5,0	
SNMP-3	0,5	1,6	4,2	
SNMP-4	0,5	1,7	4,4	
SNMP-5	0,5	1,8	4,8	
SNMP-6	0,7	2,2	5,7	
SNMP-7	0,8	1,8	2,9	
SNMP-8	0,9	1,6	3,9	
SNMP-9	0,9	6,6	18,5	
SNMP-10	1,1	1,8	3,4	58,5
SNMP-11	1,2	2,9	6,7	
SNMP-12	1,3	2,7	5,4	
SNMP-13	1,5	14,0	40,1	
SNMP-14	1,6	5,0	15,1	
SNMP-15	1,7	4,2	9,6	
SNMP-16	2,7	44,5	127,6	178,7
SNMP-17	2,7	47	140,4	251,7
SNMP-18	3,5	17,2		
SNMP-19	3,7	24,3	77,9	
SNMP-20	4,1	76,7	100,8	
SNMP-21	11,1	83,7	243,0	
SNMP-22	11,3	238,7	727,6	
SNMP-23	87,7	1822,2		

RESPONSE TIME (SNMP) - 2



RESPONSE TIME (SNMP) - 3



PERFORMANCE SUMMARY

SNMP IS BETTER
FOR A SMALL NUMBER OF OBJECTS

(COMPRESSED) WEB SERVICES IS BETTER
FOR A LARGE NUMBER OF OBJECTS

ENCODING (XML / BER) MAY NOT BE THE MAIN ISSUE

"KERNAL CALLS" ARE FREQUENTLY PROBLEMATIC

DIFFERENT SNMP AGENTS PERFORM QUITE DIFFERENTLY

CONCLUSIONS

SNMP IS GOOD FOR MONITORING SMALL NUMBER OF OBJECTS

FURTHER EVOLUTION OF SNMP FAILED

NEW (CONFIGURATION) MANAGEMENT APPROACHES ARE NEEDED

WEB SERVICE WOULD BE AN INTERESTING TECHNOLOGY

"EXPERTS" ASSUMED THAT PERFORMANCE OF WS WOULD BE A PROBLEM

THIS STUDY SHOWED THAT WS PERFORMANCE NEED NOT BE A PROBLEM

IETF STARTED WORKING ON NETCONF