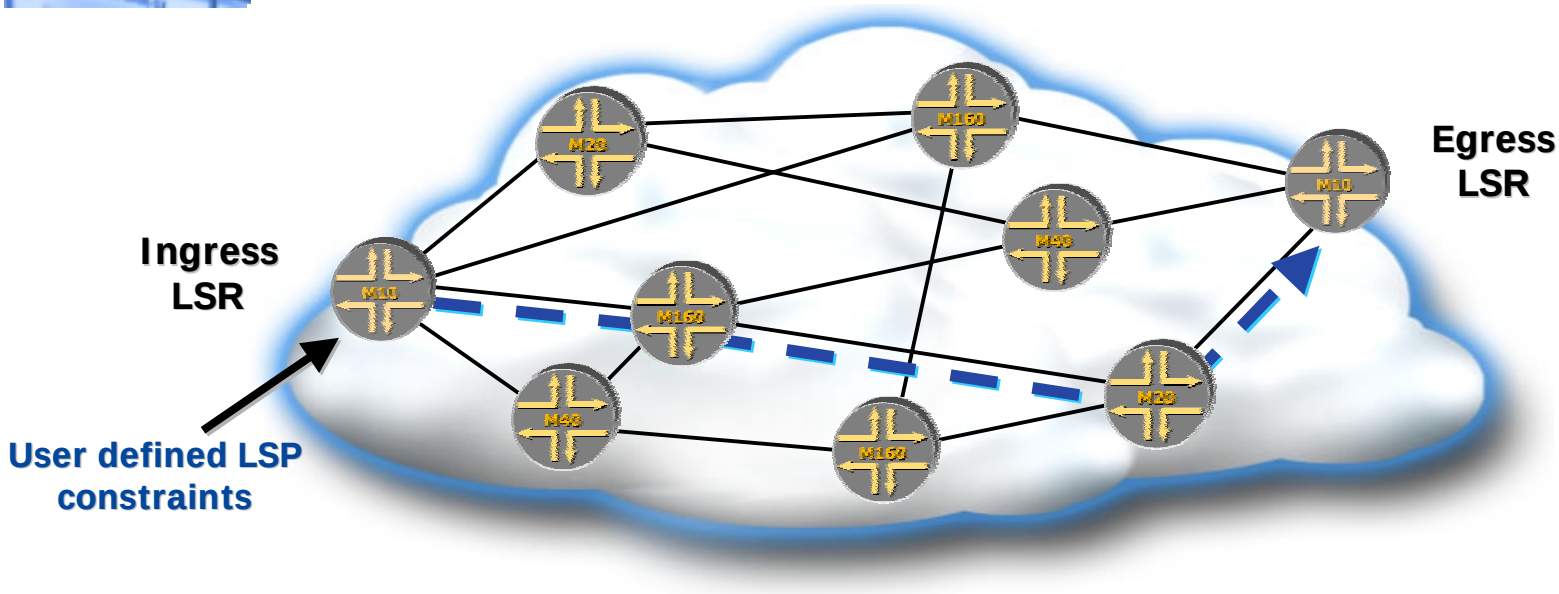
The MPLS Advantage

Part III:
Constraint-Based Routing

Agenda: Constraint-Based Routing

- Defined
- Operational model
  - Extended IGP
  - RSVP signaling
- Example
- Constraint Based Routing vs. Offline Route Calculation

Constraint-Based Routing



- Distributed online LSP path calculation
- Operator configures LSP constraints at ingress LSR
  - Bandwidth reservation
  - Include or exclude a specific link(s)
  - Include specific node traversal(s)
- Network actively participates in selecting an LSP path that meets the constraints

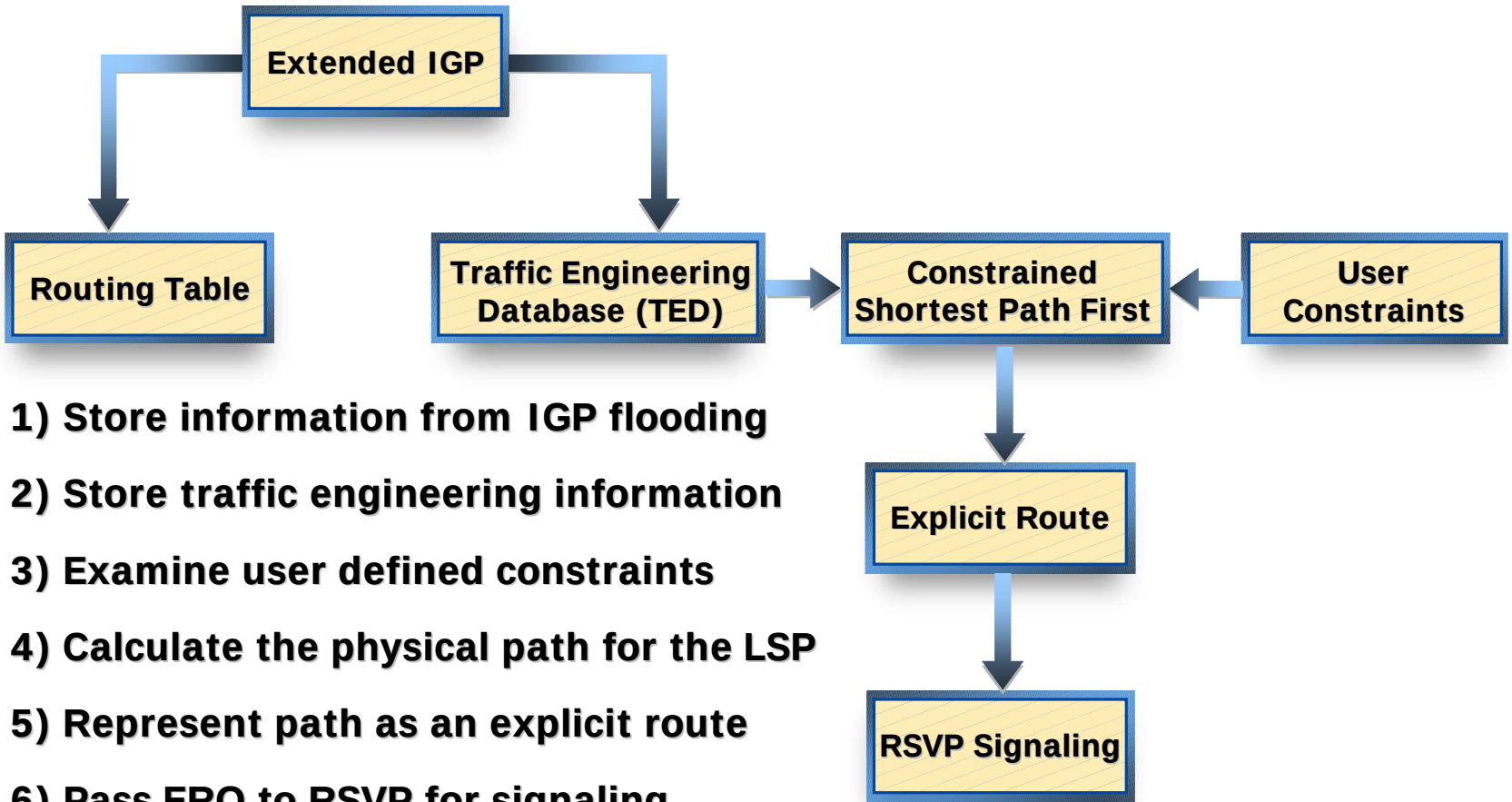
Design Considerations: Setting Link Attributes & LSP Parameters

Physical link parameters	
Available Bandwidth	◆ Maximum capacity that can be reserved on each link
Administrative group	◆ Administrative link coloring

Individual LSP parameters	
Bandwidth	◆ LSP capacity
Administrative group	◆ Administrative LSP coloring
CSPF	◆ Enable online path calculation
Adaptive	◆ Make before break
Setup priority	◆ Determine LSP setup order, pre-empt existing LSPs
Reservation priority	◆ Avoid being pre-empted by another LSP
Standby	◆ Remain up to support instant switchover
Optimization timer	◆ Enable periodic path re-optimization
CoS	◆ Rewrite precedence bits

Constraint-Based Routing: Service Model

Operations Performed by the Ingress LSR



1) Store information from IGP flooding

2) Store traffic engineering information

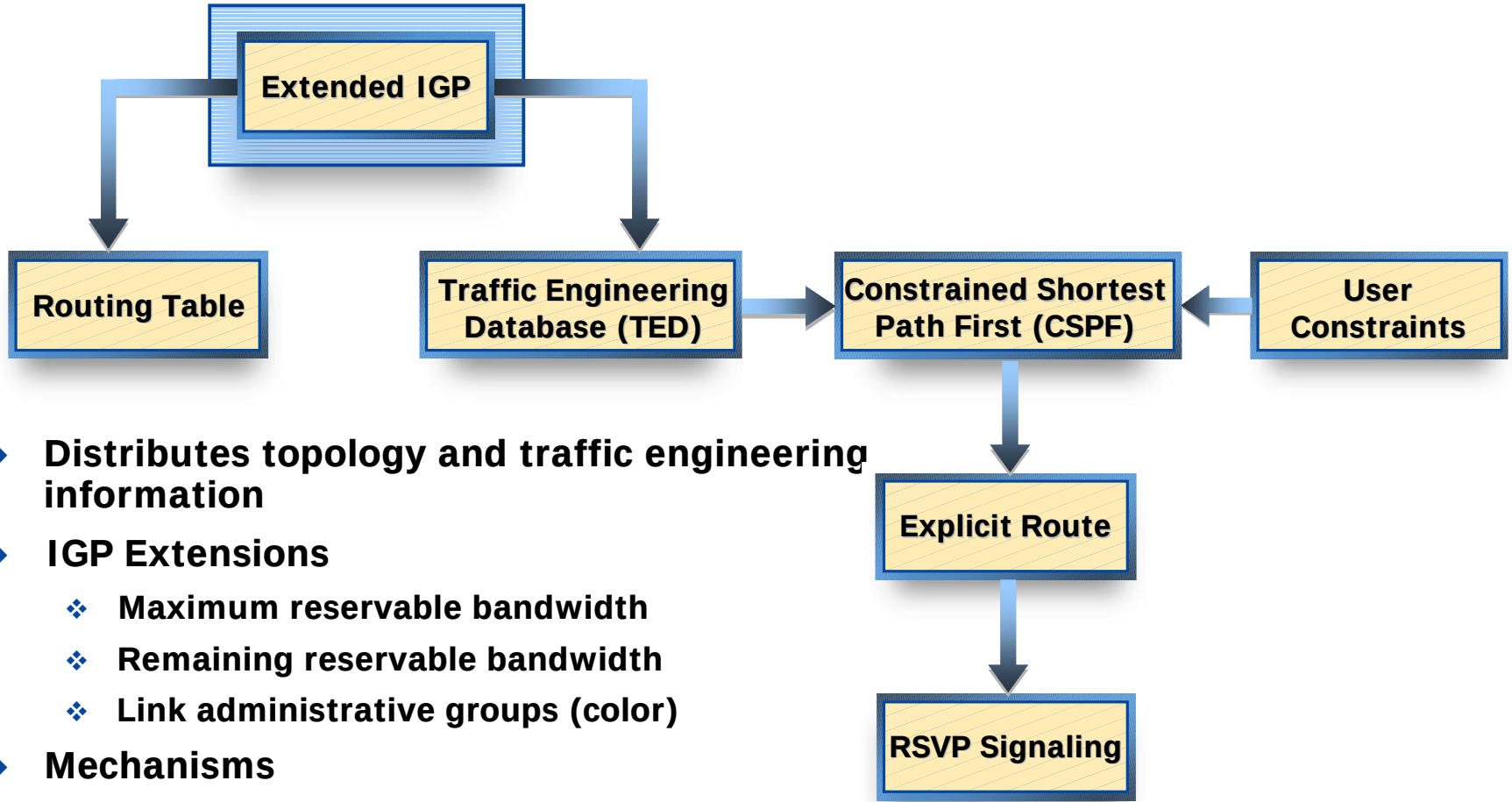
3) Examine user defined constraints

4) Calculate the physical path for the LSP

5) Represent path as an explicit route

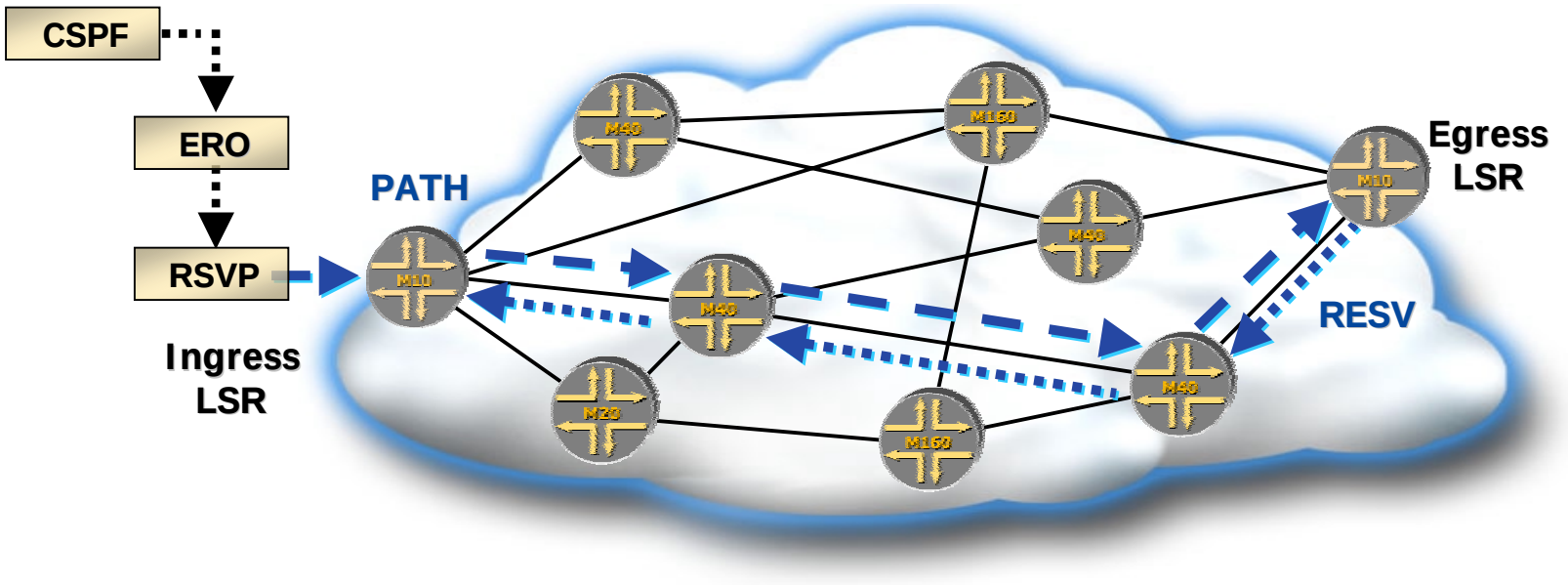
6) Pass ERO to RSVP for signaling

Constraint-Based Routing: Extended IGP



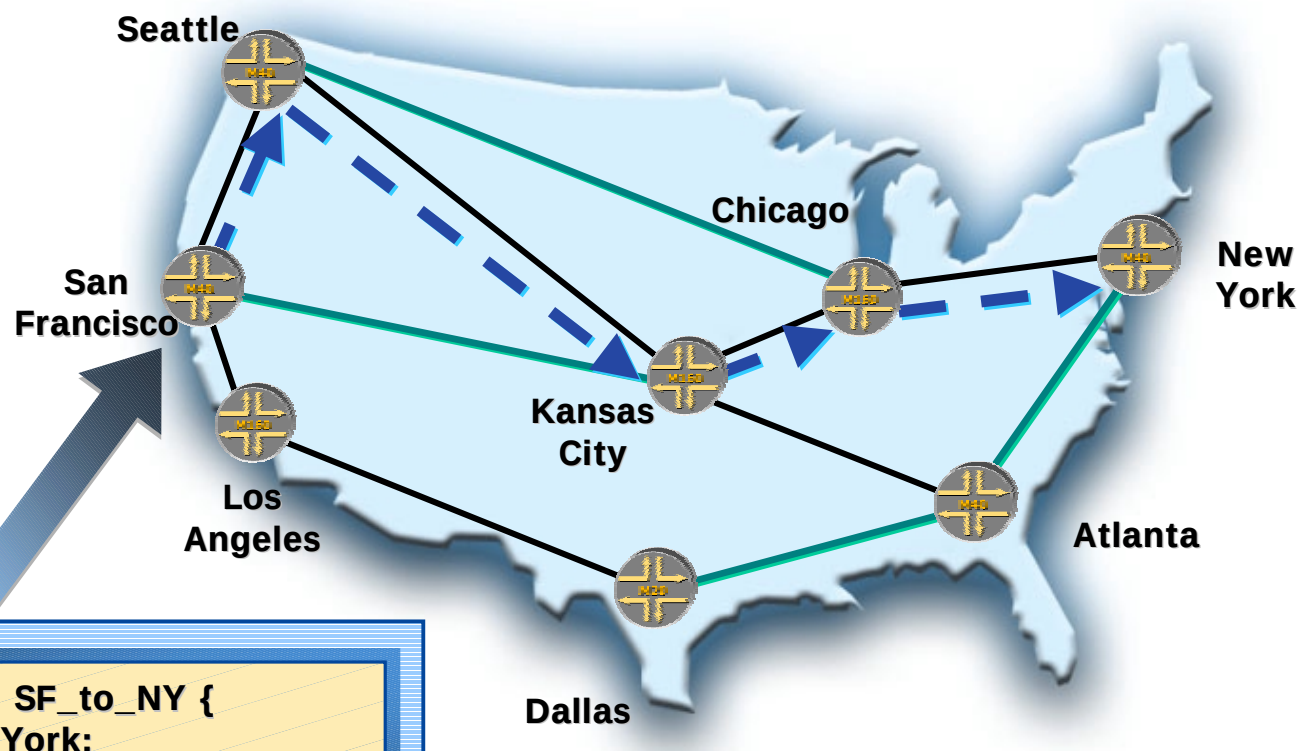
- Distributes topology and traffic engineering information
- IGP Extensions
  - Maximum reservable bandwidth
  - Remaining reservable bandwidth
  - Link administrative groups (color)
- Mechanisms
  - Extended link information flooded in IS-IS or OSPF

Constraint-Based Routing: RSVP Signaling



- Explicit route calculated by CSPF is handed to RSVP
  - RSVP is unaware of how the ERO was calculated
- RSVP establishes LSP
  - PATH: Establish state and request label assignment
  - RESV: Distribute labels & reserve resources

Constraint-Based Routing: Example




```
label-switched-path  SF_to_NY {
                to New_York;
                from San_Francisco;
                admin-group {exclude green}
                cspf}
```

Online CSPF vs. Offline LSP Calculation

	Online CSPF	Offline Calculation
Path optimization	Local	Global
Deterministic path selection	No	Yes
Response to short-term network changes	Excellent	Poor
Accommodate complex failure scenarios	Excellent	Poor
Consumption of LSR resources	Moderate	None
Suitability for network simulators	Poor	Excellent
Typical application	Small-scale deployment	Large-scale deployment

- Best of both worlds --- a hybrid approach
  - Offline – Periodically to globally optimize network
  - CSPF – Fine tune between offline calculations