

Linux Kernel AgentX Sub-Agents

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Overview

- Network Management (SNMP and AgentX)
- Motivation
- Linux Kernel Implementation
- Conclusions and Outlook

Why Network Management?

- Large computer networks cannot be managed manually
- Heterogeneous LANs

⇒ Network management is essential

Standard network management protocol in the Internet:

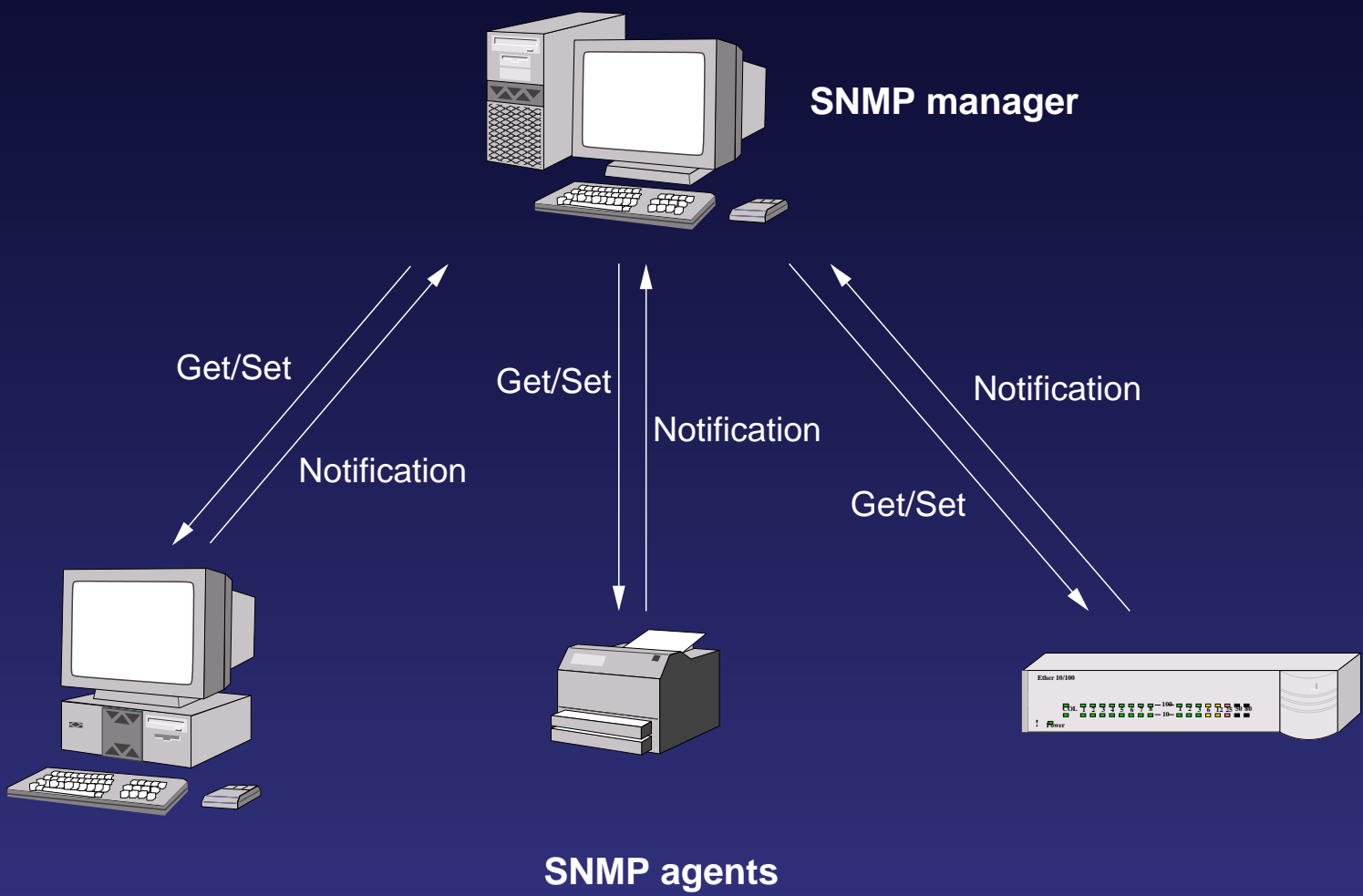
Simple network management protocol (SNMP)

Simple Network Management Protocol

SNMP contains three principal components:

- **SNMP manager**
requests and processes information from SNMP agents
- **SNMP agents**
on each device, provides management information to SNMP managers
- **Management Information Bases (MIBs)**
define the data models of certain management areas, contain scalars and tables, MIB tree

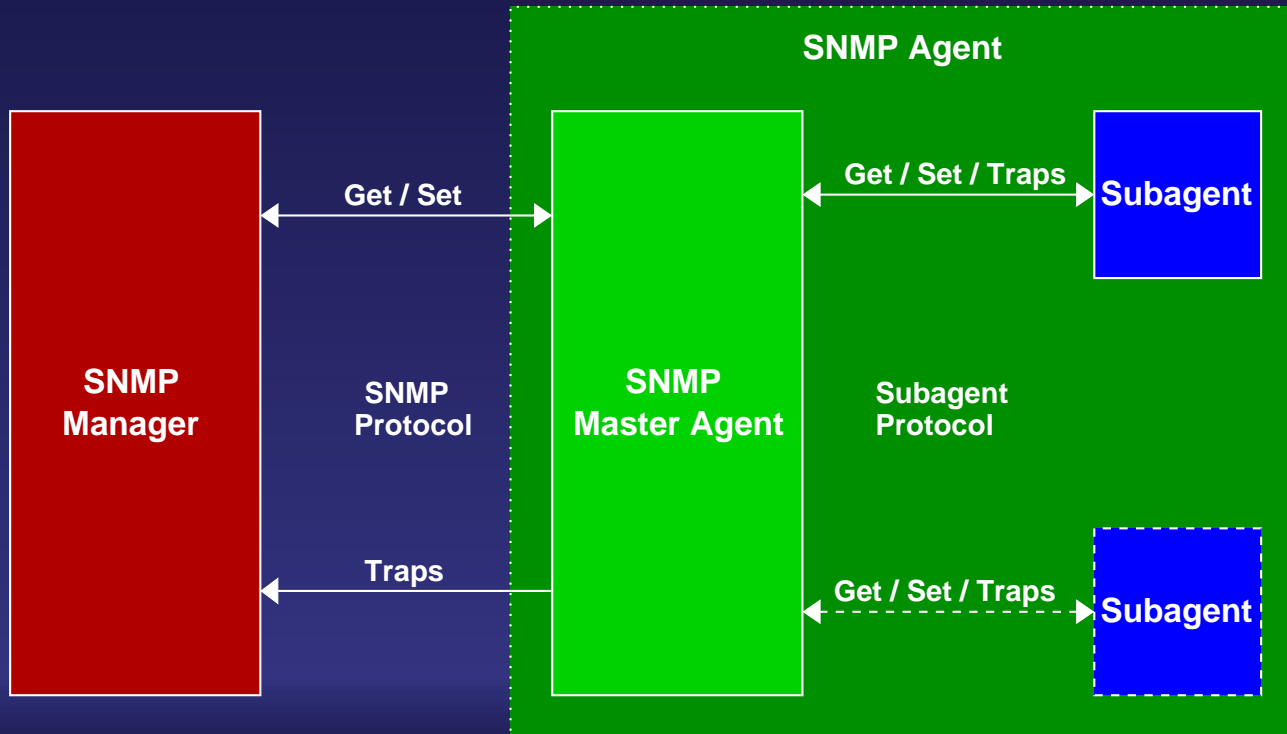
Simple Network Management Protocol (cont.)



Extensible Agents

Goals

- Seperate SNMP protocol engine from MIB instrumentation
- Facilitate the (dynamic) extension with new MIB modules
- Extensible agents should be transparent for managers



Subagent Protocols

- SNMP multiplexing protocol (SMUX), RFC 1227, May 1991
- SNMP distributed programm interface (DPI), RFC 1228, May 1991
- Enhanced MANagement Agent Through Extensions (EMANATE), commercial product
- Agent eXtensibility (AgentX), RFC 2741, January 2000

AgentX Protocol Features

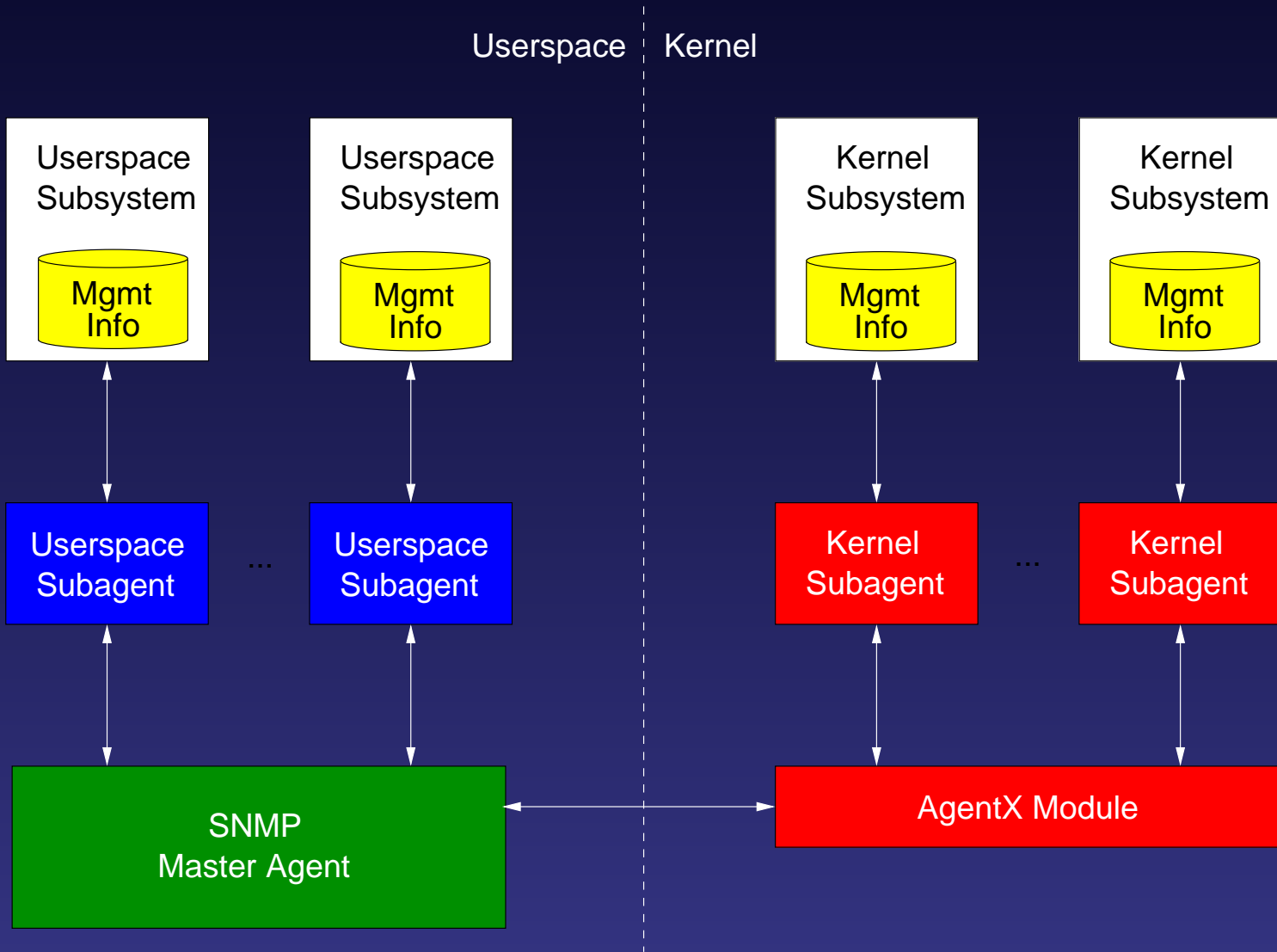
- Simplified variable encoding (SNMP uses ASN.1/BER)
- No authentication, no encryption (→ simple to implement)
- Registration conflict arbitration
- Index allocation
- Multiple sessions with one connection
- Multiphase set operation
- Mature (First subagent protocol on IETF's standards track)

Motivation

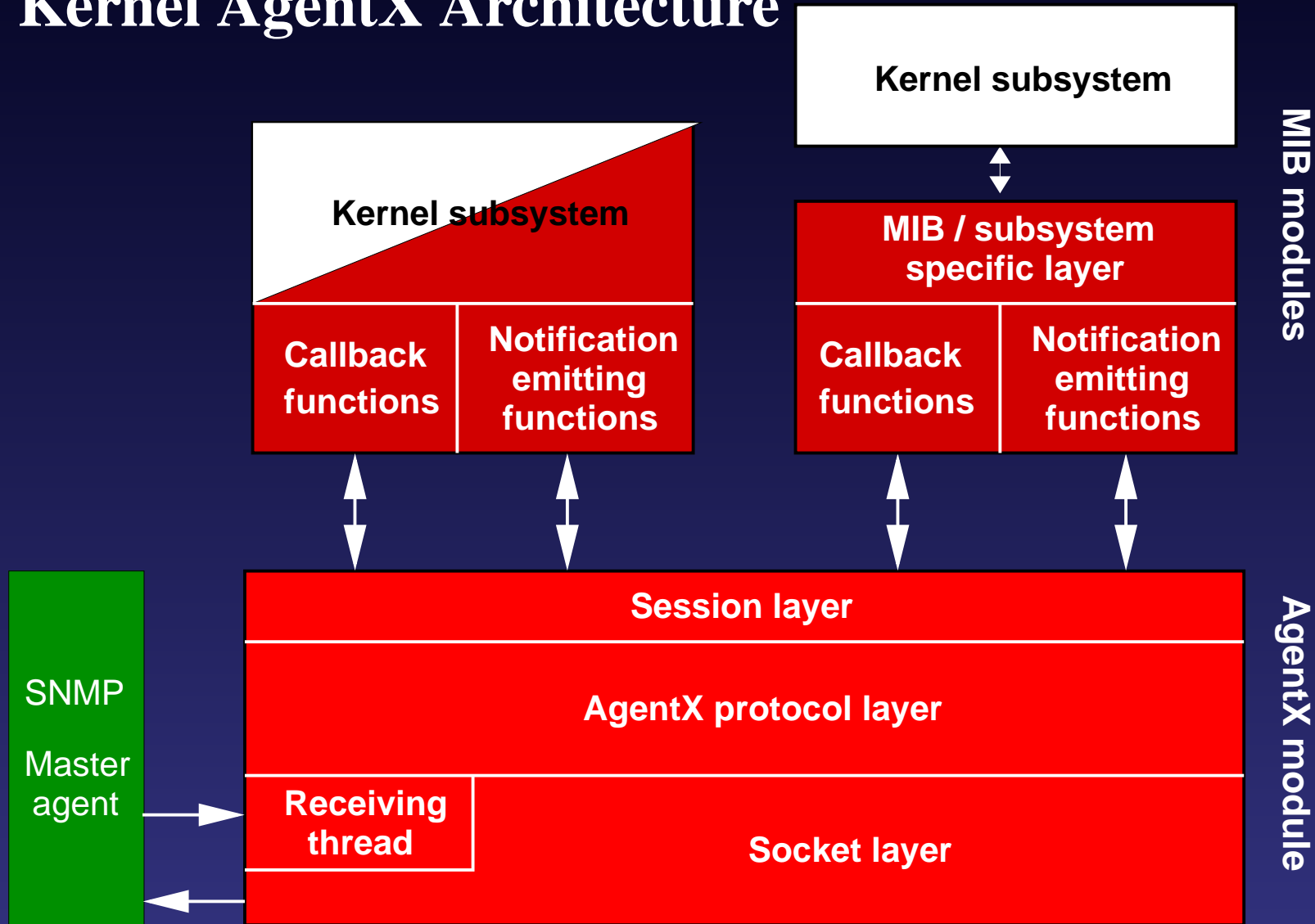
Problems of today's userspace SNMP agents for Linux

- Various methods to gather information from the kernel (`ioctl`, specific system call, `/proc` filesystem)
- Specific kernel interfaces may change
- SNMP Notifications are difficult to implement
- Functionality and management of kernel subsystem are split and often diverge

Management Architecture Overview

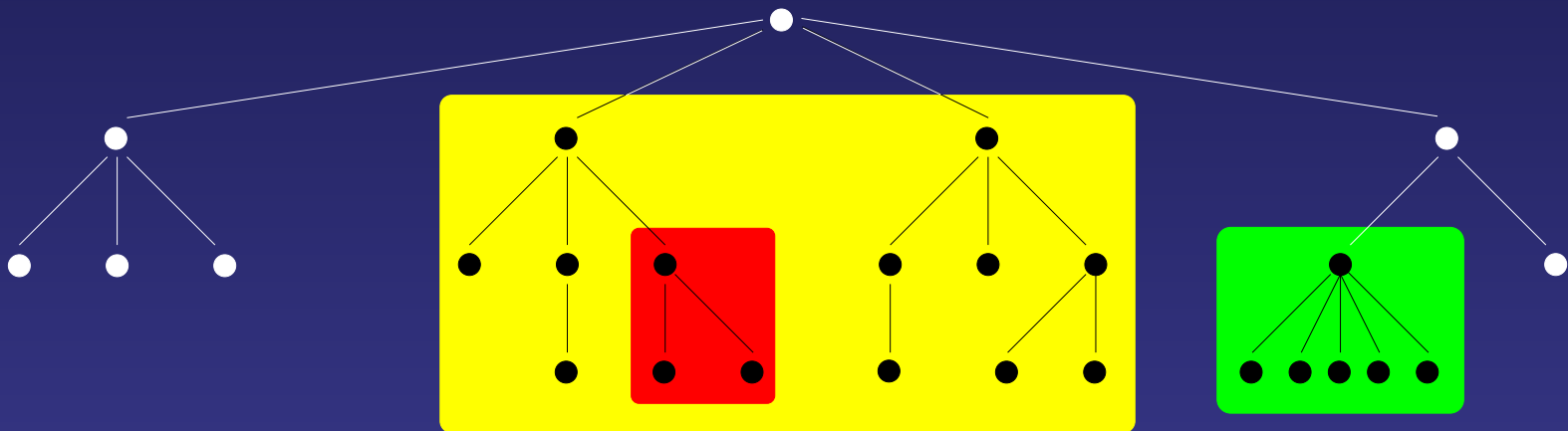


Kernel AgentX Architecture



Subagent Registration

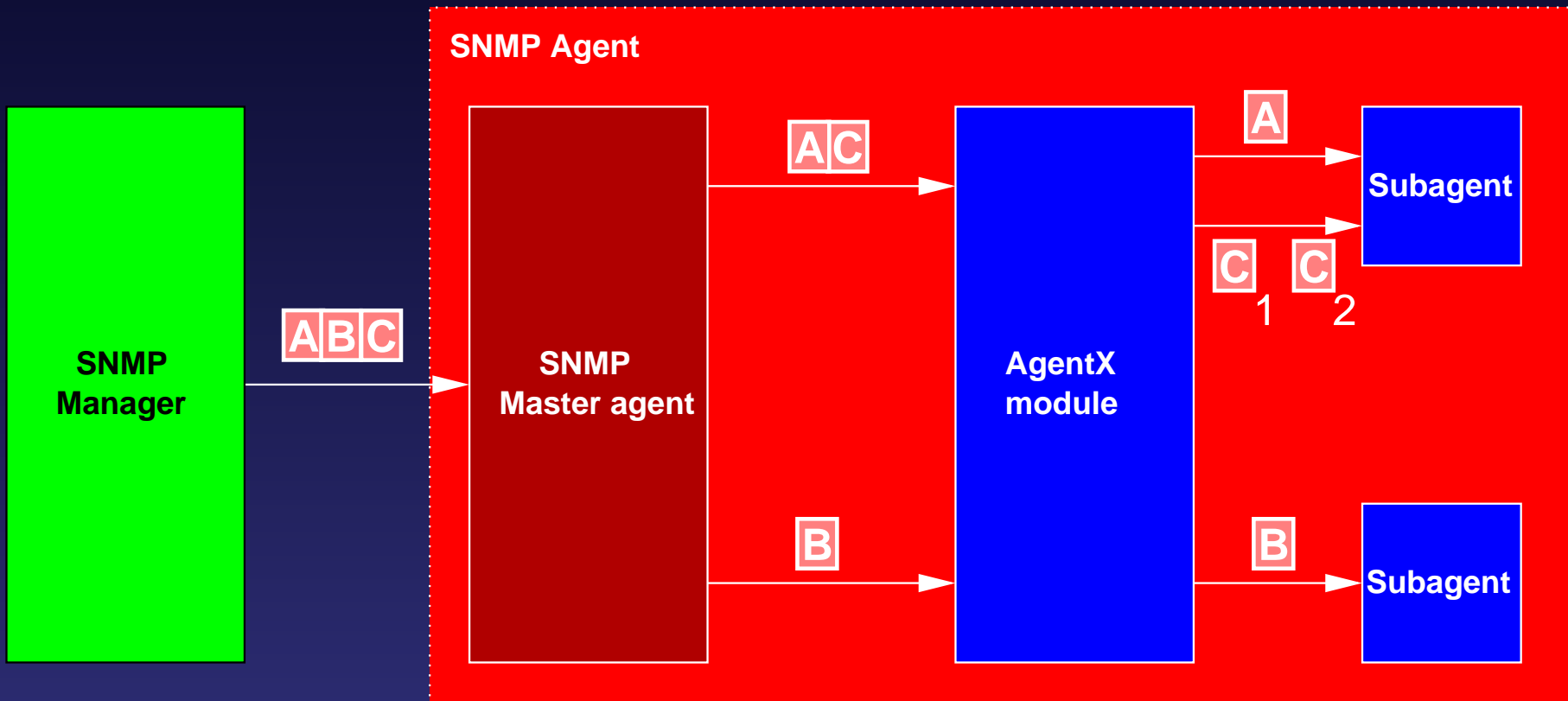
- Register MIB region
 - Registration contains list of callback functions
 - More than one registration is possible
- Callback functions handle all requests for a specific MIB subregion
- Asynchronous subagent registration does not depend on master agent



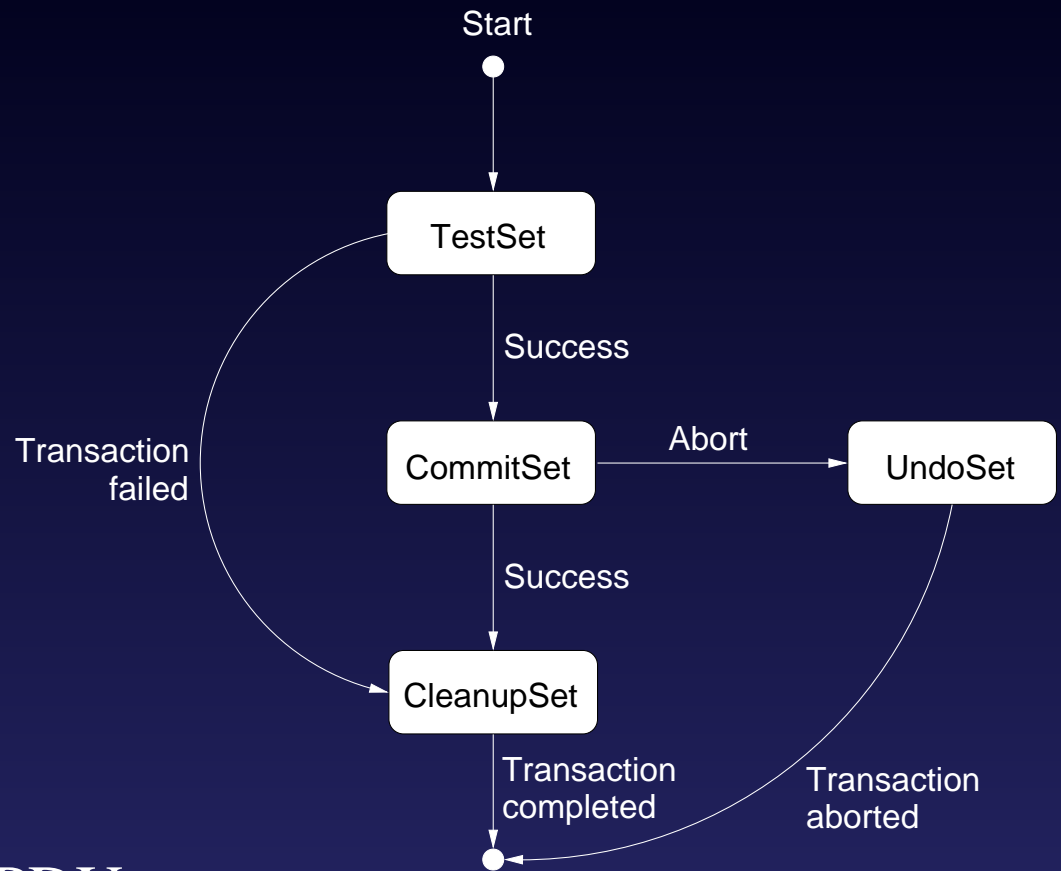
Get / GetNext / GetBulk Processing

- Transform GetNext / GetBulk into (several) Get requests
- Subagent callback functions work on a single variable
- Split up large requests and reassemble responses (Multiplexing)
- Produce errors for requests that cannot be assigned to a subagent callback function

Example: GetBulk processing



Set Transaction



- Four different AgentX PDUs
- Multiphase set operation to maintain atomic nature of SNMP set requests (all-or-nothing)
- Multiplexing similar to Get/GetNext/GetBulk requests
- Stateless subagents; Undo data is stored within the AgentX module

Implemented MIB Modules

- Interfaces MIB (IF-MIB, RFC 2863) module
 - Read-only informational elements (ifname, speed, mtu, etc.)
 - Can set interface up/down via `ifAdminStatus`
 - Can send trap when interface status changes
 - Standalone kernel module
- Linux Netfilter MIB module
 - No existing MIB, developed our own (with Frank Strauß)
 - Focuses on Netfilter core functions
 - Can show / alter / add Netfilter rules
 - Integrated in the Netfilter subsystem

Conclusions

- + Easy access to information from inside the kernel
- + Can efficiently support SNMP notifications
- + Kernel subsystem and management are integrated
- + Requires little knowledge of SNMP or AgentX protocol
- No immediate information gain except for notifications
- Programming inside the kernel is more critical to machine stability

Outlook

- Not publicly released yet but planned to
- Get feedback from the network management and the Linux community
- Implement more Standard MIBs

Links

Linux Kernel AgentX sub-agents, Diplomarbeit, September 2002
<http://www.ibr.cs.tu-bs.de/~wellnitz/kagentxd/>

The Simple Web
<http://www.simpleweb.org>

IETF AgentX Working Group
<http://www.scguild.com/agentx/>

The NET-SNMP project
<http://www.net-snmp.org>

Thanks for listening.
Questions? Comments?