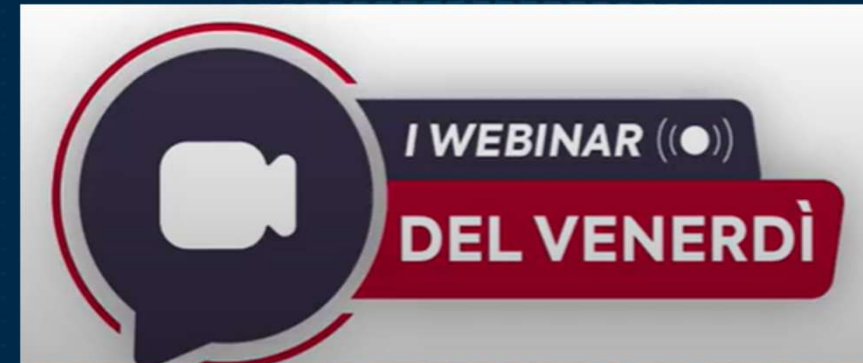


22 Novembre 2024

Reiss Romoli

SD-WAN

Aspetti tecnici e di business



SD-WAN

Software Defined – Wide Area Network

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Contact me on **LinkedIn**



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Soluzioni di Mercato

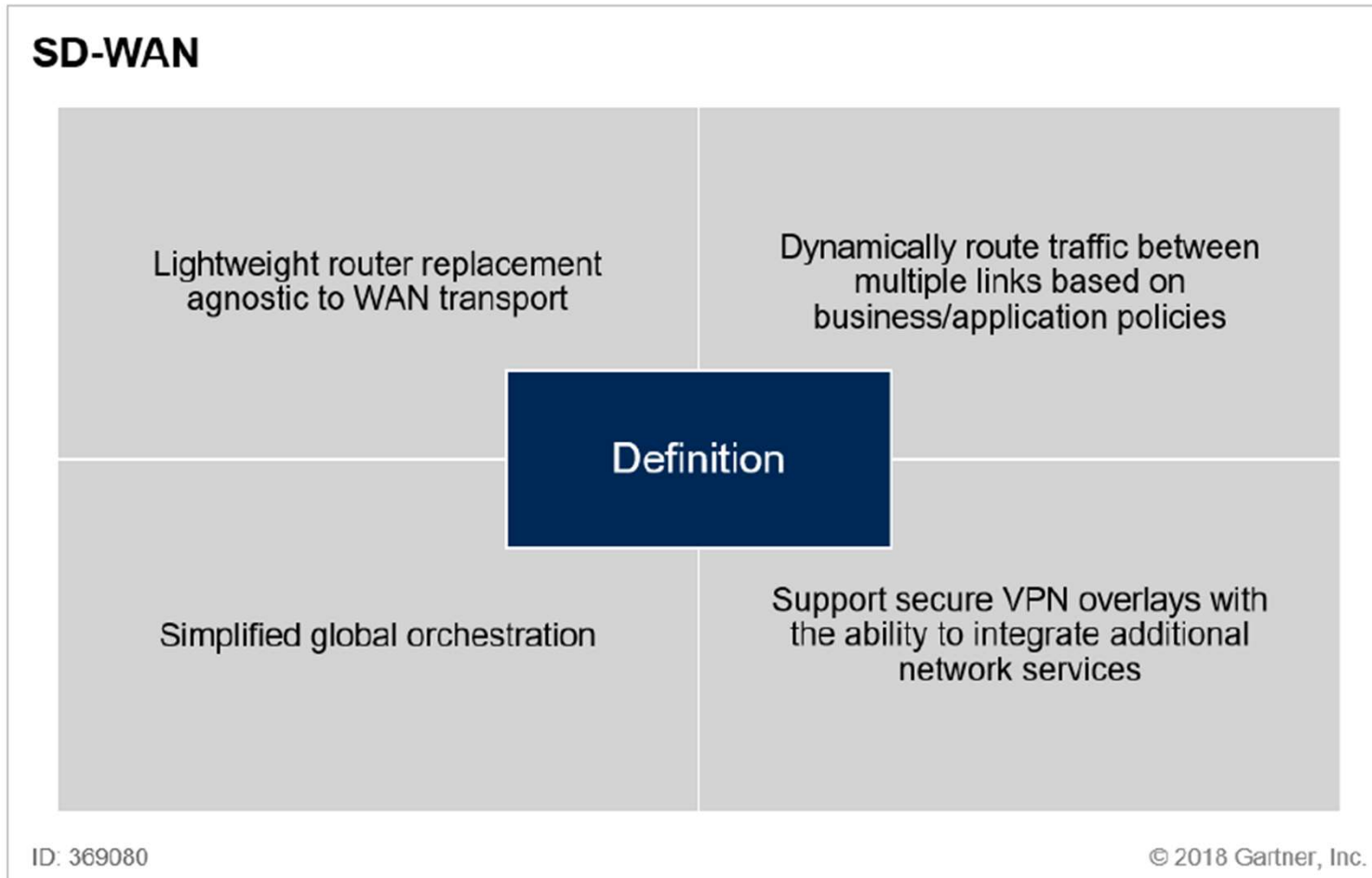
SD-WAN= Software Defined + Wide Area Network.

Applicazione del paradigma SDN (Software Defined Network) al mondo delle Connettività' su Reti Geografiche.

Impatta l'intero Ciclo di Vita dei servizi di Connettività', partendo dalla Progettazione, Delivery Provisioning fino all'Assurance, introducendo un approccio Agile, Flessibile e Dinamico.

**SD-WAN non è una EVOLUZIONE dei servizi di Connettività',
è una RIVOLUZIONE**

Definizione di SD-WAN: Gartner



* Gartner: Technology Insight for SD-WAN.

Definizione di SD-WAN: MEF Forum



An SD-WAN Service provides a virtual overlay network that enables application-aware, policy-driven, and orchestrated connectivity between SD-WAN User Network Interfaces, and provides the logical construct of a L3 Virtual Private Routed Network for the Subscriber that conveys IP Packets between Subscriber sites.

An SD-WAN Service operates over one or more Underlay Connectivity Services. Since the SD-WAN service can use multiple disparate Underlay Connectivity Services, it can offer more differentiated service delivery capabilities than connectivity services based on a single transport facility.

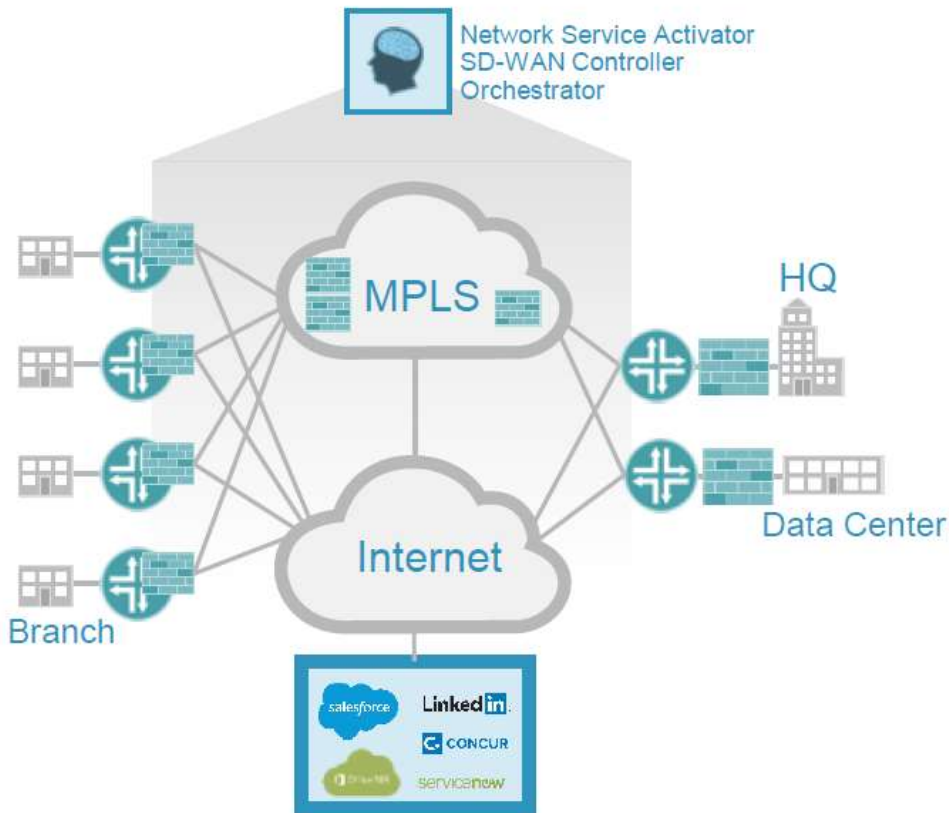
An SD-WAN service is aware of, and forwards traffic based on, Application Flows. The Service agreement includes specification of Application Flows—IP Packets that match a set of criteria—and Policies that describe rules and constraints on the forwarding of the Application Flows.

SD-WAN benefits can be manifested in the ability to adjust aspects of the service in near real time to meet business needs. This is done by the Subscriber by specifying desired behaviors at the level of familiar business concepts, such as applications and locations and by the Service Provider by monitoring the performance of the service and modifying how packets in each Application Flow are forwarded based on the assignment of policy and the real-time telemetry from the underlying network components.

** MEF 70: SD-WAN Service Attributes and Services. July 2019*

SD-WAN secondo Juniper

WHAT IS SD-WAN ?



Gartner says SD-WAN has four characteristics

Must support multiple WAN connections

MPLS, Internet, LTE etc.

Can do dynamic path selection

Allows for load sharing across WAN links

Provides simplified WAN management

Must support zero-touch provisioning of remote branch

Must support secure VPNs

And have ability to integrate additional network services like Firewall, WAN Ops etc

Reference : <https://goo.gl/leJtbN>

© 2018 Juniper Networks

JUNIPER NETWORKS

Drivers & Challenge sul Mercato della Connettività'

Il macro requisito:

Servizi che abilitano i Clienti a controllare direttamente le Connettività' contrattualizzate, con un approccio On-Demand, Sicuro, Agile e Dinamico

Top 5 Purchasing Drivers/Benefits

- Faster Service Provisioning
- Ability to scale the network on-demand
- Business agility to adjust to market dynamics
- Ability to dynamically tailor to application needs
- Lower network connectivity service costs

Top 5 Deployment Challenges

- Current OSS/BSS systems are inadequate
- Integration with legacy infrastructures
- Standards are insufficient or incomplete
- Network operators not strategically committed
- Funding constraints for deployment

SD-WAN li indirizza tutti

* Sondaggio Vertical System. 50 Service Provider + 37 Vendor

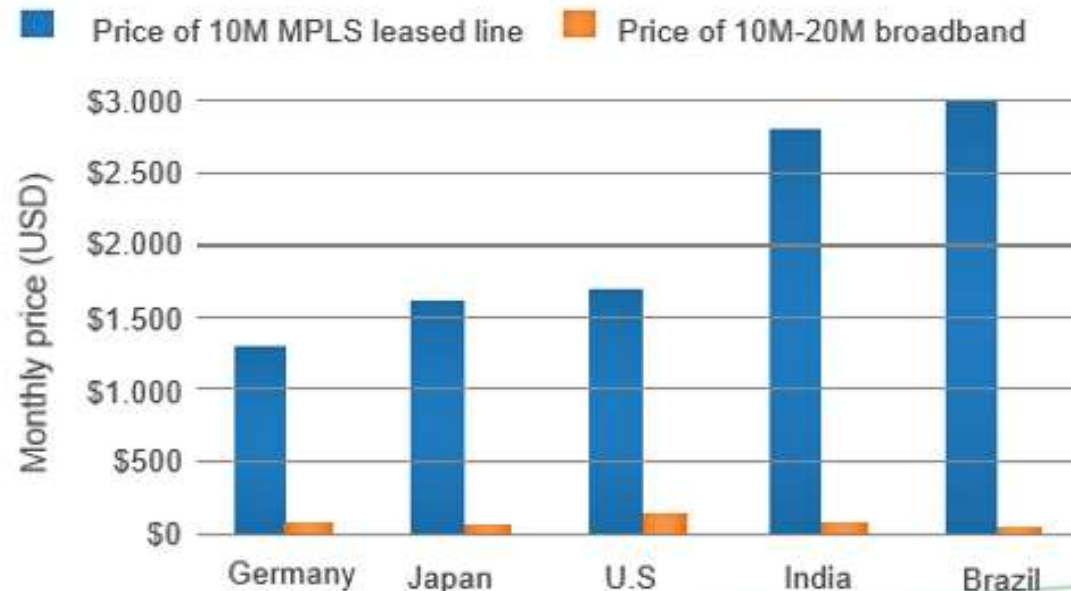
Il Prezzo per mbps: un asset distintivo di SD-WAN

The price of MPLS IP VPN is 15-50 times higher than that of broadband.

Con SD-WAN:

- Applicazioni Mission Critical su connessioni Premium;
- Applicazioni BE su connessioni Broadband.

Comparison Between Prices of MPLS Leased Lines and Broadband in Different Countries



Source: 2015 TeleGeography

SD-WAN: 4 falsi Miti

Mito

Realta'

SD-WAN sostituisce MPLS

SD-WAN puo' ottimizzare/ridurre il ricorso ad MPLS, non sostituirlo

SD-WAN garantisce la QoS

Con SD-WAN si misura latenza, packet loss e Jitter e selezionare il cammino a migliori prestazioni.
Se tutti i cammini hanno bassa qualita' SD-WAN non garantisce la QoS

L'unico beneficio di SD-WAN Vs MPLS e' il minor costo

SD-WAN non solo e' piu economico (*come prezzo per Mbps*) ma piu' semplice in termini di gestione, operation ed aggiornamento

SD-WAN e' sinonimo di WAN optimization

SD-WAN e' diverso da WAN optimization. Possono essere usati indipendentemente o combinati per ottimizzare la banda disponibile

Indice

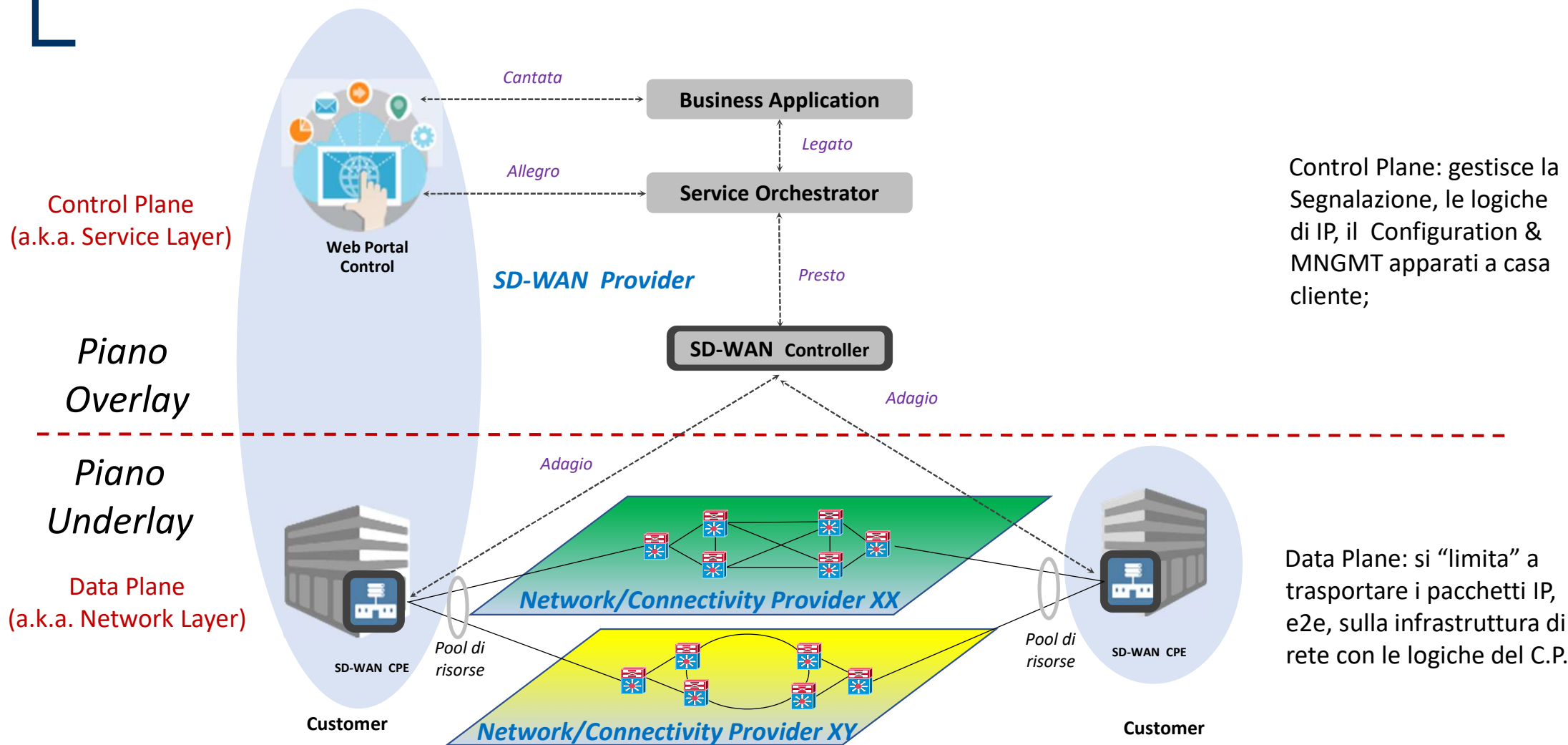
#1 Introduzione, definizioni e ... *falsi miti*

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Piano di Controllo (*Overlay*) e Piano Dati (*Underlay*)

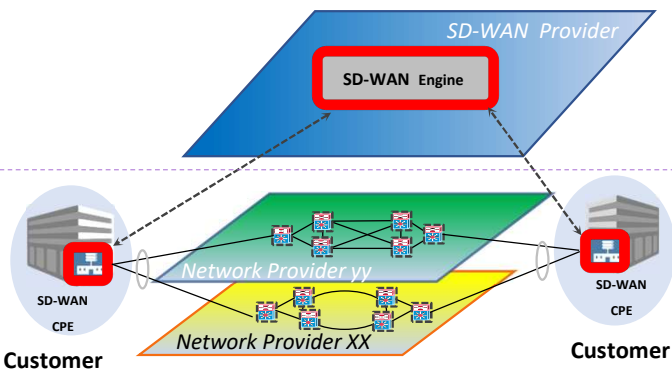


SD-WAN: Over The Top, Over The Network

Over The Top SD-WAN

Overlay SD-WAN,

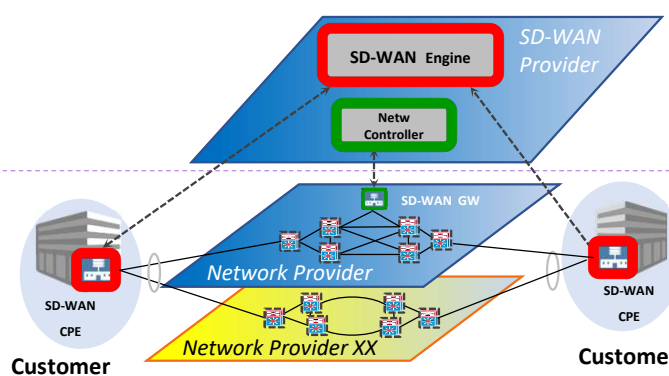
Ingegnerizzata dai Vendor di prodotti SD-WAN, Hosted & Managed dal Service Provider di SD-WAN. Il Network Provider fornisce Dumb Pipe



Over The Network SD-WAN (Light)

Hybrid/Synergistic SD-WAN:

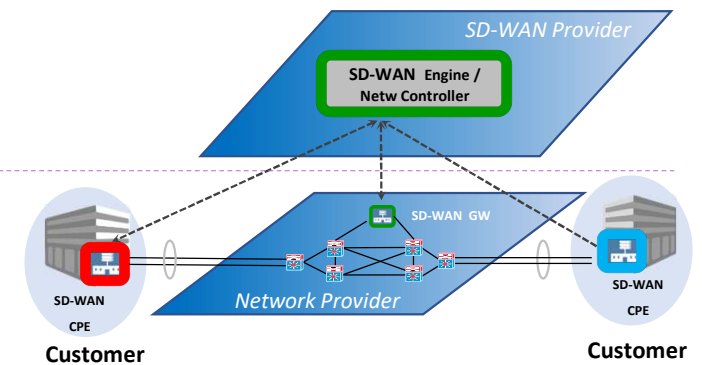
> integrazione con la connettività di rete e sue funzioni (e.g. Bandwidth on Demand, BoD)



Over The Network SD-WAN (Full)

"Network Based" SD-WAN:

Ingegnerizzata dal Network Provider, piena integrazione con la connettività Underlay



Service Layer

Network Layer

Vantaggi e Svantaggi

- Il SP sfrutta Partering (se il Vendor SD-WAN porta i Clienti);
- I Network Provider sono in competizione;
- SD-WAN Vendor Lock-in (Il SP puo dover offrire molteplici prodotti SD-WAN).

Vantaggi e Svantaggi

- Uguali a soluzione OTT;
- Aggiunge funzioni distintive Network Based al puro Overlay.

Vantaggi e Svantaggi

- Un unico Network Provider;
- Assenza di Vendor Lock-in (vincolo su CPE);
- Soluzione in competizione con i Prodotti dei vendor SD-WAN.

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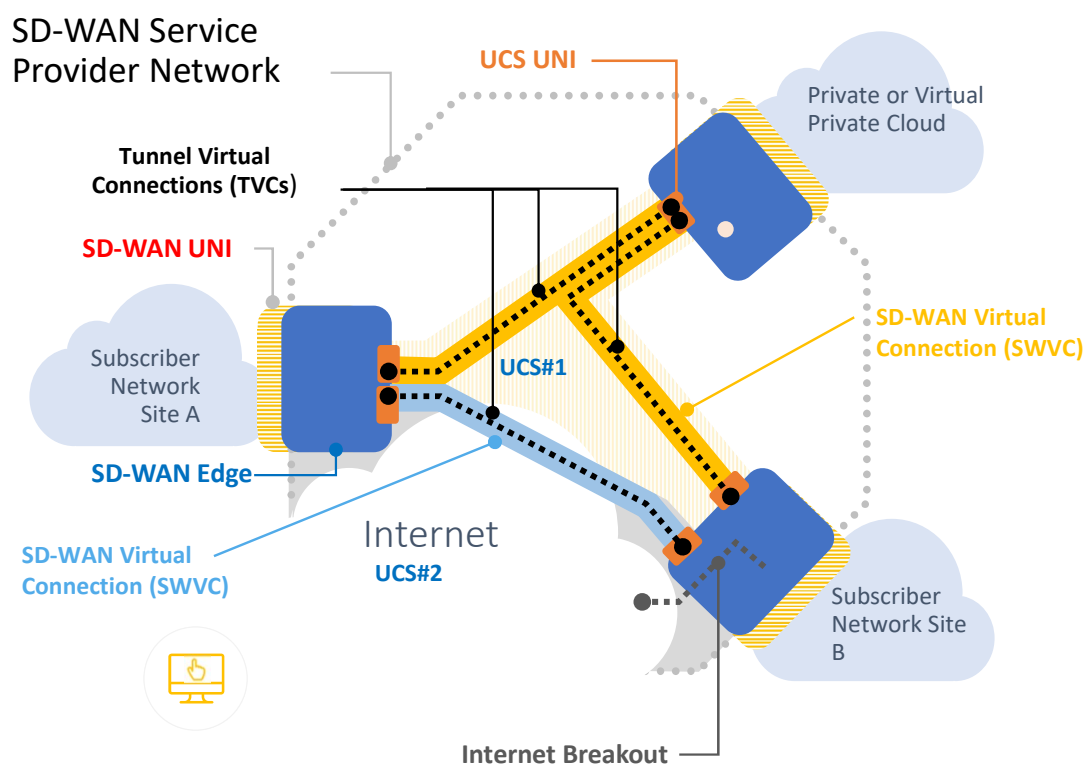
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SD-WAN: terminologia standard



- ✓ **SD-WAN User to Network Interface (UNI)**
Punto di demarcazione tra i domini amministrativi del Service Provider e del Cliente
- ✓ **SD-WAN Virtual Connection (SWVC)**
Connessione Logica, multipoint, tra SD-WAN UNIs appartenenti al Servizio SD-WAN Service
- ✓ **SD-WAN Virtual Connection End-Point (SWVC EP)**
Punto di assegnazione ed attivazione delle “Application Flow Policies”
- ✓ **SD-WAN Edge**
Punto di contatto tra SD-WAN UNI ed UCSs; associa i pacchetti alle “Application Flows”, agisce le policies e seleziona il TVC su cui instradare ogni flusso
- ✓ **Underlay Connectivity Service (UCS)**
Una qualsiasi connettività WAN impiegata dal servizio SD-WAN: Ethernet, IP, MPLS VPN, Accesso Internet, Trasporto Ottico, connettività Mobile, ...
- ✓ **Tunnel Virtual Connection (TVC)**
Percorso point-to-point sull’UCSs impiegato dal servizio SD-WAN
- ✓ **Internet Breakout**
“Application Flows” instradato da SD-WAN UNI direttamente su Internet (non diretto verso un'altra SD-WAN UNI)

* Mef 3.0: SD-WAN Technical Overview. October 2022.

SD-WAN: un servizio “Application Aware”

- Il “Networking” tradizionale seleziona i cammini dei pacchetti o delle trame sulla base di protocolli di routing o bridging in funzione degli header dei pacchetti o trame o sul Port Addressing;
- SD-WAN identifica “Application Flows” ed instrada selettivamente ogni Applicazione sul Cammino (Path) che meglio ne soddisfa i requisiti;
- Application Flows sono definiti sulla base di campi dei pacchetti che possono considerare i livelli OSI 2 e 3 (Network Address), ma anche spingersi oltre, fino al livello 7 (Application);

Un pacchetto viene associato ad un “Application Flow_pippo” se ne rispetta il set di criteri: “Application Flow Specification_ pippo”

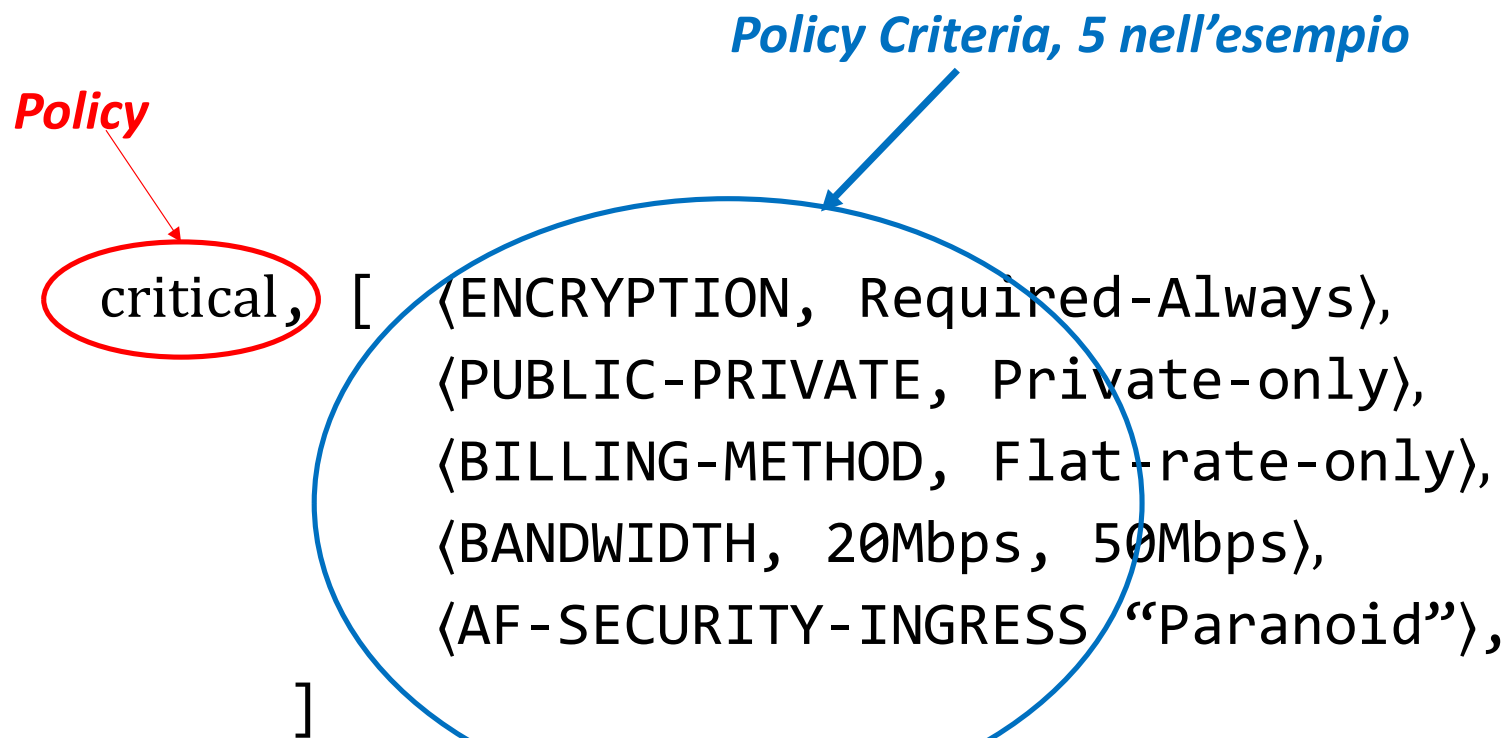
- I Service Providers possono fornire un catalogo che comprenda “Application Flow Specifications” anche complesse.

SD-WAN: un servizio “Policy-Based”

- SD-WAN consente di definire degli “Application Flows” e conseguentemente instrada ogni “Application Flow” sul cammino (Path) che meglio soddisfa i requisiti per quel flusso;
- Quanto sopra si realizza mappando opportune “Policy” ad ogni “Application Flow”;
- La Policy contiene regole su come processare ed instradare l’“ApplicationFlow”
Ad esempio, l’“Application Flow”:
 - richiede Crittografia?
 - Può andare sulla Big Internet? (*nel caso la Big internet sia uno degli Ucs disponibili*)
 - Ha dei vincoli sulla ampiezza di banda (*banda minima, banda garantita*)?
 - Ha requisiti sulle performances (*loss, delay, etc.*)?
 - ...

Come si costruisce una Policy

Policy = insieme di n "Policy Criteria"



* Mef 3.0: SD-WAN Technical Overview. October 2022.

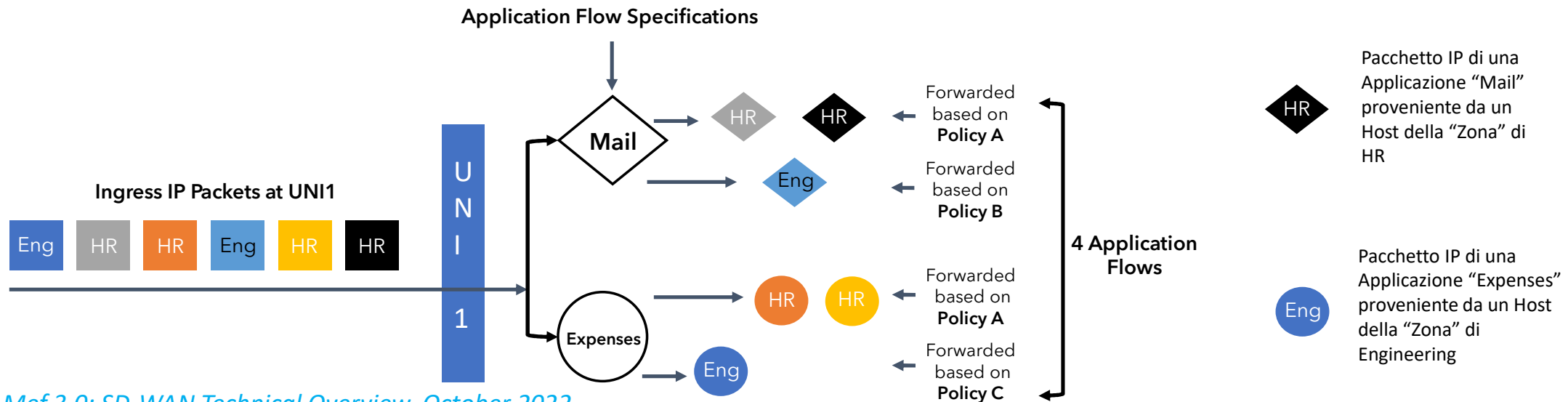
Zones (e.g. IP Address Range)

Gli Host del Cliente possono essere partizionati in “Zones”: range di IP Address (*non sovrapposti*)

Ad esempio:

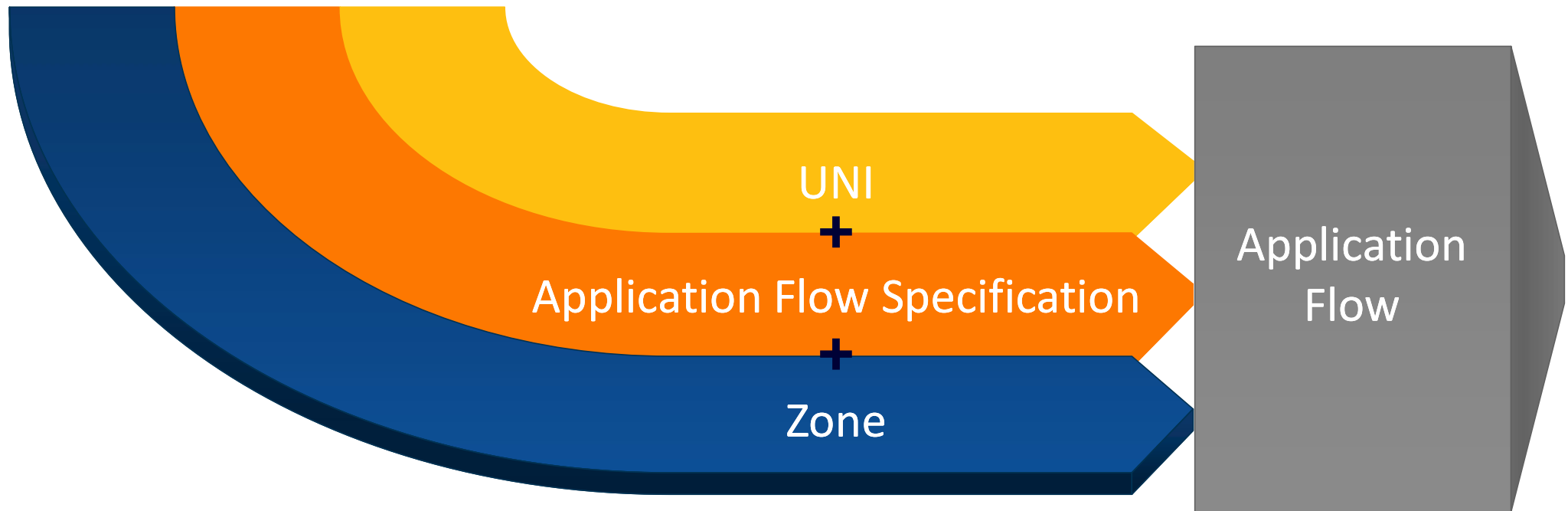
- Zone “Human Resources”: 192.168.1.128/29;
- Zone “Engineering”: 192.168.1.192/26.

Le Policies sono assegnate agli Application Flows



* Mef 3.0: SD-WAN Technical Overview. October 2022.

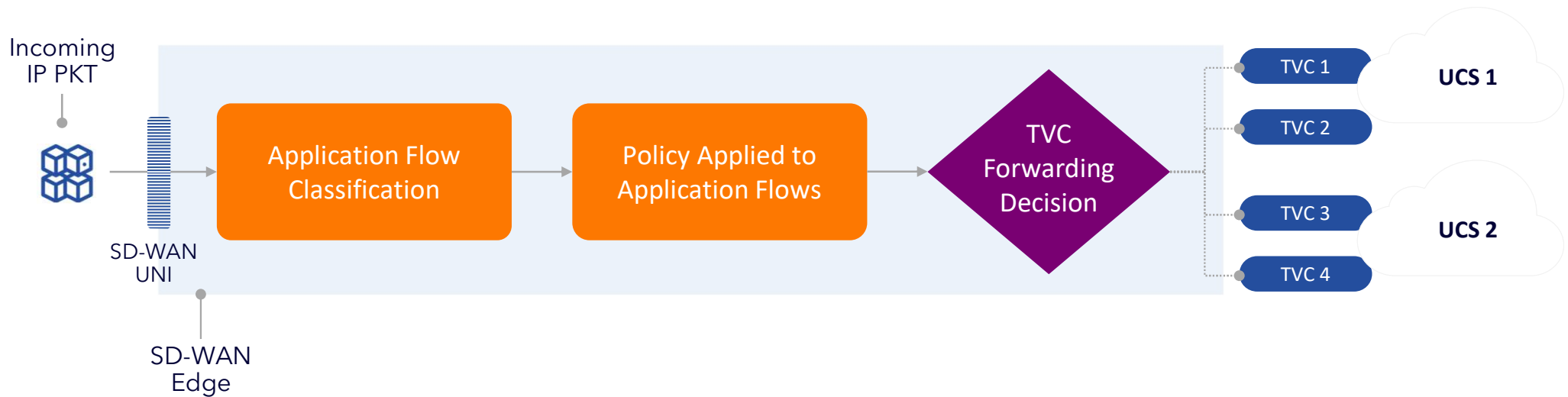
Application Flow



Un Application Flow è definito univocamente dalla triade:
UNI + Application Flow Specification + Zona

** Mef 3.0: SD-WAN Technical Overview. October 2022.*

SD-WAN Application Flow & Policy Function

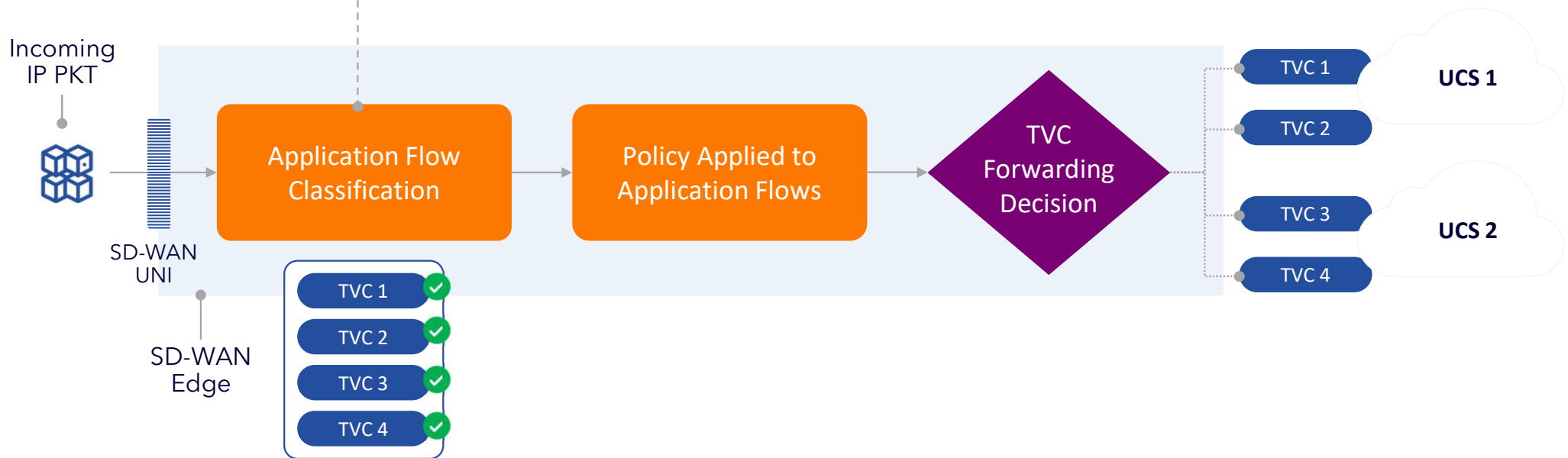


* Mef 3.0: SD-WAN Technical Overview. October 2022.

SD-WAN Application Flow & Policy Function

Example Classification Criteria:

- Src/Dst IP Address
- L4 Protocol
- Src/Dst Port
- Custom match

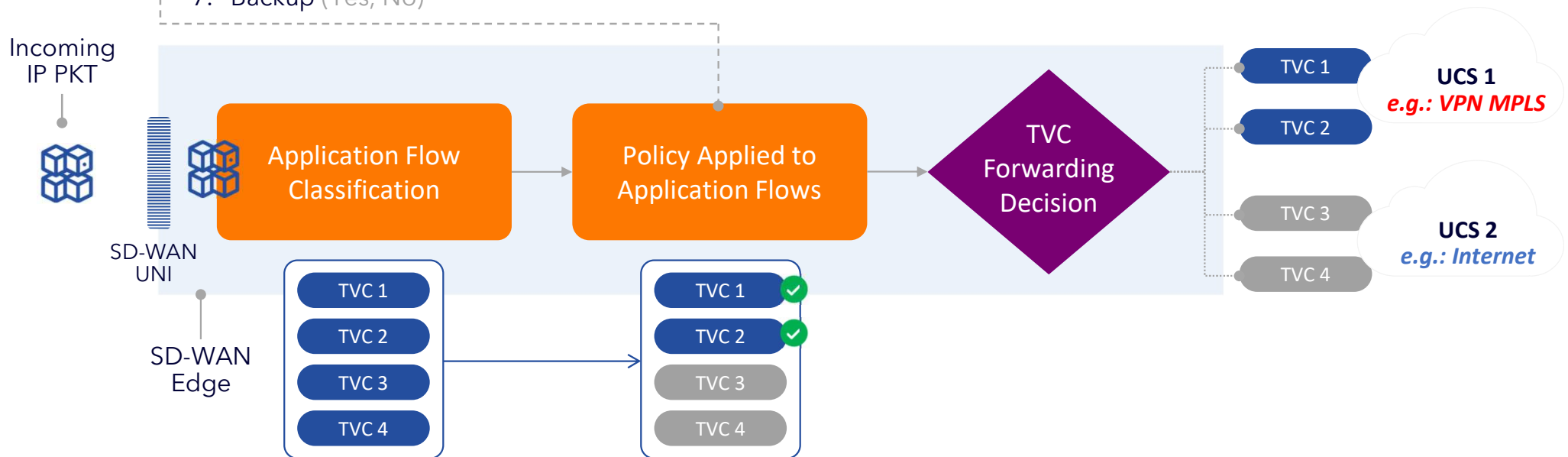


* Mef 3.0: SD-WAN Technical Overview. October 2022.

SD-WAN Application Flow & Policy Function

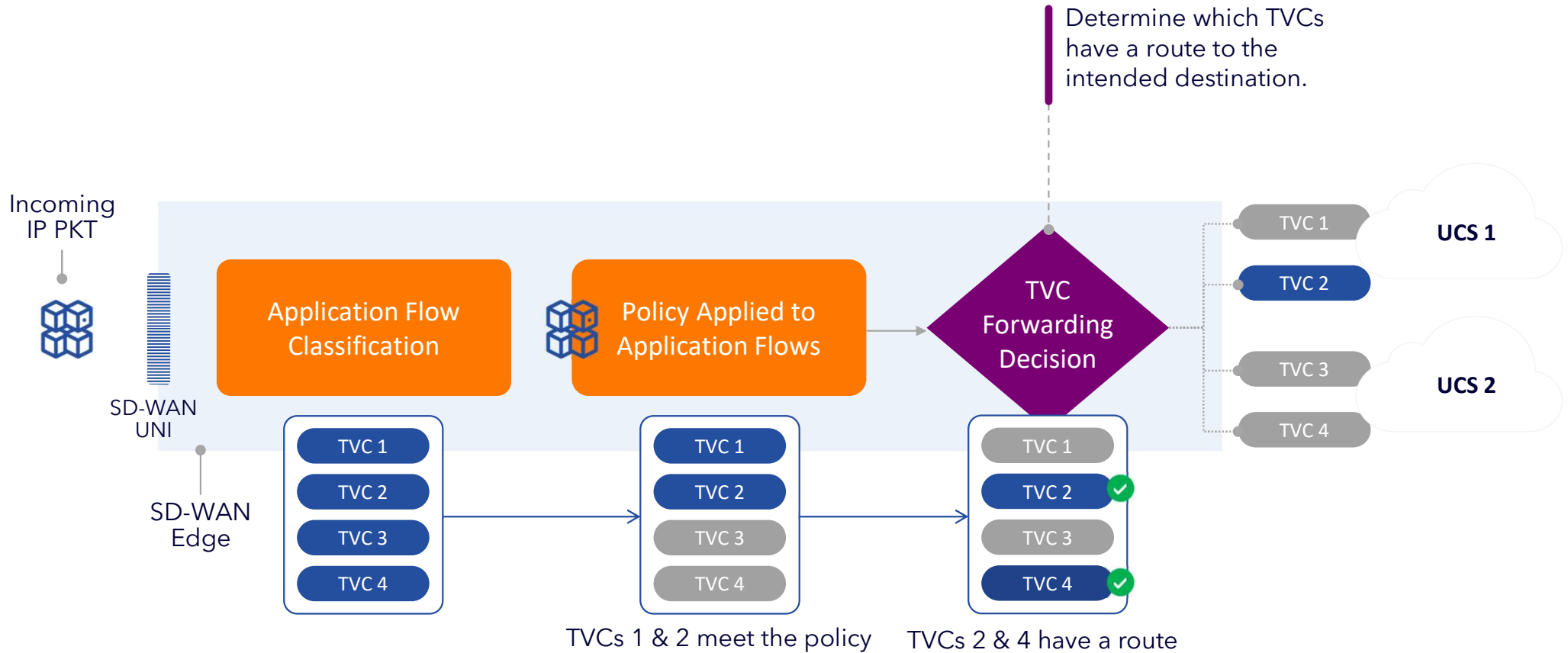
Each Policy includes:

1. Encryption (Yes, either)
2. Public-private (**Private-only**, either)
3. Virtual-topology (Virtual Topology Name)
4. Egress-zones (List of Zone Names)
5. Internet-breakout (Yes, No)
6. Billing-method (Flat-Rate-only, Usage-Based-only, Either)
7. Backup (Yes, No)
8. Performance (Subscriber indicates important Metrics for each App. Flow + a bound on acceptable value)
9. Bandwidth (Committed and Max Rate)
10. AF-Security (*Disabled* or a list of Security functions & associated parameters from MEF 88)



* Mef 3.0: SD-WAN Technical Overview. October 2022. TVCs 1 & 2 meet the policy

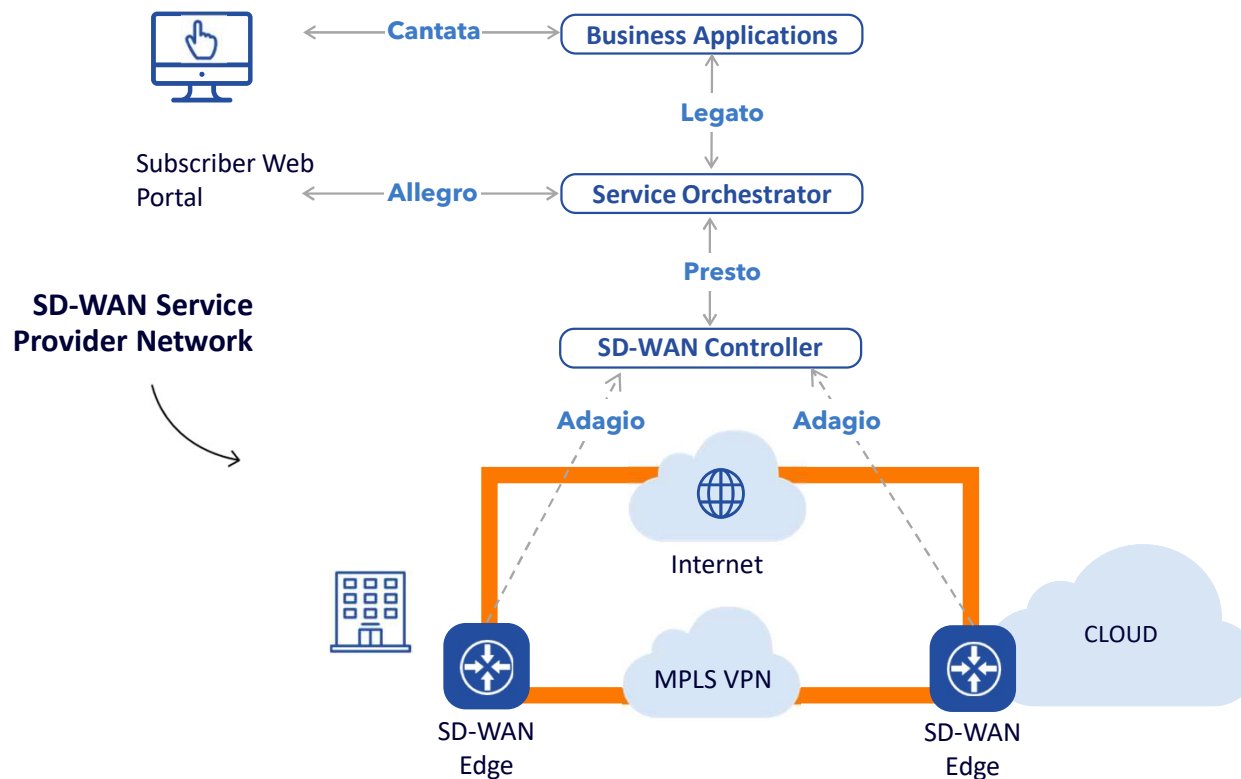
SD-WAN Application Flow & Policy Function



* Mef 3.0: SD-WAN Technical Overview. October 2022.

Hybrid WAN: SD-WAN Service su Internet ed MPLS UCSs

Large Enterprise

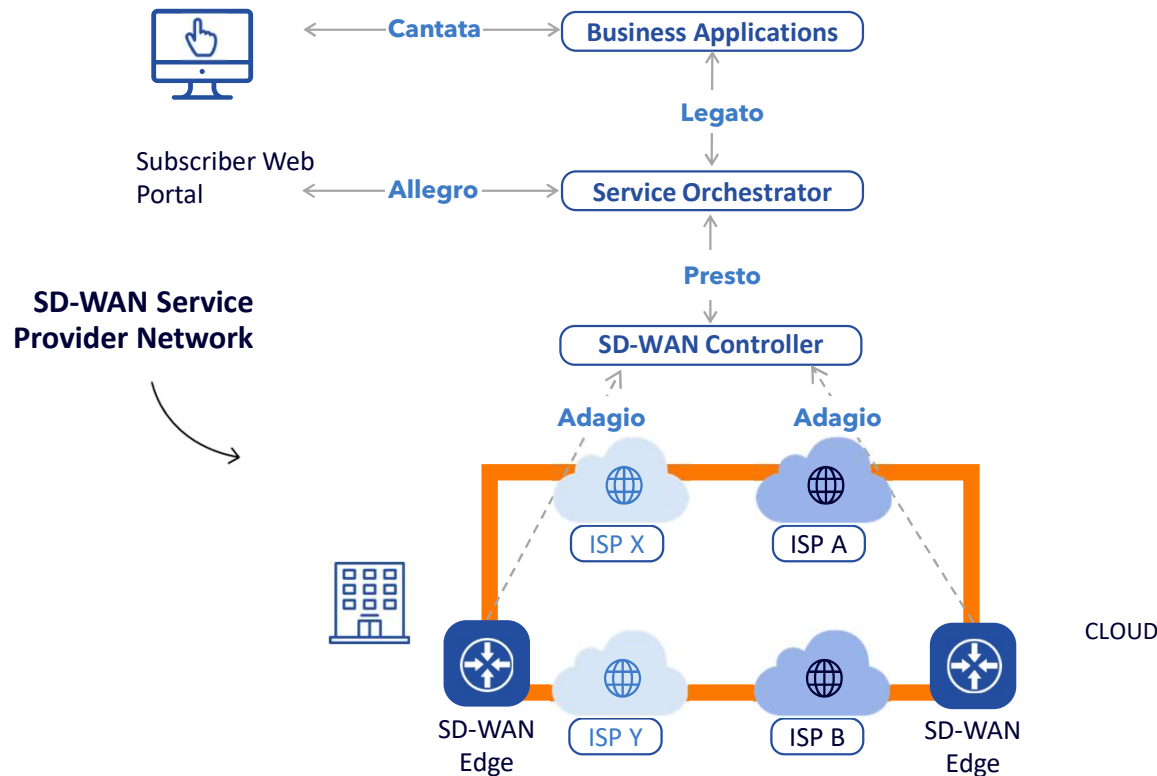


- TVCs crittografati su UCS Internet
- Prevedere Banda aggiuntiva per le sedi ad un prezzo inferiore
- Upgrade di Network Availability and Resiliency
- Internet ed MPLS VPN UCS possono essere forniti da diversi Service Provider

* Mef 3.0: SD-WAN Technical Overview. October 2022.

Dual Internet UCSs: SD-WAN Service over Multiple ISPs

Small Site

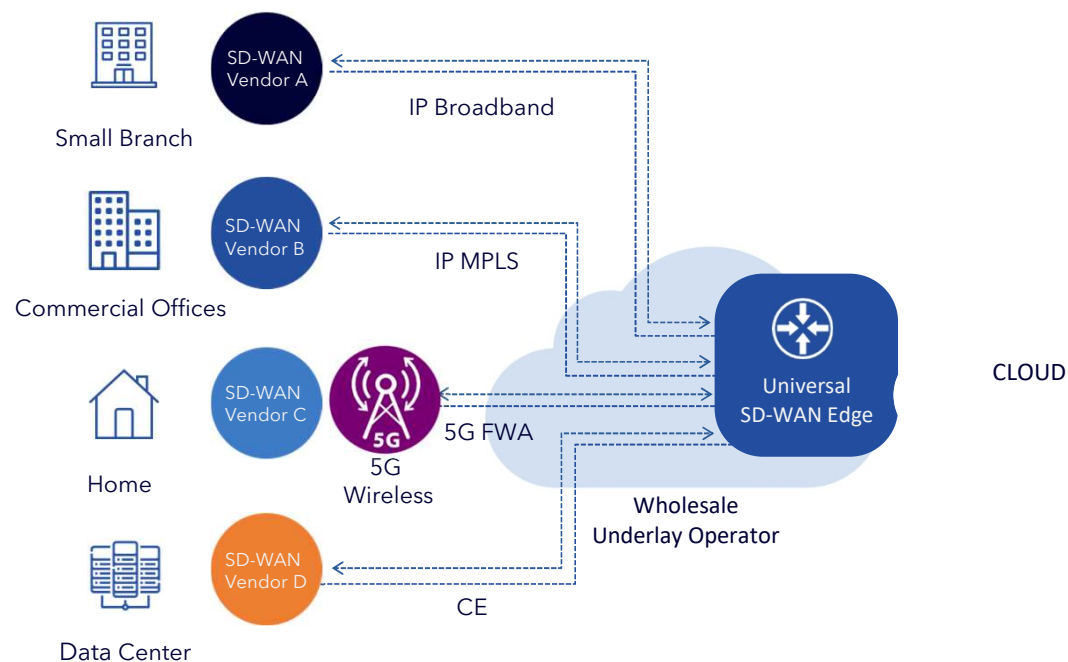


- TVCs SD-WAN Crittografati su ogni Internet UCS di ogni ISP
- Uso di ISPs multipli garantisce la Provider diversity
- Migliore Network Availability and Resiliency
- ISPs possono non coincidere con l'SD-WAN Service Provider

* Mef 3.0: SD-WAN Technical Overview. October 2022.

Universal SD-WAN Edge for the Cloud

Cloud Side



- Progettata per il Cloud e Service Provider Edge dove occorre supportare la eterotecnologia di SD-WAN CPE vendors
- Minima Interoperabilità tra vari SD-WAN vendors a livello di data, control, telemetry and management plane
- Baseline interop con la possibilità' per SD-WAN vendors/providers di differenziarsi con funzionalità SD-WAN arricchite/innovative

* Mef 3.0: SD-WAN Technical Overview. October 2022.

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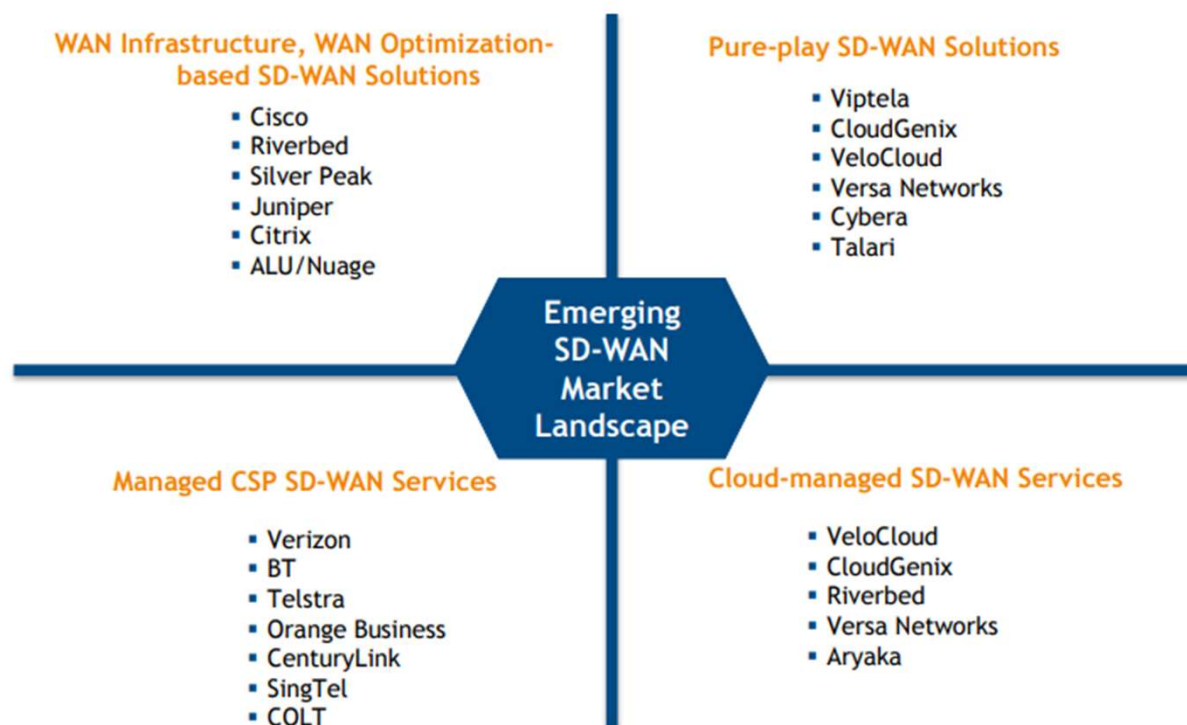
#1 Introduzione, definizioni e ... *falsi miti*

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Emerging SD-WAN Landscape



* IDC: *Delivering Digital Transformation At Scale: Network Trends and Architectures, 2016*

(*) including SIs, managed SPs, ISPs, SD-WAN vendors and other players

Gartner Magic Quadrant

* Versa Webinar: What do the Expert Say. Dec 2023



Gartner Magic Quadrant for SD-WAN



* <https://blogs.cisco.com/networking/cisco-named-a-leader-2018-gartner-magic-quadrant-wan-edge-infrastructure>

* <https://www.fortinet.com/solutions/gartner-wan-edge>

<https://www.fortinet.com/>
3 Ottobre 2024

Cisco e le 2 soluzioni SD-WAN

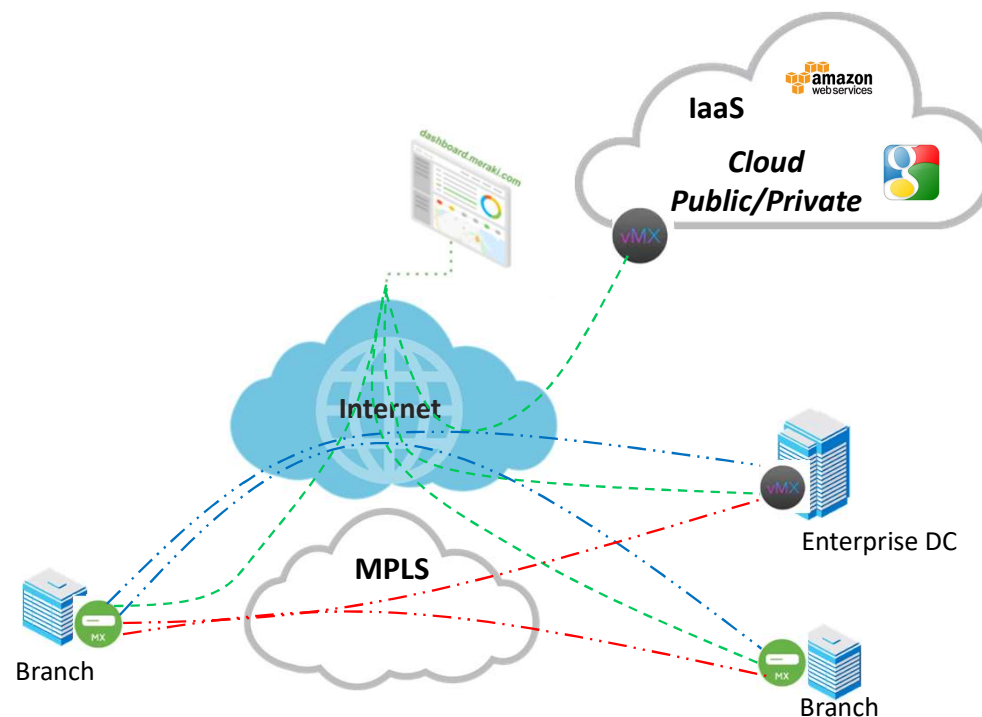
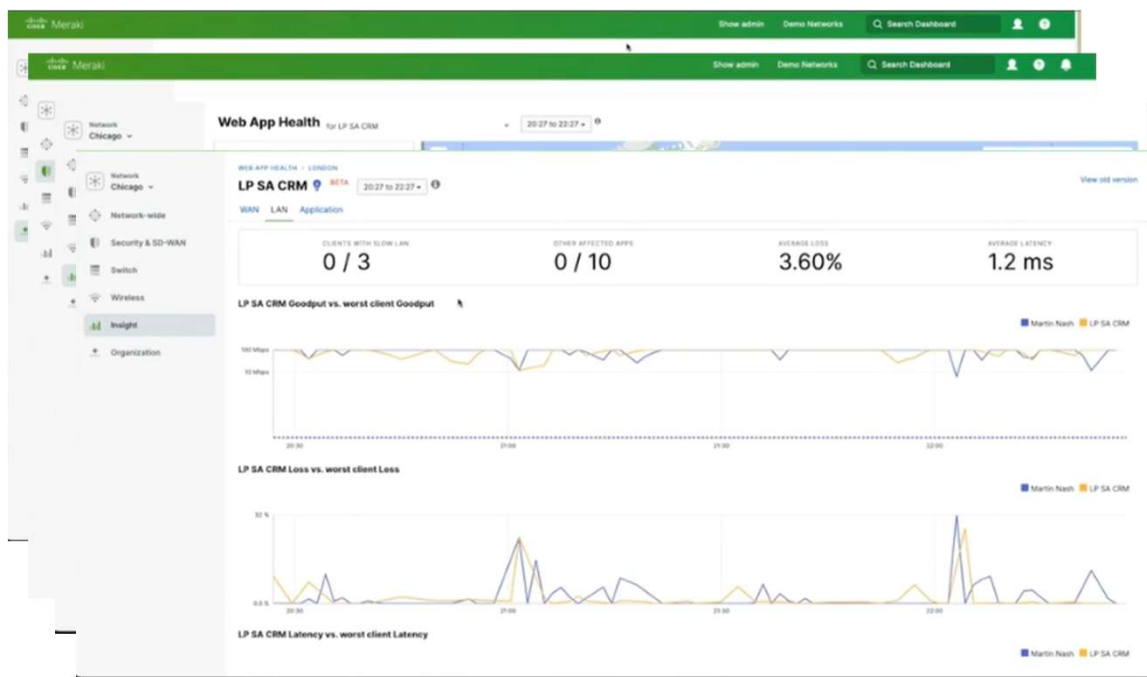


Cisco Meraki + Cisco Viptela

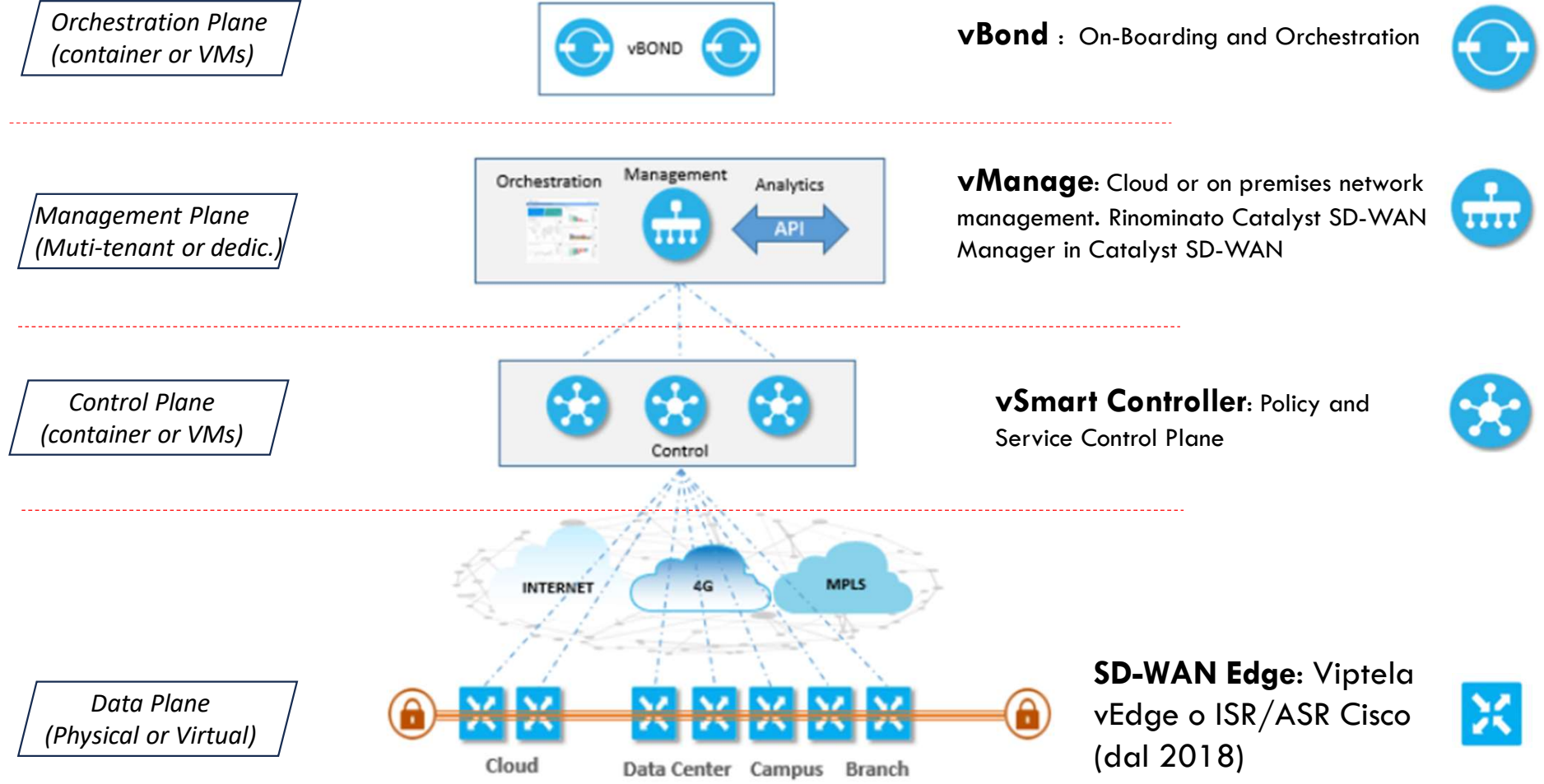
Cisco Meraki: architettura e componenti

Cisco Meraki:

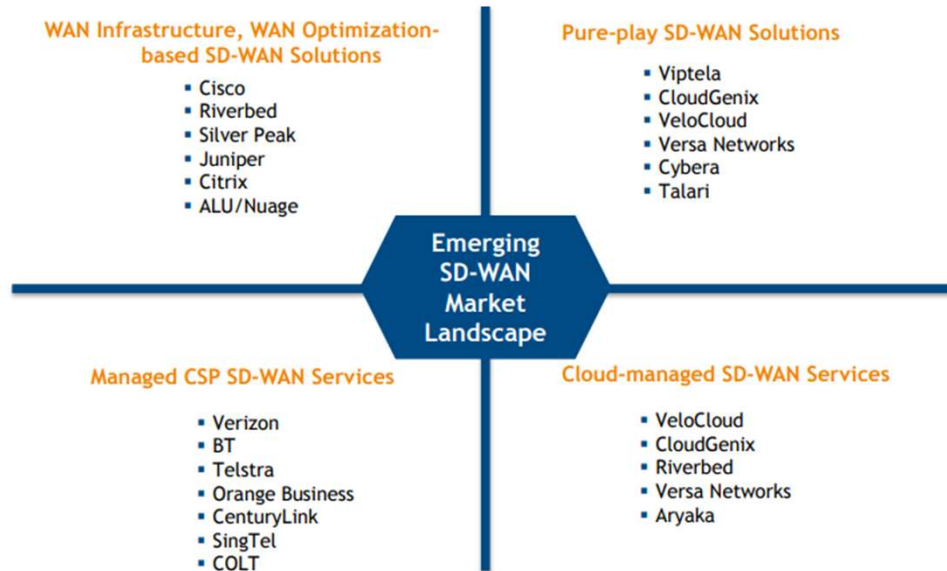
- Appliances fisici serie MX  o virtuali 
- Dashboard Cloud Based per Management & Analytics



Cisco Viptela: architettura e componenti

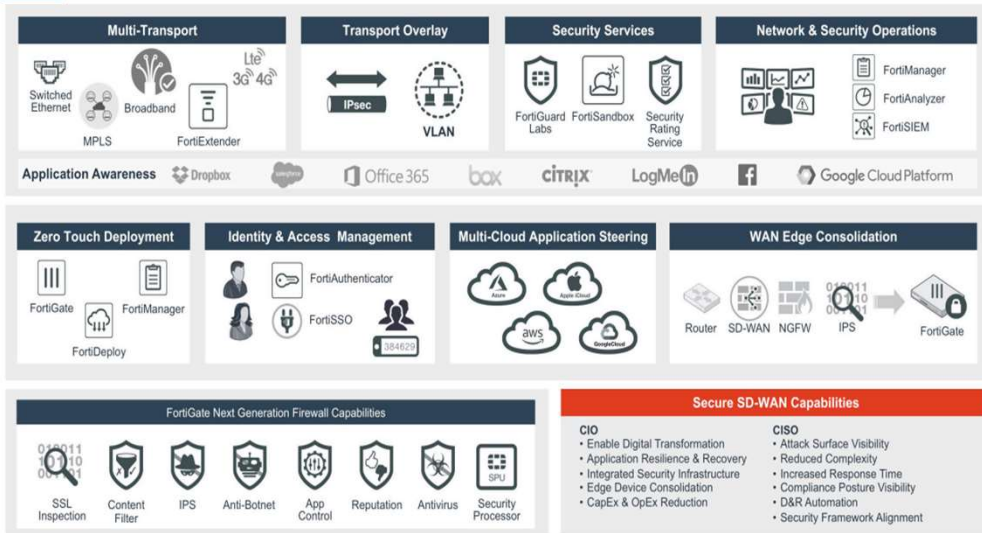


Emerging SD-WAN Landscape

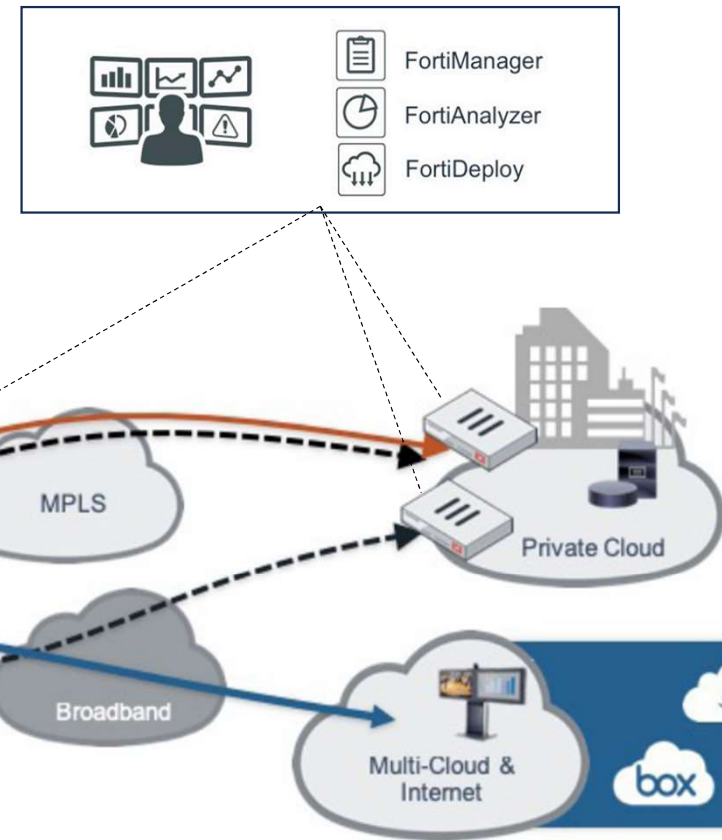


* IDC: Delivering Digit Transform, At Scale: Network Trends and Architect, 2016





Fortinet Secure SD-WAN: architettura e componenti **FORTINET**



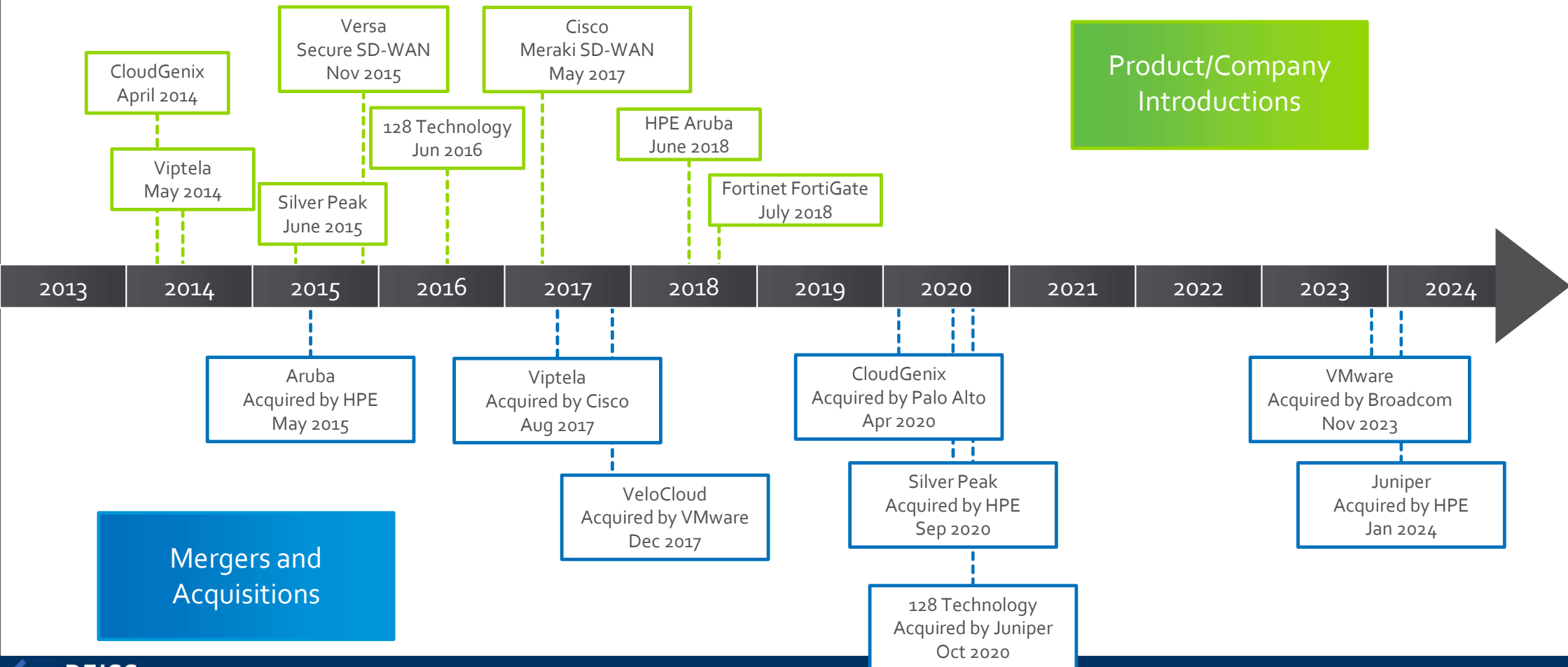
Source: Fortinet. Ra-sd-wan-reference-architecture



Fortinet Secure SD-WAN solution:

- FortiGate 
- FortiManager 
- FortiAnalyzer  e FortiDeploy 

Merge & Acquisition



SD-WAN

Grazie per l'attenzione



Mario Bianchetti
Contact me on [LinkedIn](#)