

SDN Implementation in IHEP

SHAN ZENG

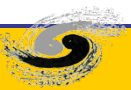
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17th Oct, 2016

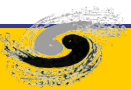
Outline

- IHEP at a Glance
- Why SDN in IHEP?
- How SDN in IHEP?
 - Updated work on SDN@WAN
 - **New:** SDN in network security
 - **New:** SDN@Data Center
- Future Plan
- Summary



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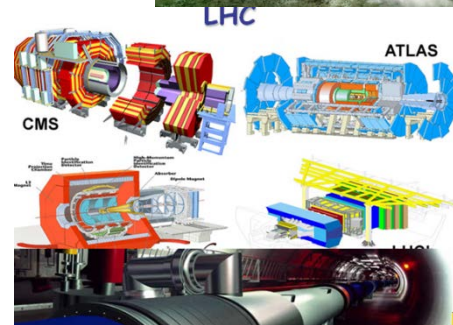
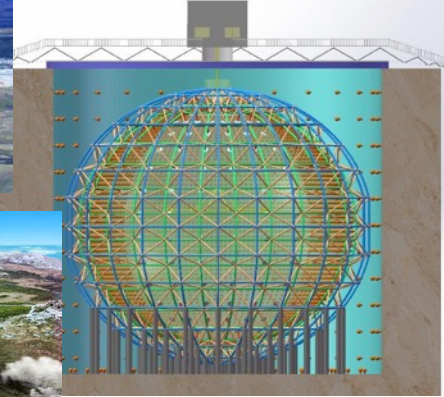
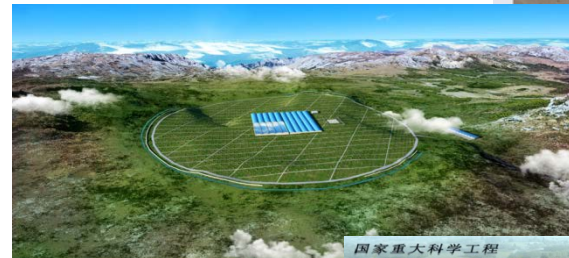
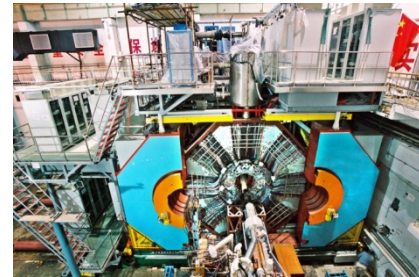
IHEP at a Glance

- 1500 staffs, with ~1200 scientists and engineers
- Four(Six) sites currently
 - Beijing, Dongguang(CSNS), Shenzhen (dayabay), Tibet (Yangbajing), Jiangmen (JUNO), Chengdu (LHASSO)
- The largest fundamental research center in China with following research fields:
 - Experimental Particle Physics
 - Theoretical Particle Physics
 - Astrophysics and cosmic-rays
 - Accelerator Technology and applications
 - Synchrotron radiation and applications
 - Nuclear analysis technique
 - Computing and Network applications



Major Projects

- **BEPCII/BESIII**
 - 36 Institutes from China, US, Germany, Russian, Japan,...
 - 5PB data in 5 years
- **Daya Bay Neutrino experiment**
 - 39 Institutes from China, US, ...
 - 400TB/year data collected
- **Yangbajing in Tibet**
 - Cosmic-ray observatory,
 - Collaborations of China, Italy, Japan
 - ~200TB raw data per year.
- **JUNO**
 - Jiangmen Underground Neutrino Observatory
 - ~ 1PB Raw data per year
- **LHAASO**
 - the Large High Altitude Air Shower Observatory
 - ~ 2PB Raw data per year
- **CSNS**
 - Chinese Spallation Neutrons Source
- **LHC**
 - Members of ATLAS and CMS
 - WLCG Tire-2 at IHEP
- **AMS (Alpha Magnetic Spectrometer)**



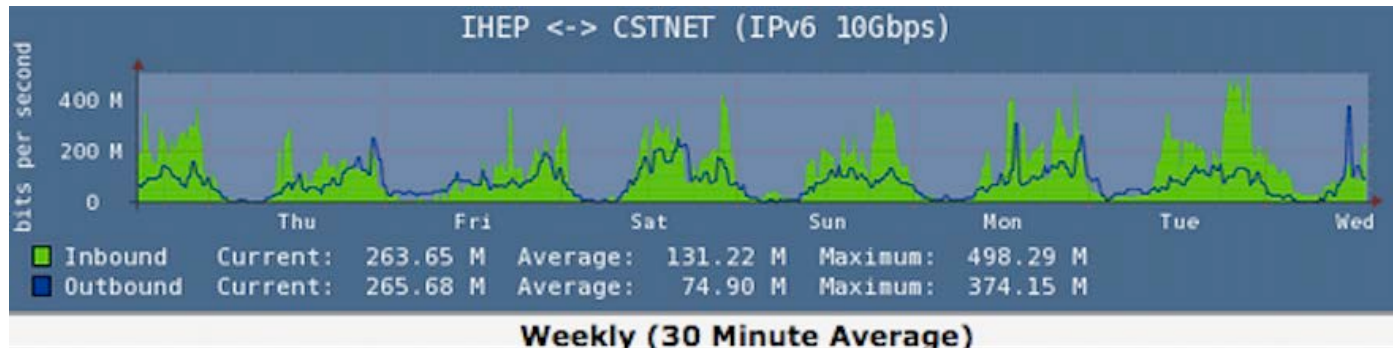
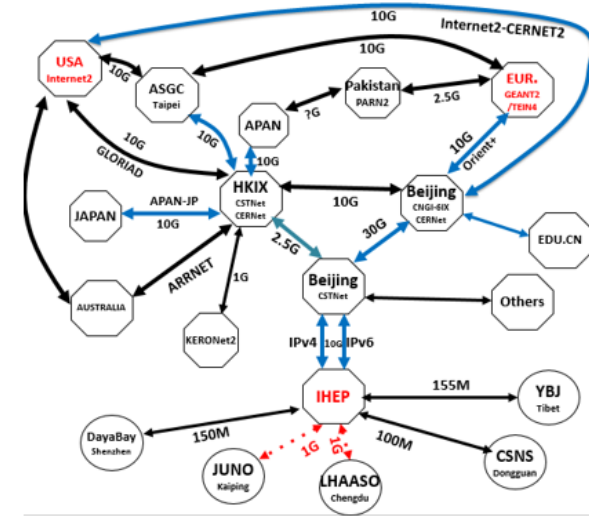
Current Network Status for IHEP

- IPv4

- Good connection for international cooperation
- A little poor for the domestic communication
 - Universities...

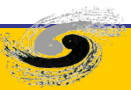
- IPv6

- Available bandwidth is good
- But unstable,
 - related with different time



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HEP Computing Challenges

- Rapid access to data stores & efficient data exchange
- Secure, efficient access to worldwide computing resources
- The requirement of the tenant network in the cloud environment is changing from time to time



Network Requirements

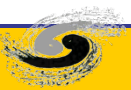
- Good reliability and availability
- Flexible: easy to configure
- Good performance

- Monitor and measure the status and performance of network
- Show and find the best network resources
- ...



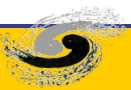
What shall we do for this?

- Provide a simple, flexible, robust, high performance and central—controlled network environment
- SDN is one of the Choices...



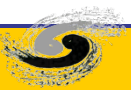
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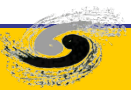
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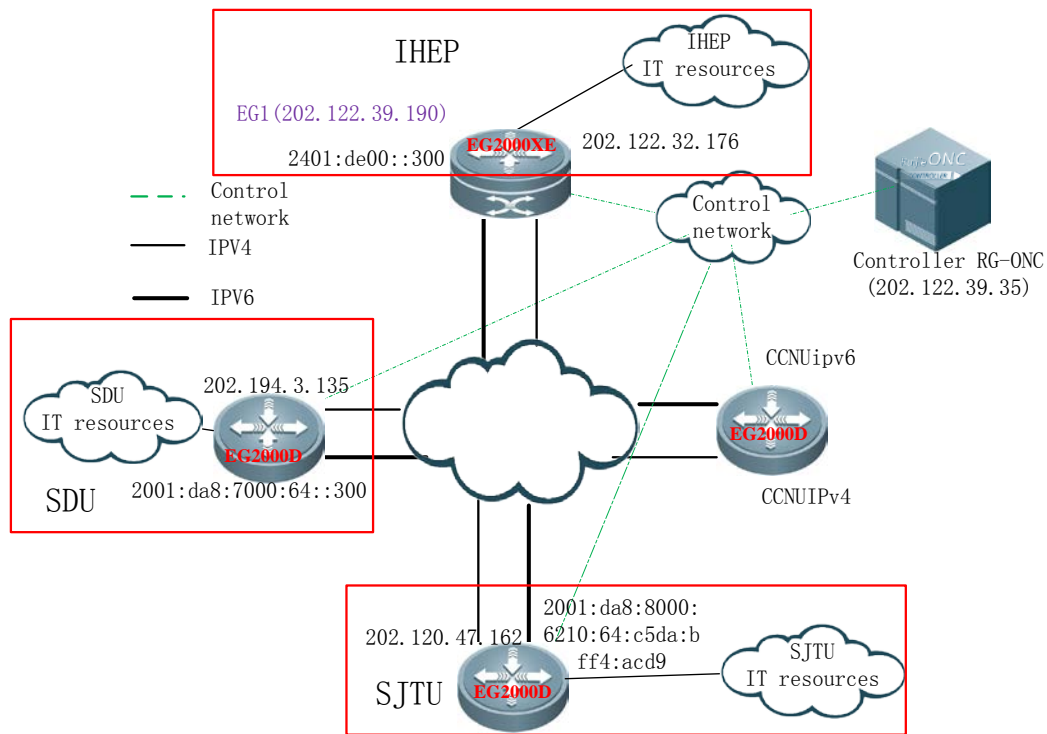
SDN@WAN

provide by Fazhi Qi

- Improve the data exchange performance, based on the current
 - Network infrastructure
 - Applications
- Thoughts
 - Overlay: use IPv4 & IPv6 network link/Separately or Aggregately
 - Automatically and Dynamically network path choosing based on the application requirements and network performance status
 - Route switching
 - Bandwidth merging



Deployment status



- Network topology
 - SJTU (Shanghai Jiao Tong University), SDU (Shandong University), CCNU (Central China Normal University), IHEP
 - IPv4 & IPv6

Updated work in SDN@WAN

WEB UI: Controller dashboard

HPCN Controller
admin
修改密码
保存
退出

设备列表

设备名称	设备ID	IP端口	MAC	协议版本	类型	操作模式	端口	流表项	操作
IHEP-SDN	OF13 openflow:897516188626	202.122.39.190:60607	00:d0:f8:22:33:d2	OF1.3	未知	不发默认表项	16	4	
SDU-SDN	OF13 openflow:897516188658	202.194.3.135:43550	00:d0:f8:22:33:f2	OF1.3	未知	不发默认表项	14	2	
SJTU-SDN	OF13 openflow:897516188650	202.120.47.162:58778	00:d0:f8:22:33:ea	OF1.3	未知	不发默认表项	14	4	

1-3 of 3 items

SDN Switch info

端口
流表
组表
计量表

端口号	类型	端口名称	接收数据包	发送数据包	接收字节	发送字节	接收丢包	发送丢包	接收错误	发送错误	接收帧错误	接收溢出错误	接收CRC校验错误	冲突
1	OF	Gi0/0	0	0	0	0	0	0	0	0	0	0	0	0
2	OF	Gi0/1	22339986	22555170	1992543773	16774248571	0	0	0	0	0	0	0	0
3	OF	Gi0/2	8048808	31381023	1844894255	24781167423	0	0	0	0	0	0	0	0
4	OF	Gi0/3	0	0	0	0	0	0	0	0	0	0	0	0
5	OF	Gi0/4	0	0	0	0	0	0	0	0	0	0	0	0

1-5 of 16 items

Flow table info

设备名称	输入端口	源MAC	目的MAC	以太网类型	VLAN	源IP	目的IP	协议	源端口	目的端口	动作	字节数	包数	持续时间(秒)	空闲超时	优先级
SJTU-SDN	*	*	*	IPv4	*	*	192.168.2.0/24	*	*	*	CONTROLLER	8500	96	80097	0	100
SJTU-SDN	*	*	*	IPv4	*	*	172.16.52.0/24	*	*	*	CONTROLLER	0	0	62975	0	100
SJTU-SDN	*	*	*	IPv4	*	*	202.194.3.131	*	*	*	CONTROLLER	0	0	62975	0	100
SJTU-SDN	*	*	*	IPv4	*	*	172.16.51.0/25	*	*	*	CONTROLLER	0	0	62975	0	100

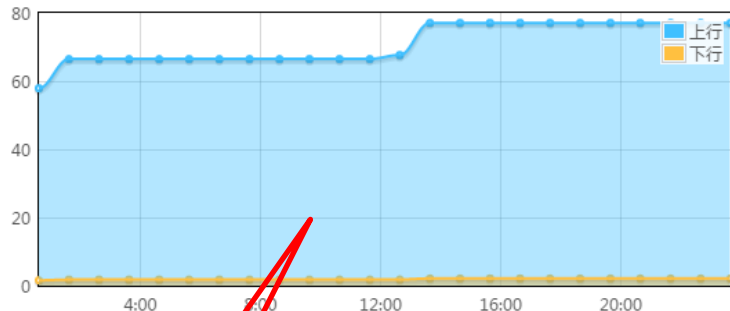
Controller dashboard – link performance statistics

链路质量统计

Tu2(14)@IHEP-SDN(202.122.39.190:34268)----->Tu2(12)@SJTU-SDN(202.120.47.162:54019)

视图类型: 天 有效带宽 查询

单位: Mbps



上行1天内平均/最大有效带宽: 71.04/77.08 Mbps
下行1天内平均/最大有效带宽: 1.93/2.11 Mbps

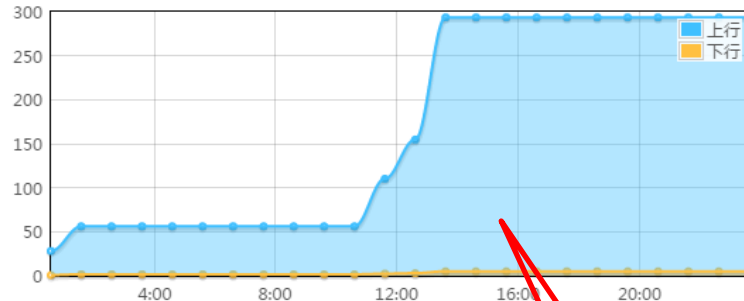
Available bandwidth (ipv4)

链路质量统计

Tu26(17)@IHEP-SDN(202.122.39.190:34268)----->Tu26(15)@SJTU-SDN(202.120.47.162:54019)

视图类型: 天 有效带宽 查询

单位: Mbps



上行1天内平均/最大有效带宽: 170.26/293.68 Mbps
下行1天内平均/最大有效带宽: 3.26/5.09 Mbps

Available bandwidth (ipv6)

业务监测

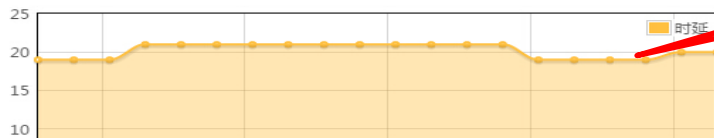
链接起点	链接终点
Tu16(12)@SJTU-SDN(202.120.47.162:36713)	Tu36(14)@SDU-SDN(202.194.3.135:46489)
Tu36(14)@SDU-SDN(202.194.3.135:46489)	Tu16(12)@SJTU-SDN(202.120.47.162:36713)
Tu1(9)@SJTU-SDN(202.120.47.162:36713)	Tu3(11)@SDU-SDN(202.194.3.135:46489)
Tu3(11)@SDU-SDN(202.194.3.135:46489)	Tu1(9)@SJTU-SDN(202.120.47.162:36713)

1-4 of 4 items

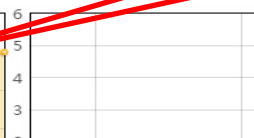
业务流统计

分

单位: ms



单位: %



latency (ipv6)

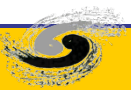
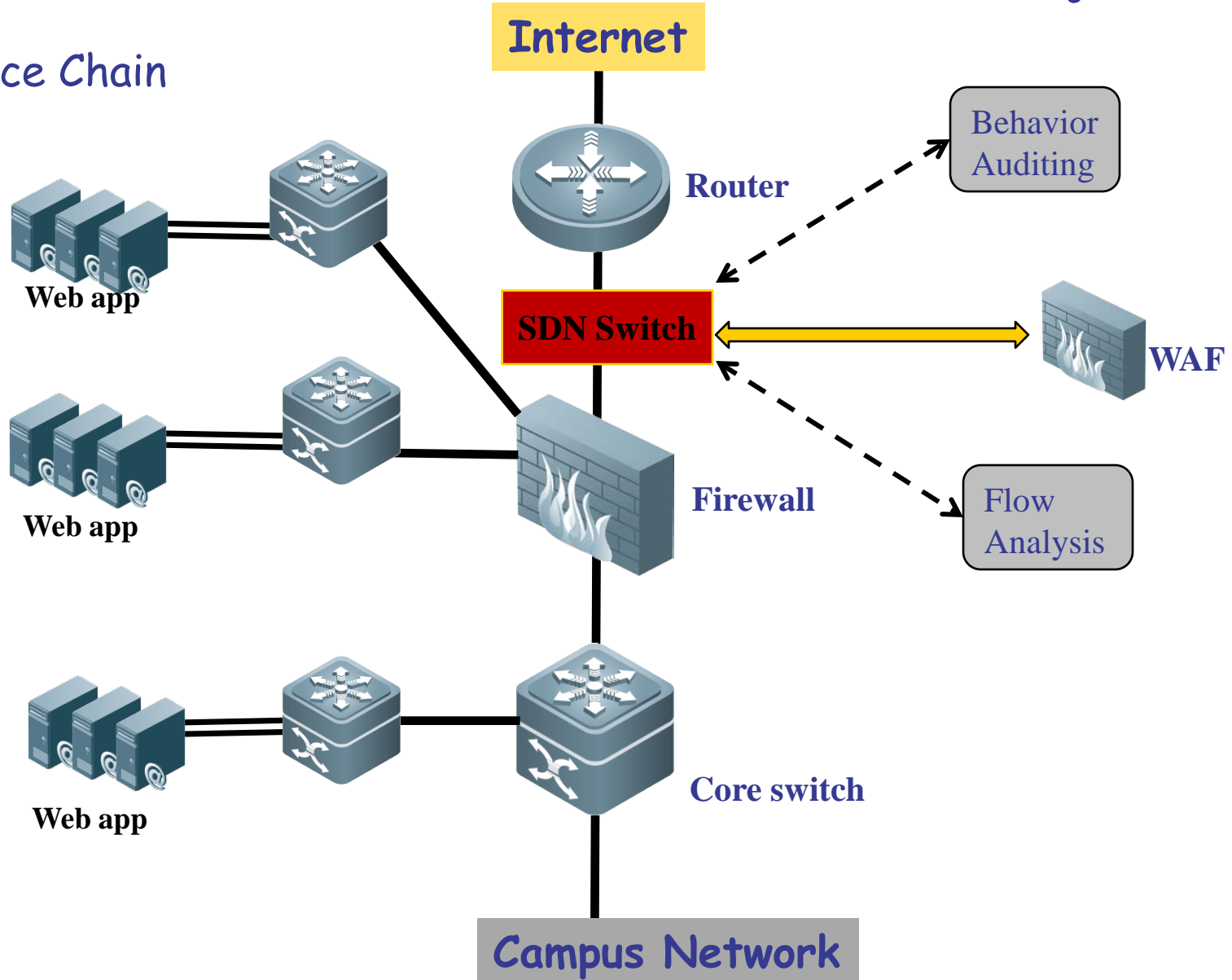
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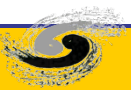
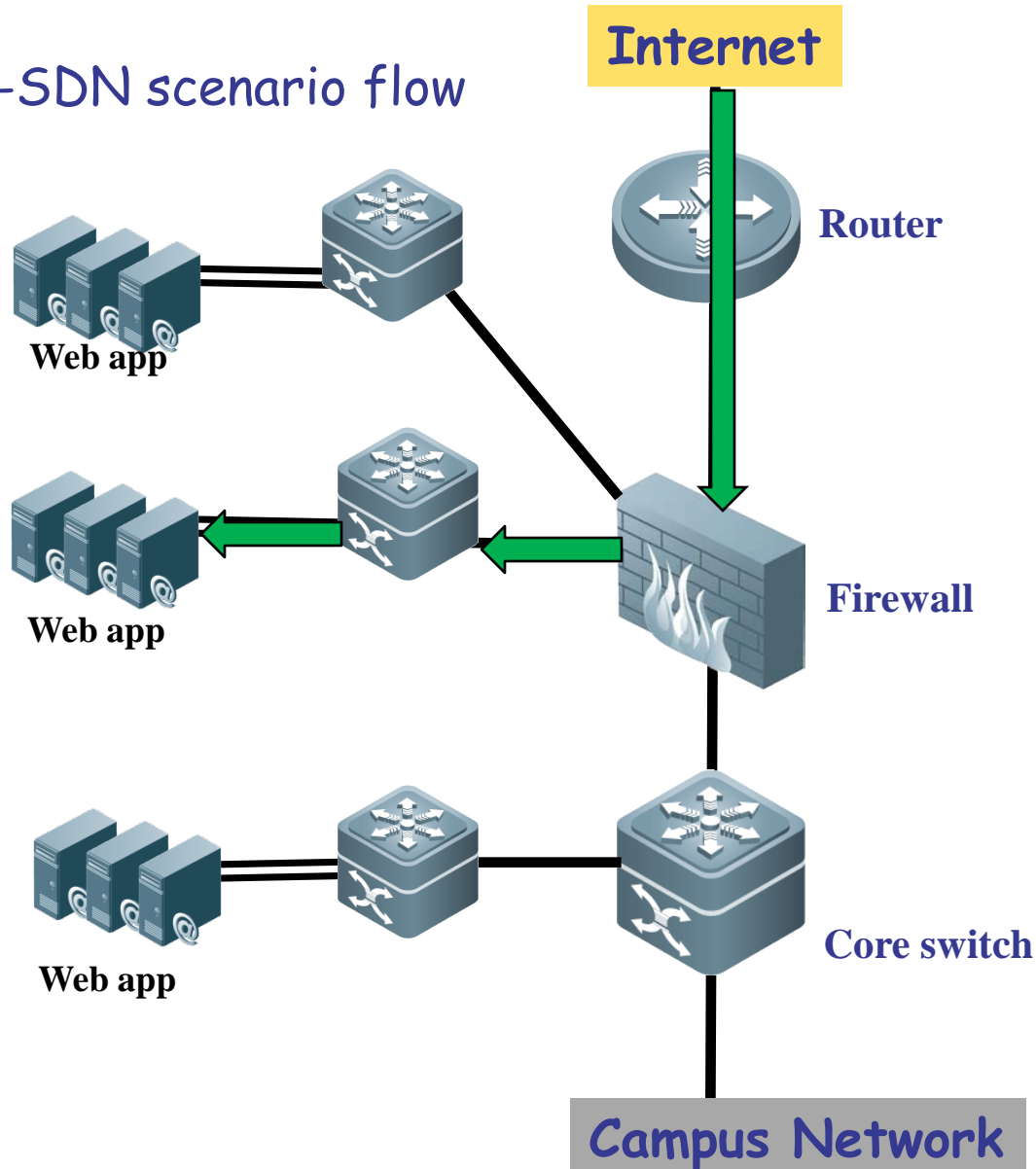
SDN Solution in Network Security

Service Chain



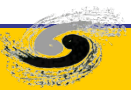
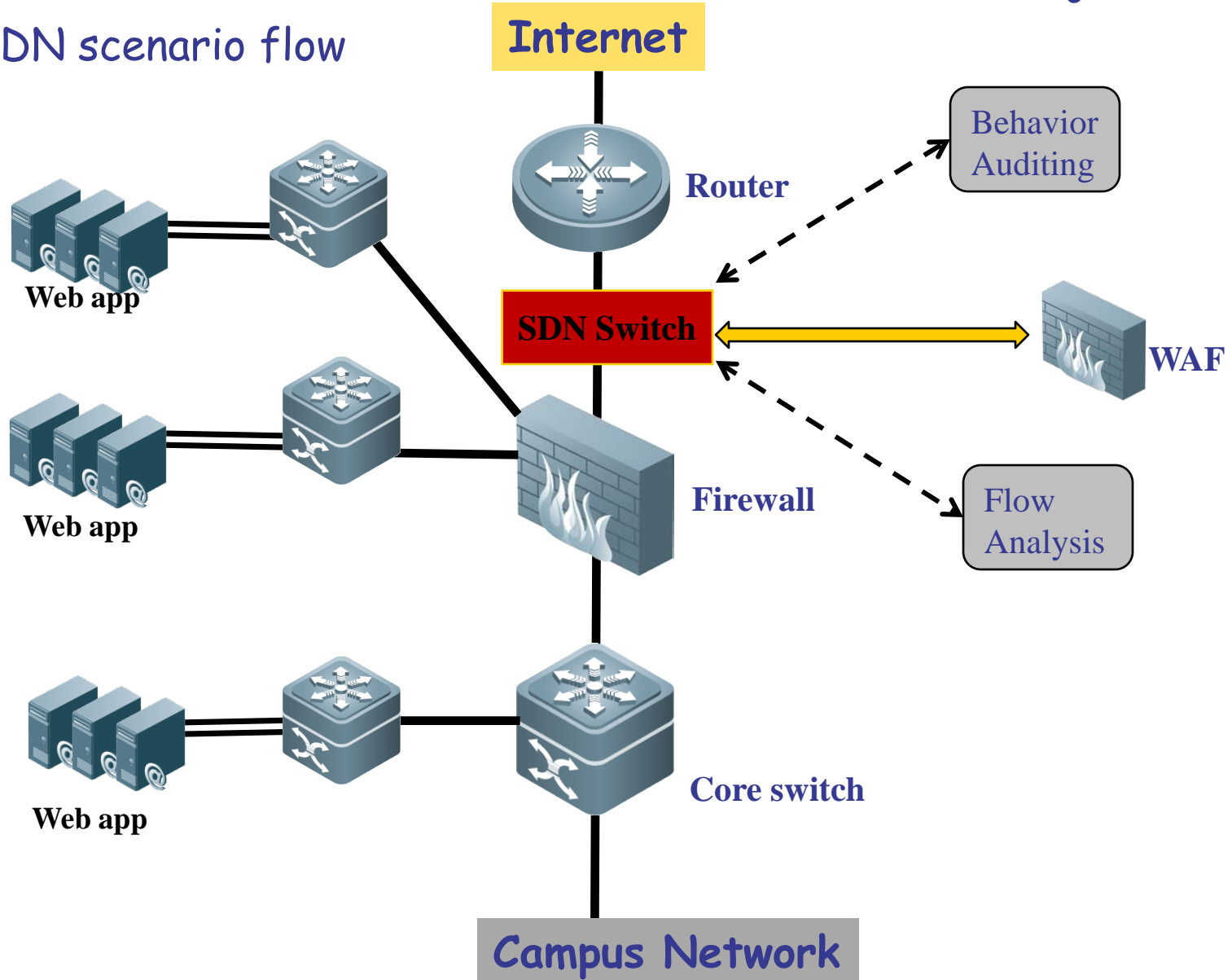
SDN Solution in Network Security

NON-SDN scenario flow



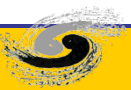
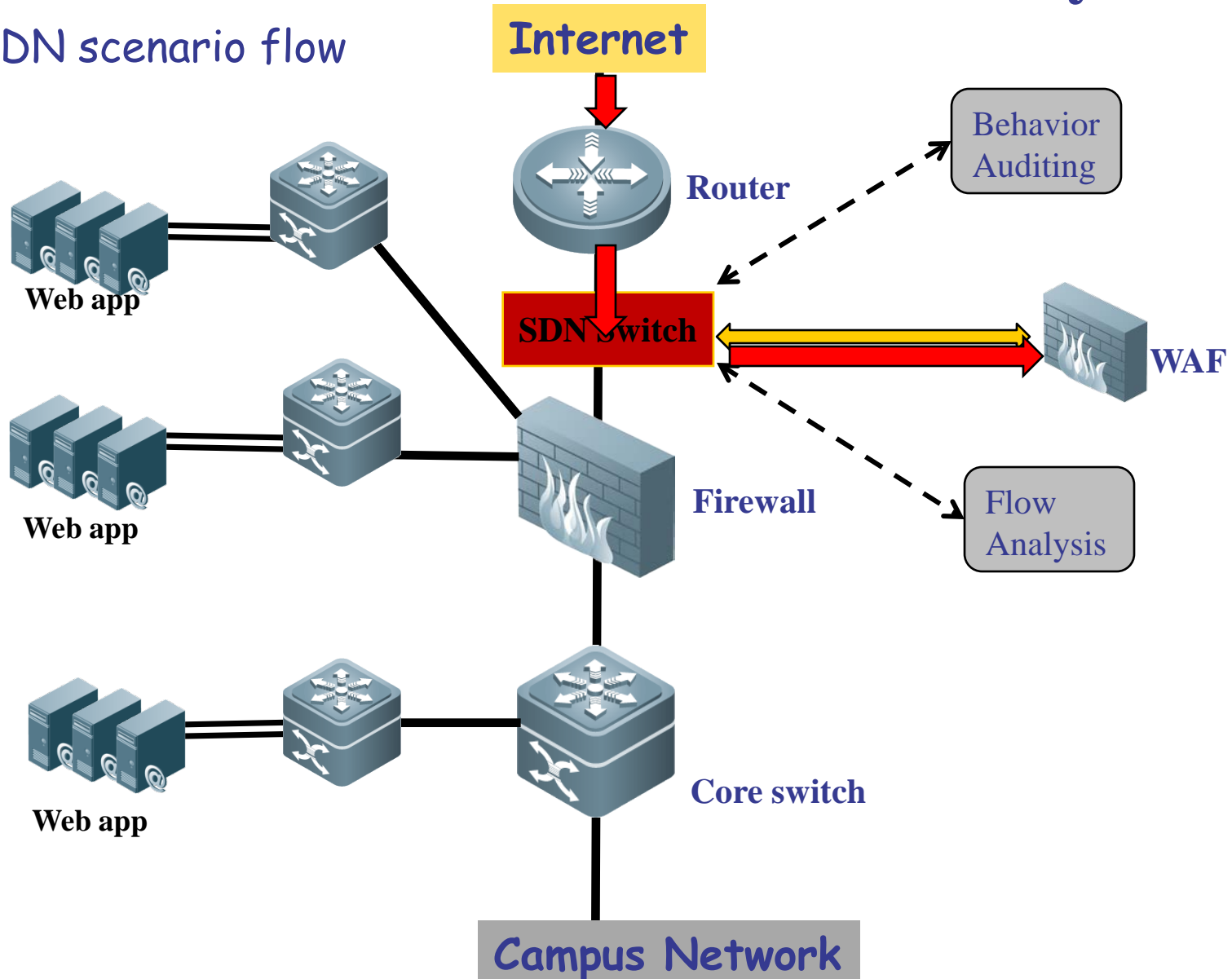
SDN Solution in Network Security

- SDN scenario flow



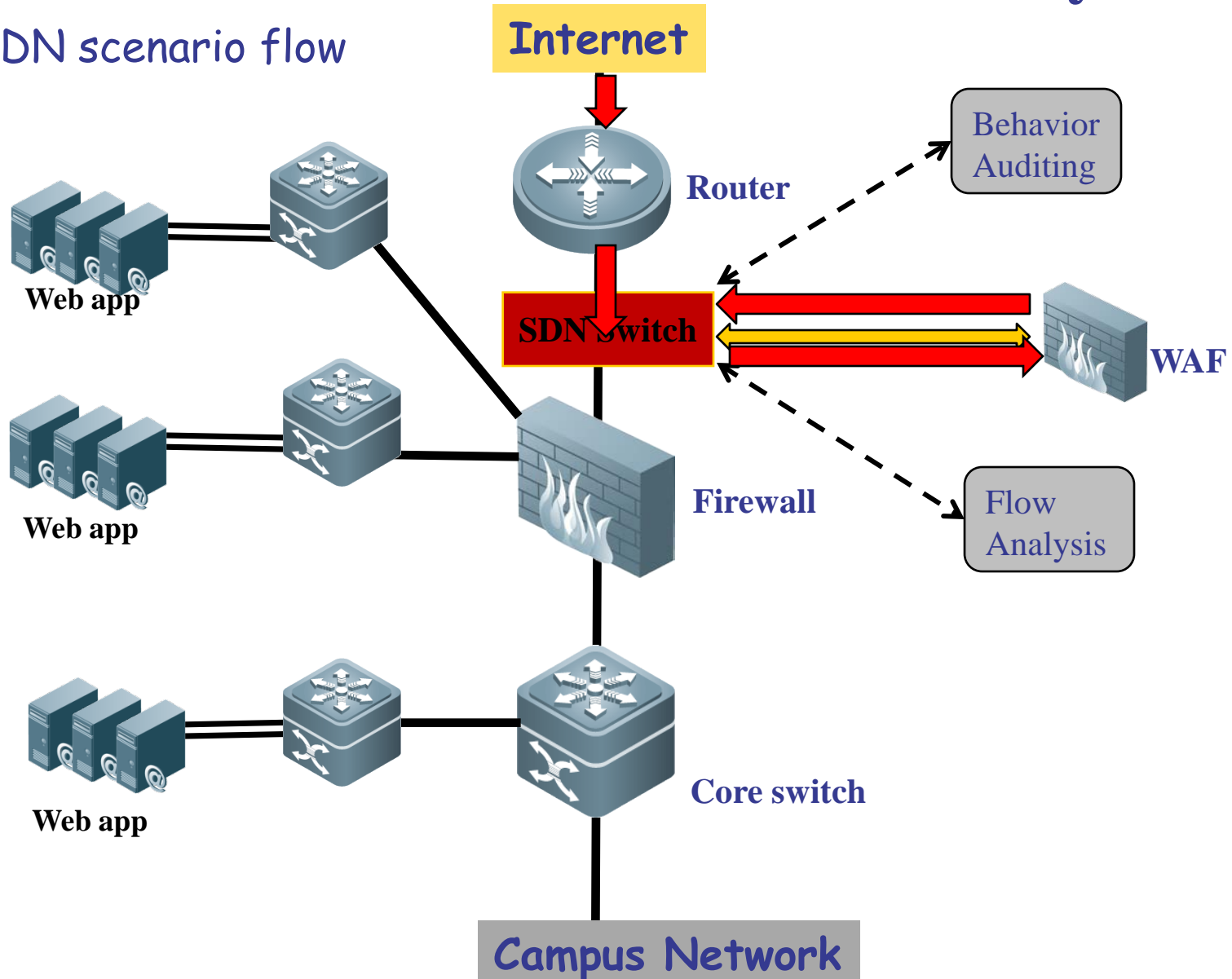
SDN Solution in Network Security

- SDN scenario flow



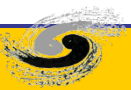
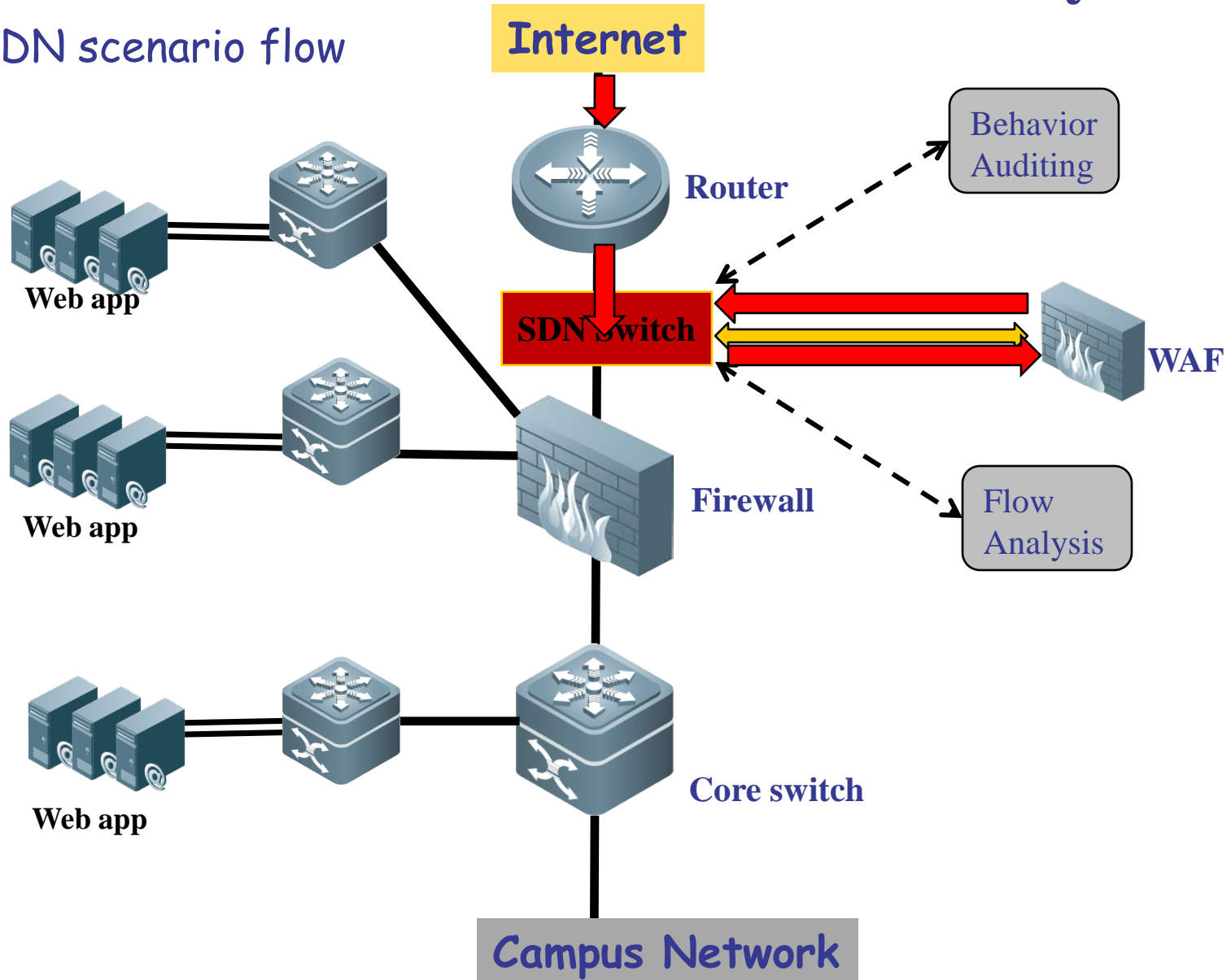
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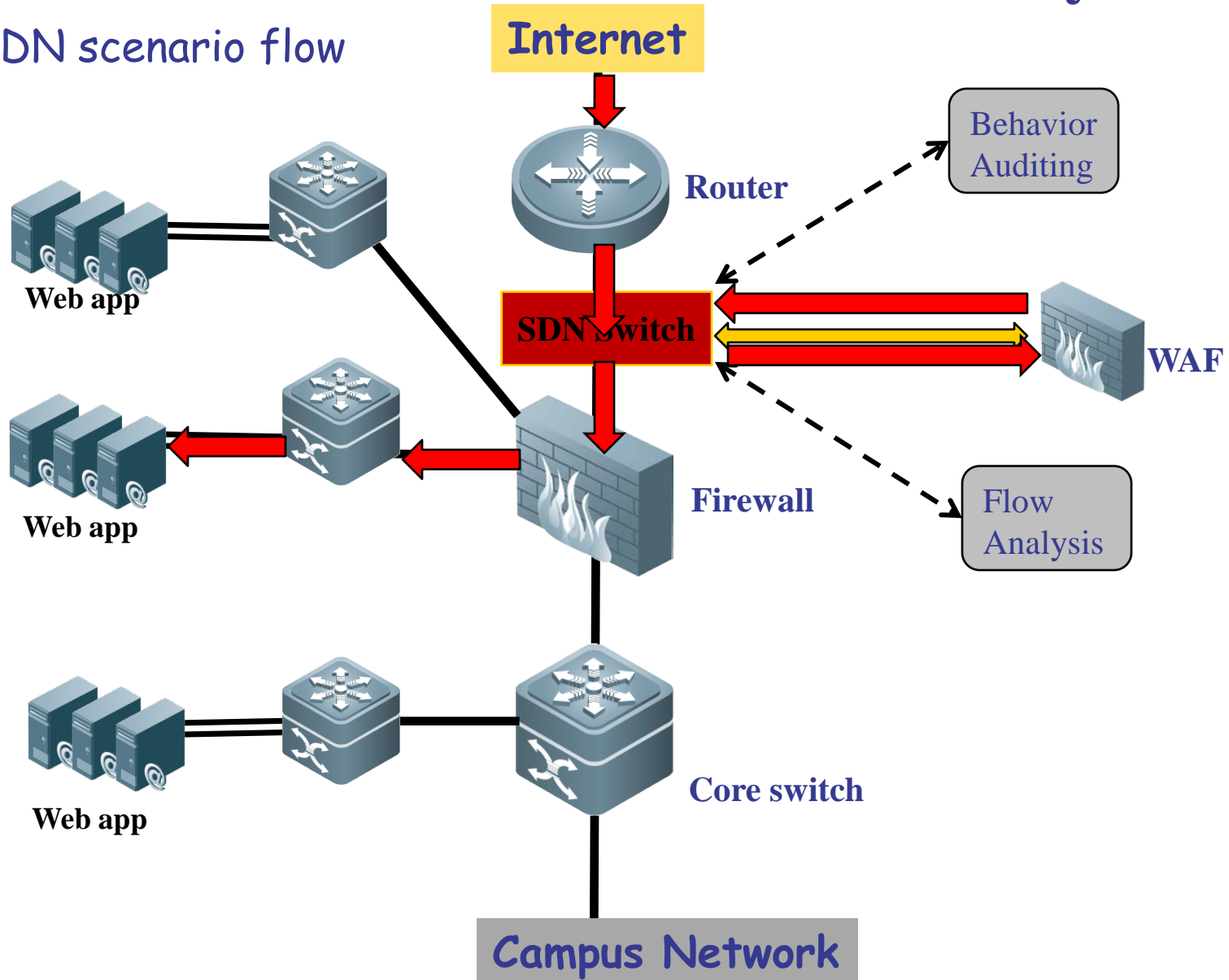
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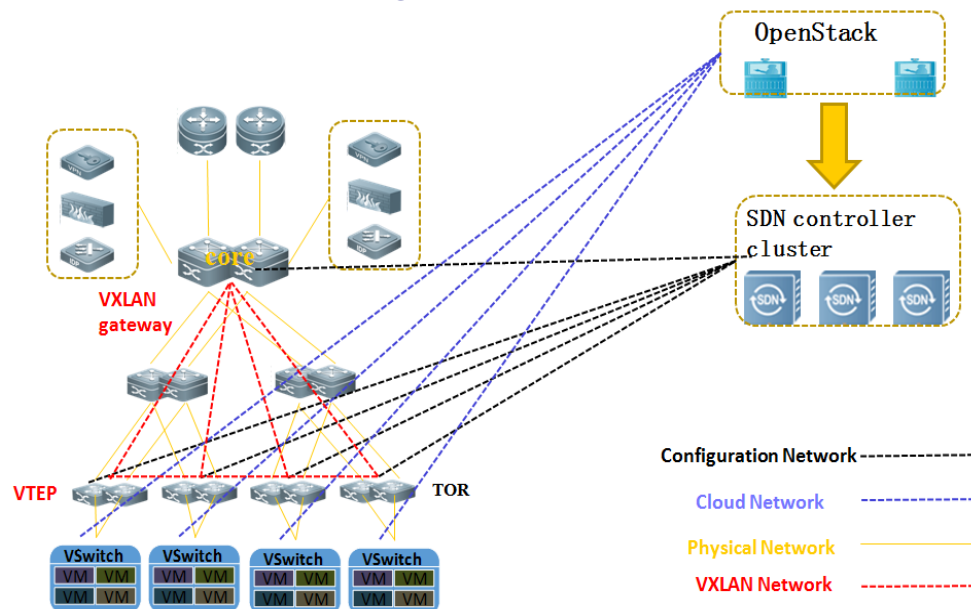
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SDN Solution in Data Center Cloud Environment

Integrated with openstack

- Cloud computing becomes more and more popular
- IHEP has built its own cloud platform based on OpenStack
- More and more applications have moved to this platform
- Compute and storage resources becomes flexible, however, under the traditional network architecture, network capability becomes the bottleneck of restricting the flexible application of cloud computing.
- So we introduce a SDN solution @datacenter



Tenant VM

<input type="checkbox"/>	云主机名称	镜像名称	IP 地址	配置	值对	状态	可用域	任务	电源状态
<input type="checkbox"/>	VM4	cirros	192.168.2.3	m1.tiny	-	运行中	nova	无	运行中
<input type="checkbox"/>	VM3	cirros	192.168.1.5	m1.tiny	-	运行中	nova	无	运行中
<input type="checkbox"/>	VM2	cirros	192.168.1.4	m1.tiny	-	运行中	nova	无	运行中
<input type="checkbox"/>	VM1	cirros	192.168.1.3	m1.tiny	-	运行中	nova	无	运行中

正在显示 4 项

OpenStack
vm

Controller Side

ip	mac	vlan
192.168.2.3	fa:16:3e:1a:1a:c8	3040
192.168.1.3	fa:16:3e:1a:54:f0	3005
192.168.1.4	fa:16:3e:5d:be:53	3005
192.168.1.5	fa:16:3e:40:37:0a	3005
192.168.1.2	fa:16:3e:8b:85:ab	3005
192.168.3.2	fa:16:3e:6a:77:03	3037
192.168.2.2	fa:16:3e:9e:49:e0	3040



Flexible configuration for each Flow

- Edit profile to add action for a flow

- Meter: used to specify bandwidth for specific application in cloud environment
- Drop
- Mirror
- redirect

TCP ~~192~~ **DESTINATION PORT**

UDP SOURCE PORT

UDP DESTINATION PORT

TCP Flags **None** ▼

Actions Settings **Add Action** ▼

Action Type: METER

Node

192.168.23.76

Ingress ports

1 [eth1/1/1]

Rate Limit (Mbps): 100



Topology view

OpenStack orchestration tool---Cloudify

Cloudify

Deployments > nodecellar2 > nodecellar2d1

App Status: 100%

Topology | Network | Events | Select view | Select workflow | ▶

nodejs_vm (1/1) | mongod_vm (1/1)

nodejs (1/1) | mongod (1/1)

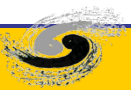
nodecellar_app (1/1)

Events

- Workflow Stage - nodejs_vm
2014-05-07 05:13:19
Installing plugin bash_runner
- Workflow Stage - nodejs_vm
2014-05-07 05:13:18
Installing plugins
- Task end successfully - nodejs_vm
2014-05-07 05:13:18
Task succeeded
'worker_installer.tasks.start'
- Task started - mongod_vm
2014-05-07 05:13:16
Task started [plugin_installer.tasks.install]

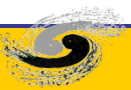
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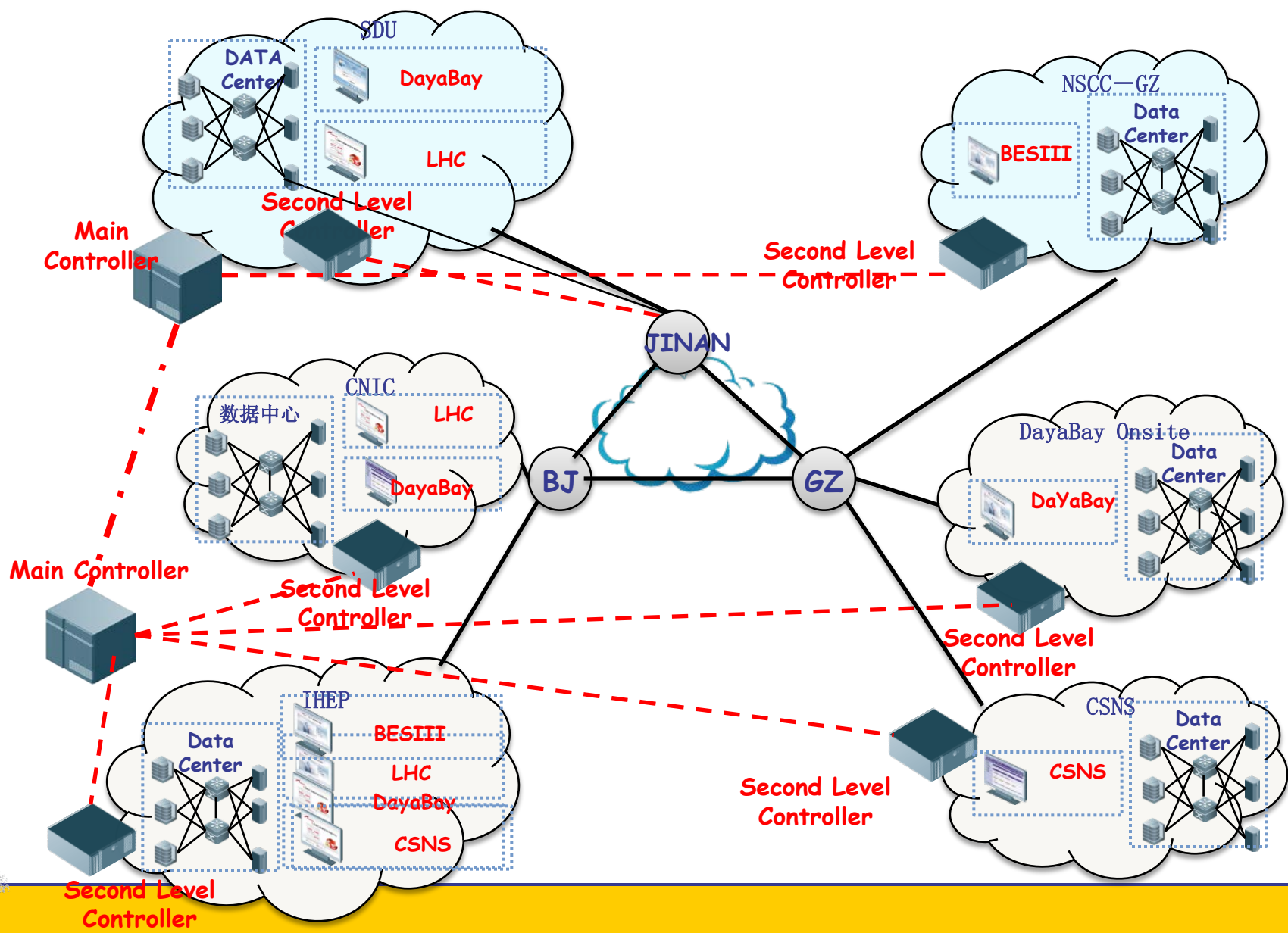


Future plan

- Connect all the network security devices including behavior auditing and flow analysis to SDN switch
- Research on the high performance multi-controller solution and deploy it
 - Hierarchy management:
 - Top level controller: Core switch
 - Second level controller: TOR switch
- Research on the Load balance between ODL controller and switches
- Develop and deploy monitoring pages for the system

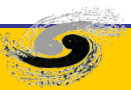


Future plan: SDN@WAN → CHEPDTN



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Summary

- SDN @Data Center test bed had already been built
- More network security devices will be connected to SDN switch
- High performance controller cluster is under researching
- SDN @WAN is in production
 - The preliminary results of this experimentation look promising and the team intends to continue working on this subject to improve the performance and efficiency
- Comments & suggestions: sdn-group@maillist.ihep.ac.cn



Q&A?

