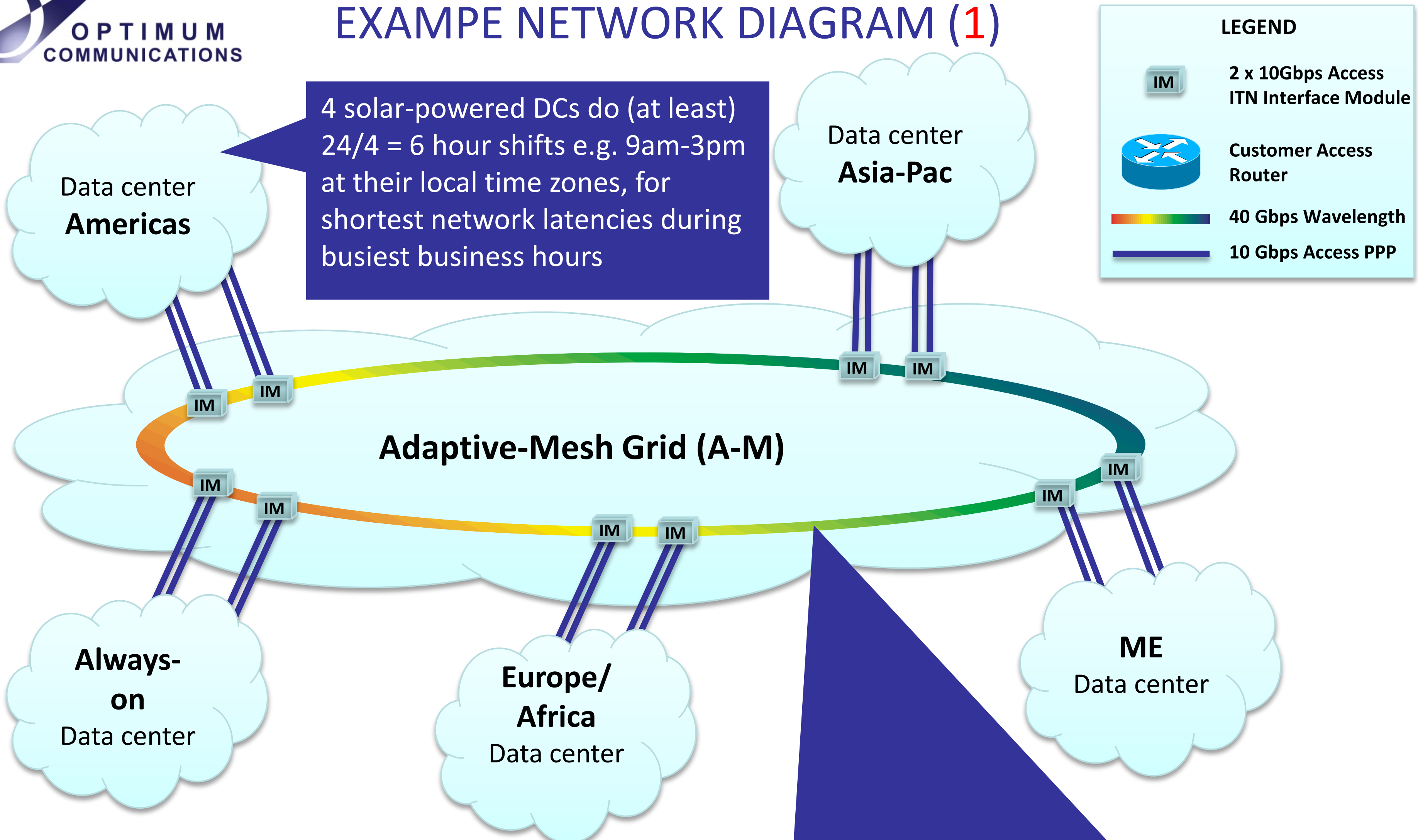
# FOLLOW-THE-SUN ADAPTIVE-MESH GRID

Assumptions:

- Round-the-world wavelength ring
- Considered *example*: Grid of 5 fiber-optics connected zero-emission Data Centers (DCs):
  - 4 solar-powered Data Centers (DCs) at 24/4 = 6 hour of time zone difference apart (e.g. Europe/Africa, Americas, Asia-Pac, ME);
  - 1 always-on (e.g. wind and/or geothermal powered, electric grid connected) DC
- Network connectivity and data center access required at all time zones continuously
- However, only two of the data centers need to be active at any time

# EXAMPE NETWORK DIAGRAM (1)

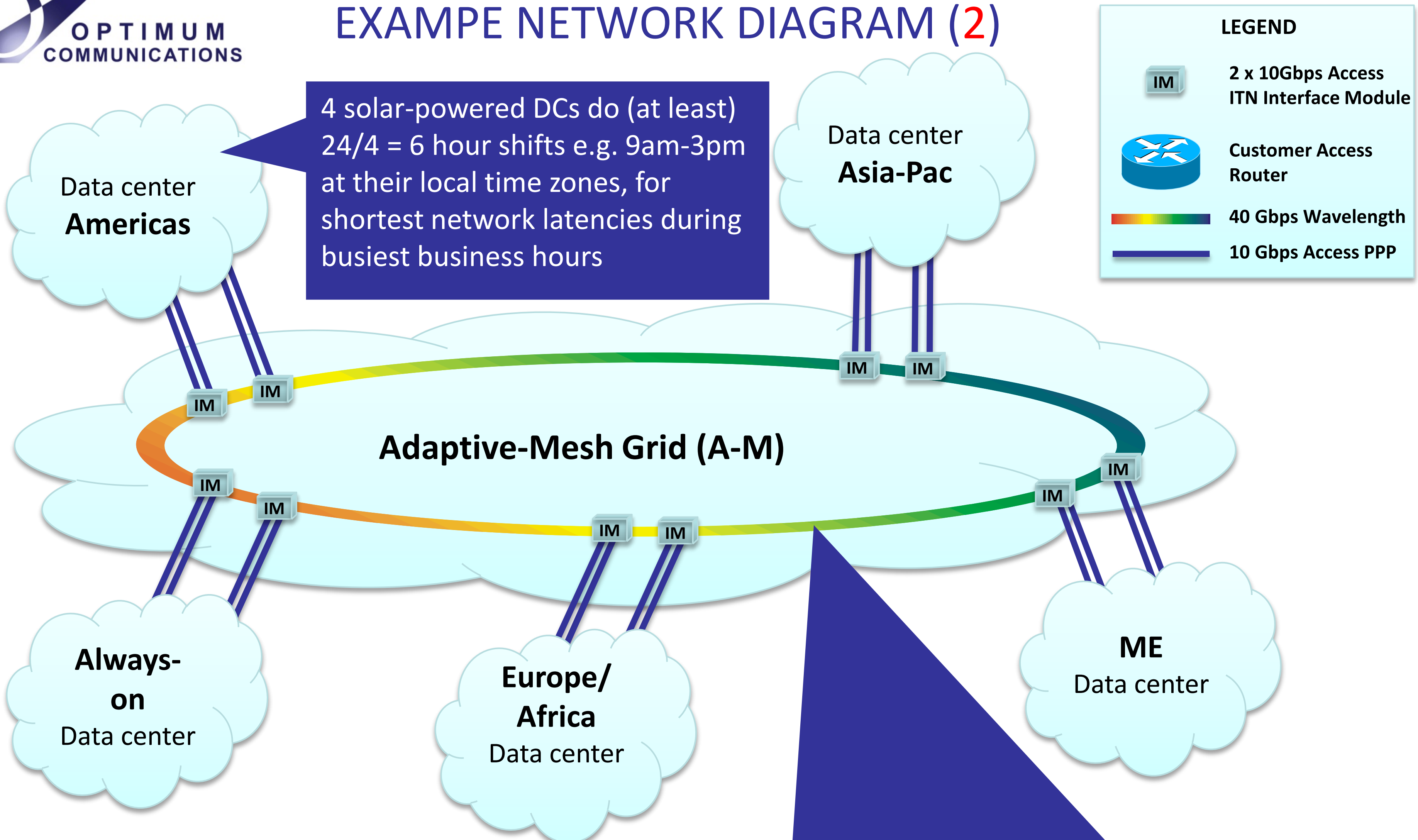
4 solar-powered DCs do (at least) 24/4 = 6 hour shifts e.g. 9am-3pm at their local time zones, for shortest network latencies during busiest business hours




- A-M ring section provides a dynamically channelized network bus (STS-192 for 10Gbps DC access link) for each egress access port on the local half-ring for transport of data from sources along the bus to the given destination port

# EXAMPE NETWORK DIAGRAM (2)

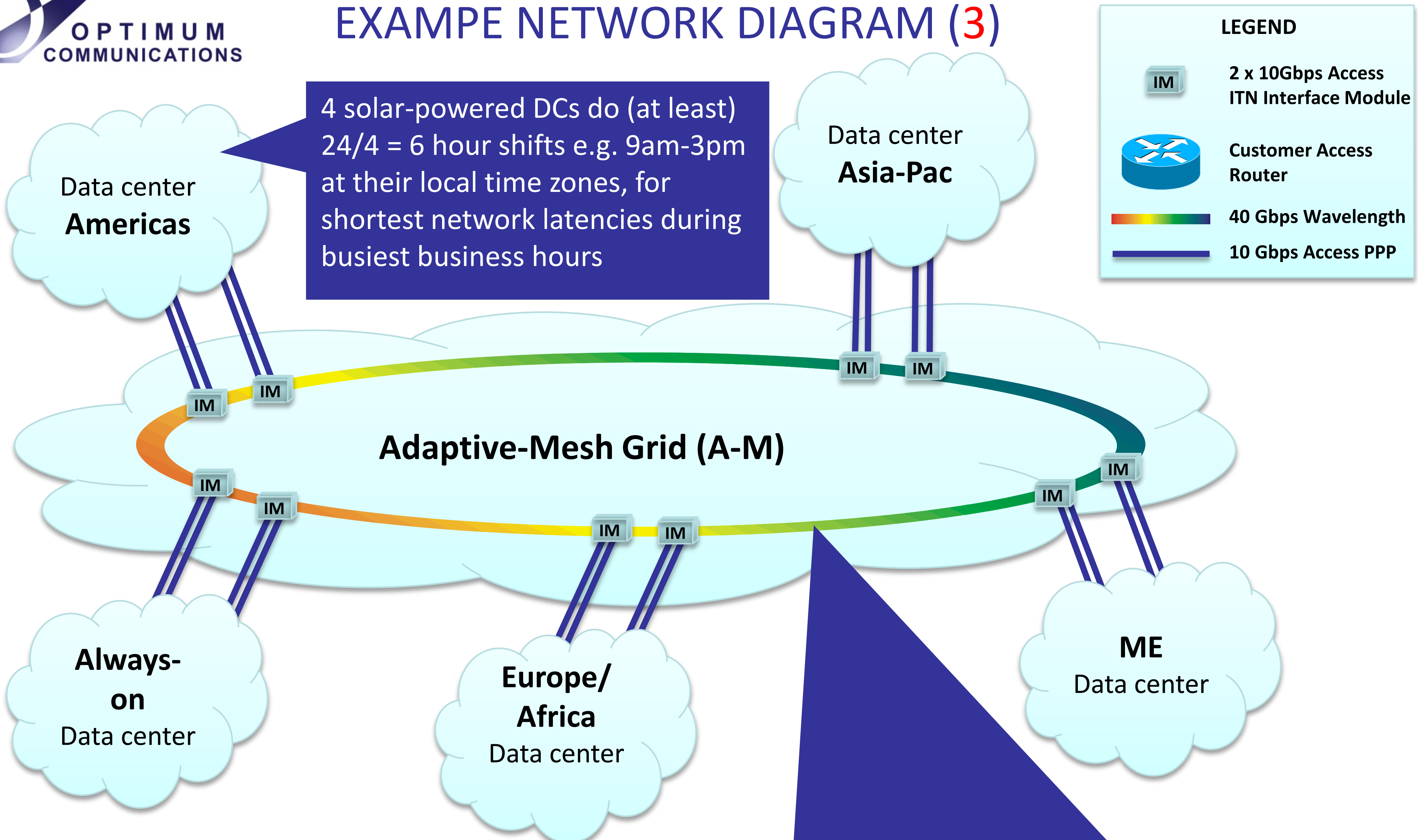
4 solar-powered DCs do (at least) 24/4 = 6 hour shifts e.g. 9am-3pm at their local time zones, for shortest network latencies during busiest business hours




- At any given ring section, such a bus is needed per each destination data center on local half ring

# EXAMPE NETWORK DIAGRAM (3)

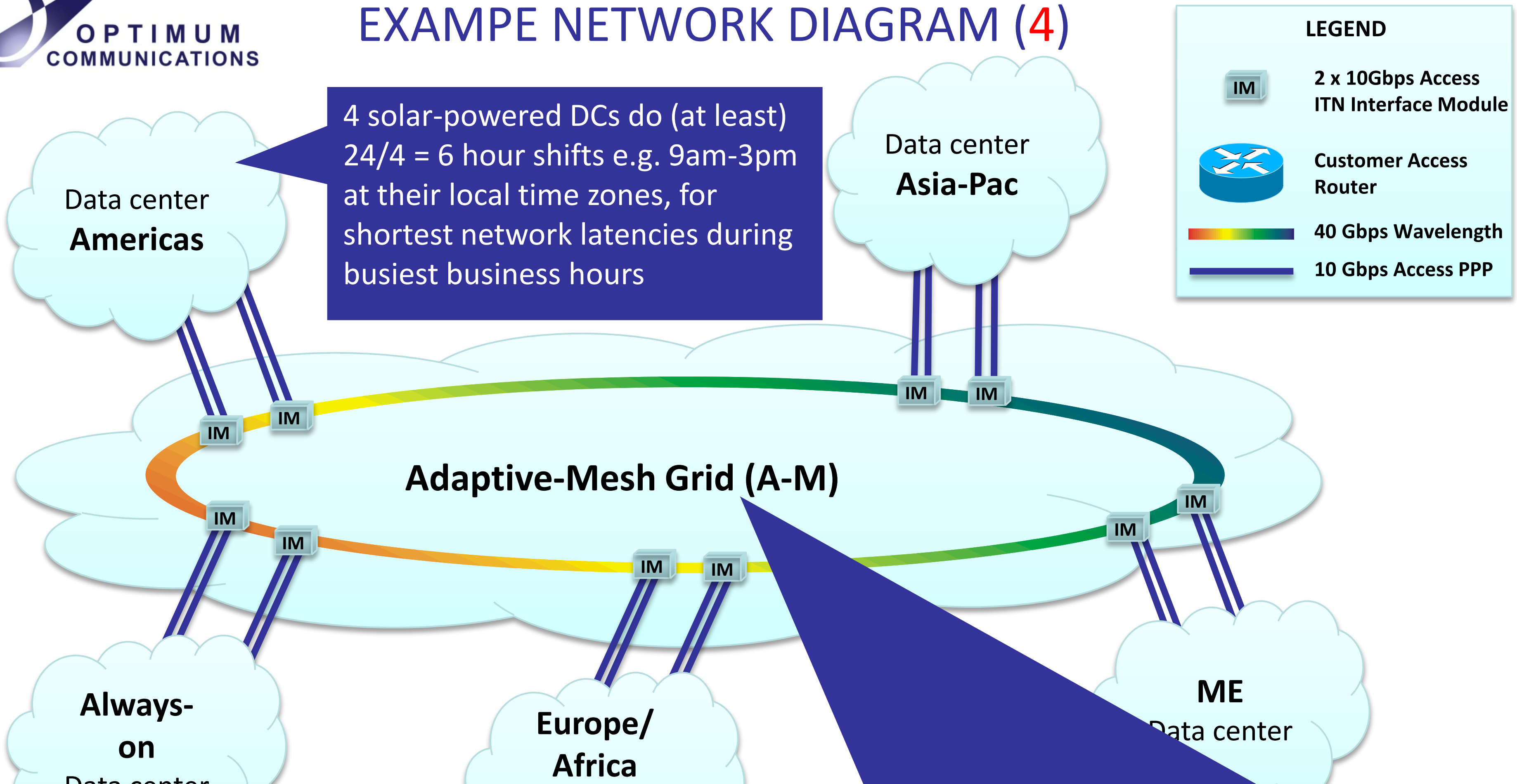
4 solar-powered DCs do (at least) 24/4 = 6 hour shifts e.g. 9am-3pm at their local time zones, for shortest network latencies during busiest business hours




- Case of 2 destination DCs per half-ring:

⇨ 2 (10Gbps) network buses needed on each A-M ring section per each direction

# EXAMPE NETWORK DIAGRAM (4)

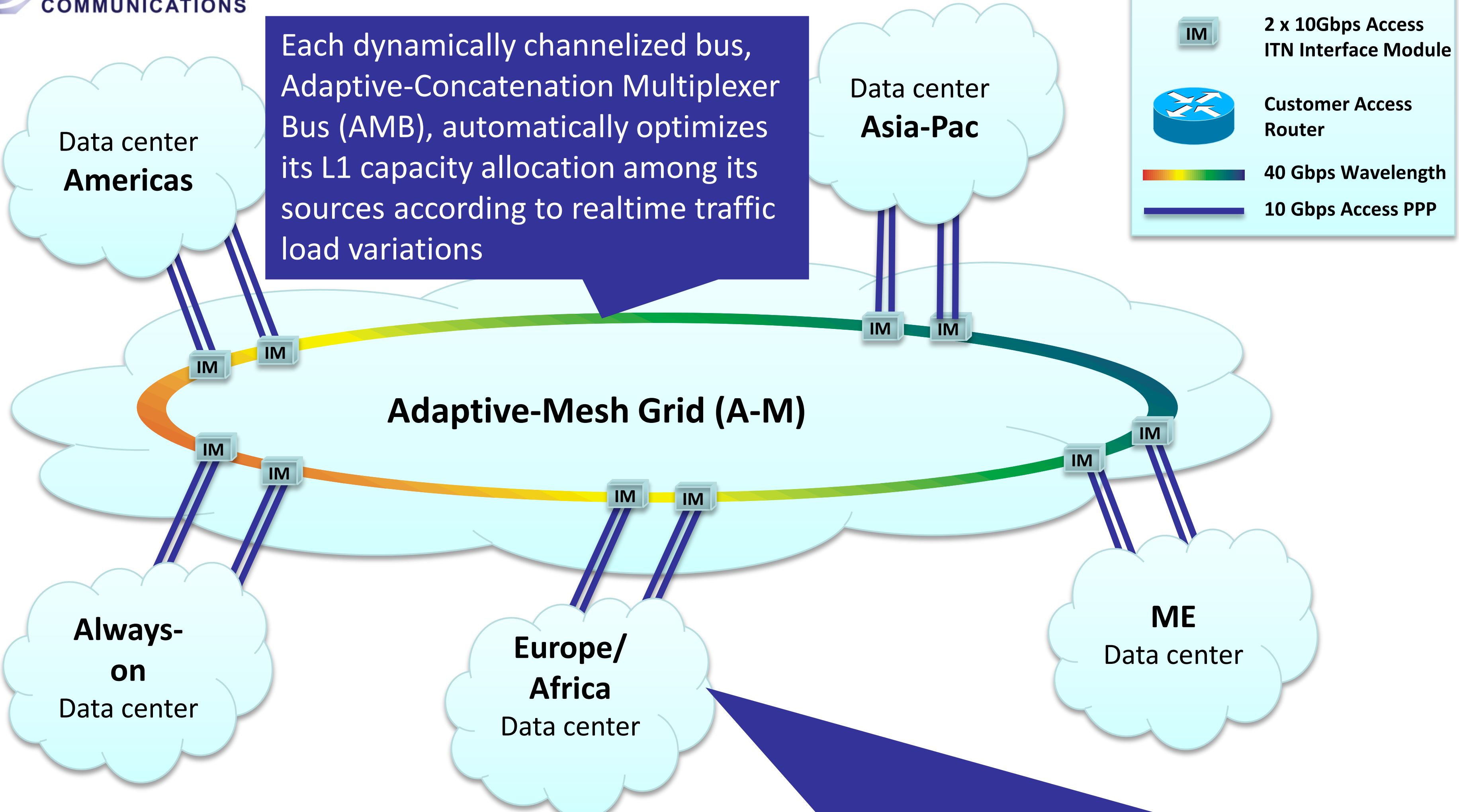



- With entire network doubled, the buses of A-M consume in total 2 x 2 x 10Gbps = 40Gbps of ring capacity, i.e., a <u>single</u> 40G wavelength suffices
- Conventionally, for equal performance (single packet hop) network connectivity, 10G wavelength loop needed per each of the 20 10Gbps access ports, for a total of <u>twenty</u> wavelength loops required on the fiber ring, plus 200Gbps of packet switch capacity

⇨ <u>Adaptive L1 channelization of A-M grid can reduce network capacity costs by factor of 20:1</u>

# FOLLOW-THE-SUN OPERATION (1)

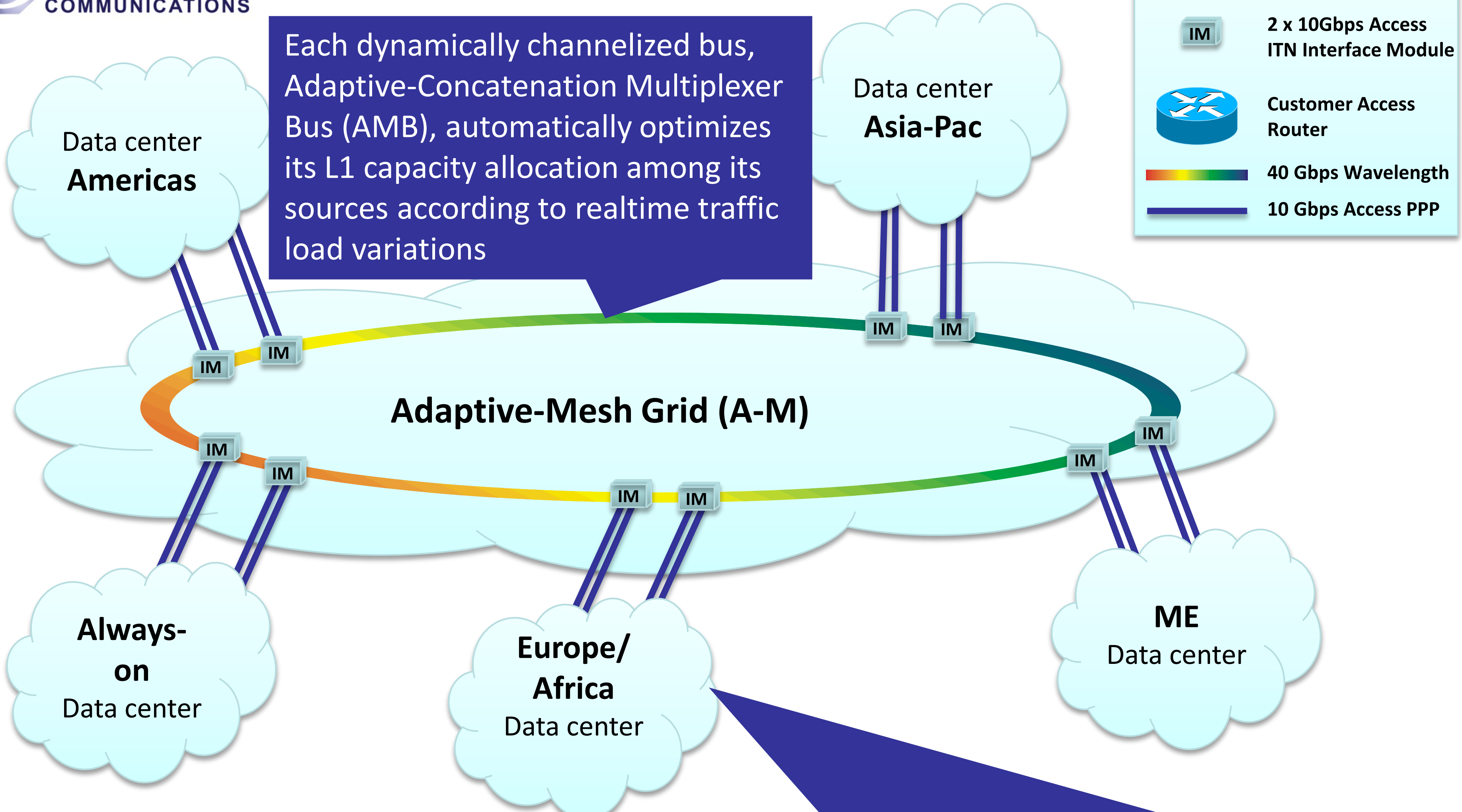
Each dynamically channelized bus, Adaptive-Concatenation Multiplexer Bus (AMB), automatically optimizes its L1 capacity allocation among its sources according to realtime traffic load variations




1) At 9am, solar-powered DC becomes the active DC for new requests, and gets latest process data from the always-on DC

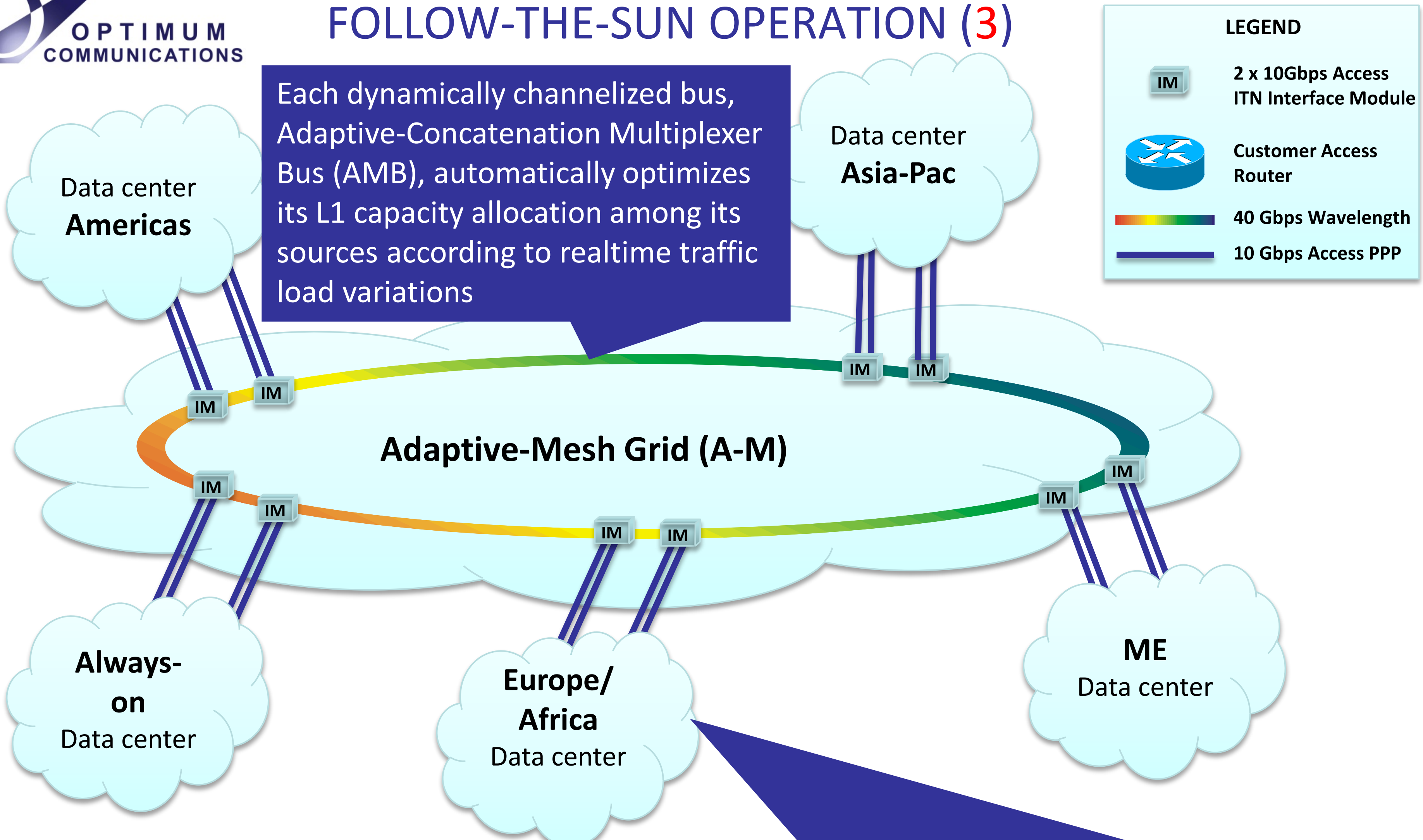
# FOLLOW-THE-SUN OPERATION (2)

Each dynamically channelized bus, Adaptive-Concatenation Multiplexer Bus (AMB), automatically optimizes its L1 capacity allocation among its sources according to realtime traffic load variations




2) At 3pm, DC stops taking new jobs (which are directed to solar powered DC at -6hr), backs up its data and transfers any remaining processes to always-on DC. AMBs to that destination allocate their capacity to the source IMs at the 3pm DC, for 40Gbps transfer

# FOLLOW-THE-SUN OPERATION (3)

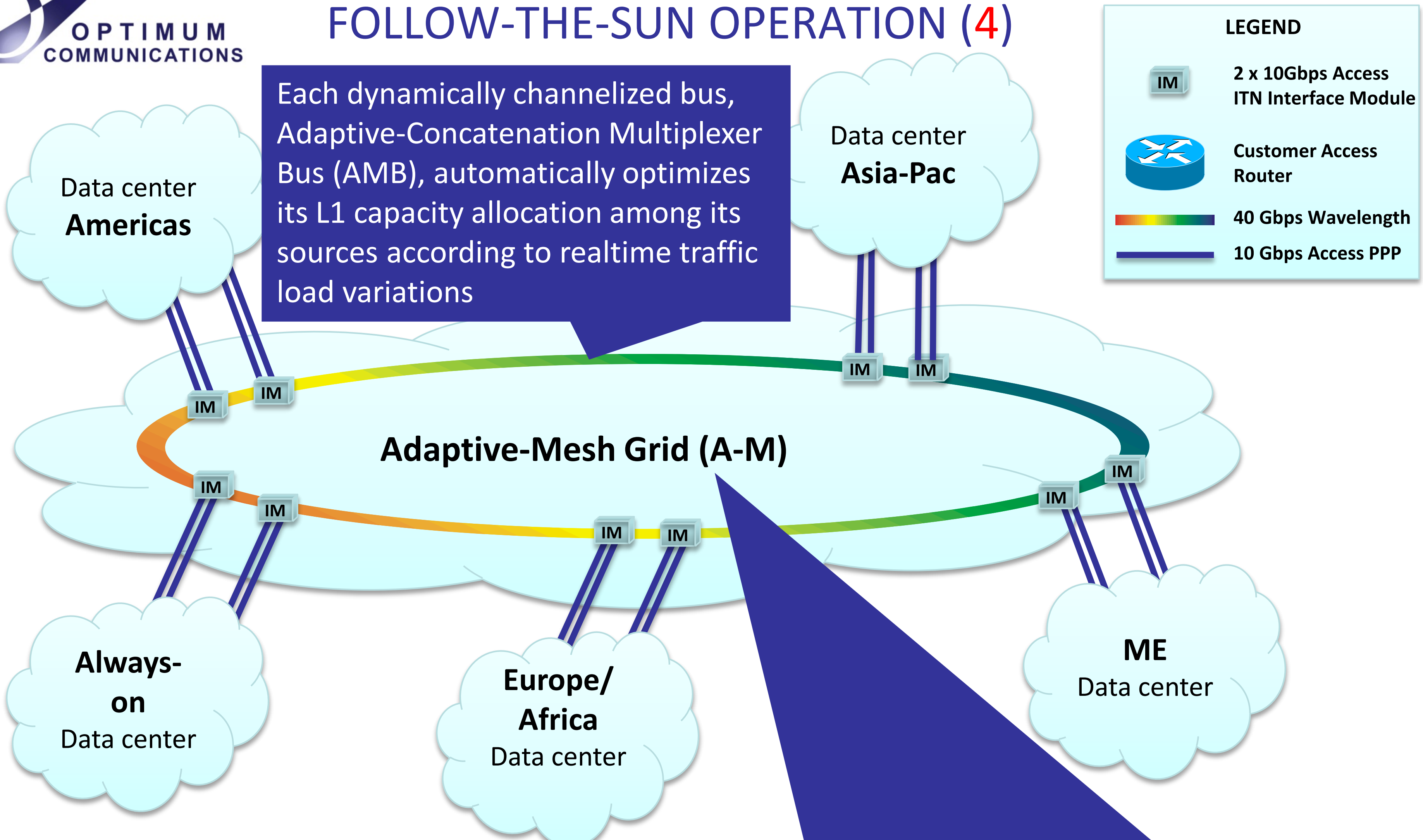



Each dynamically channelized bus, Adaptive-Concatenation Multiplexer Bus (AMB), automatically optimizes its L1 capacity allocation among its sources according to realtime traffic load variations

3) Outside 9am-3pm from any given time zone, processes get directed to either the current active solar-powered DC or the always-on DC, depending on the distances and the respective loads

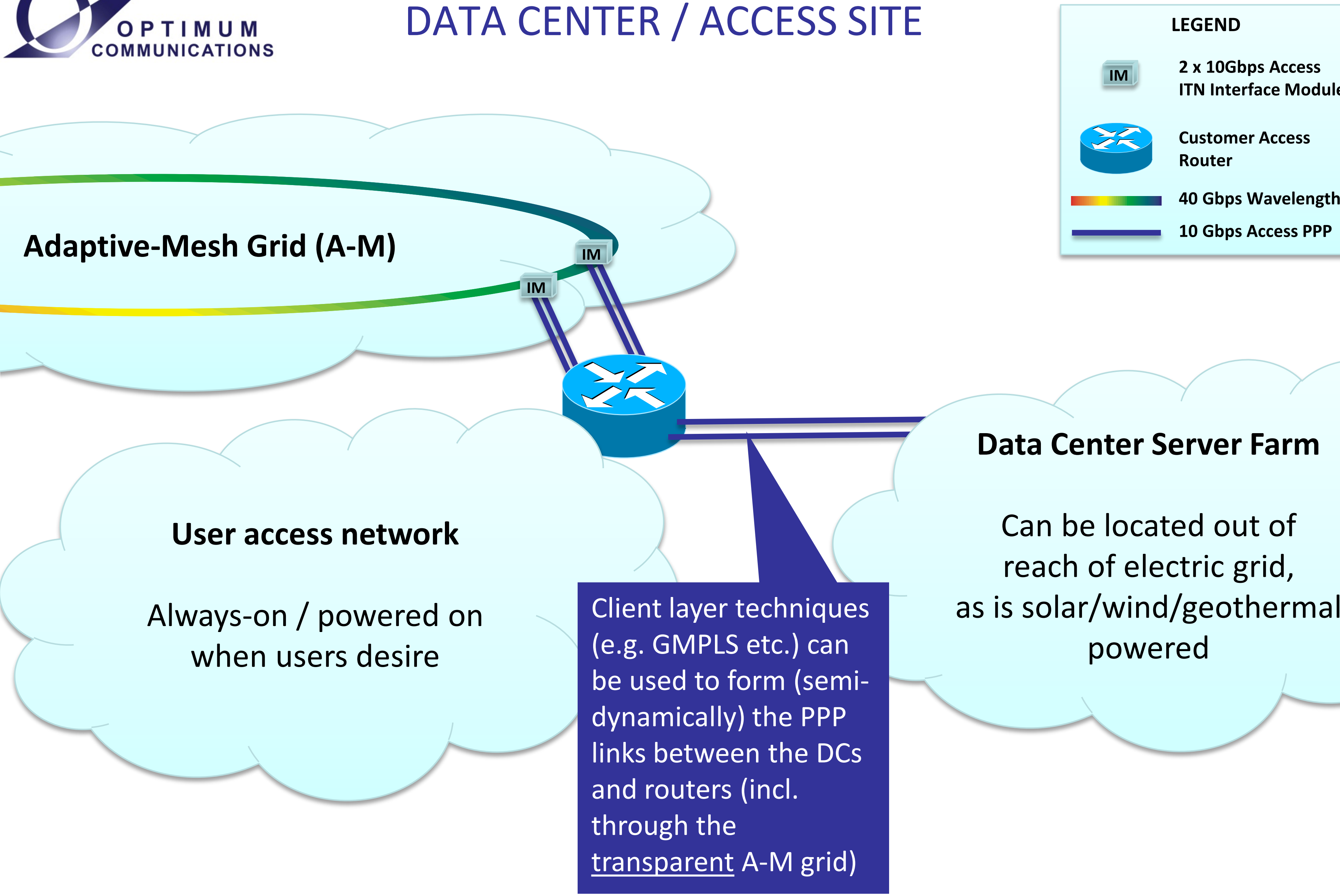
# FOLLOW-THE-SUN OPERATION (4)

Each dynamically channelized bus, Adaptive-Concatenation Multiplexer Bus (AMB), automatically optimizes its L1 capacity allocation among its sources according to realtime traffic load variations




✓ A-M optimizes network capacity allocation <u>automatically</u> according to data load variations, without external signaling/control

# DATA CENTER / ACCESS SITE



# BENEFITS (1)

- To provide equal network connectivity (i.e. non-oversubscribed full mesh connectivity among the 5 sites with total of 20 10Gbps access points) conventionally would require 20 wavelength loops on the global fiber ring -- instead of just one that suffices for A-M -- plus doubled 200Gbps core router/switch I/O capacity, which can be eliminated with A-M
- ✓ A-M considerably reduces the materials and electric power needed for the network
- ✓ A-M reduces cost base for the network by 20:1, *making the near-zero-emission data center grid economically viable*

# BENEFITS (2)

- Hardware-automated, automatic network capacity allocation optimization process
  - programmable logic allows flexible yet straightforward hardware automated control plane, rather than multi-layer distributed software implementation involving complex signaling, middleware etc.

✓ Deterministic, reliable operation *required by service providers and enterprises*

# BENEFITS (3)

- Total 24h (always-on DC) + 4x6h (the 4 day-shift DCs) = 2x24 powered-on DC hours, vs. 5x24h that would conventionally be required

✓ 5:2 reduction in electricity demand, without significant performance trade-off (and none during peak business hours)

⇨ Solar and wind powered IT grids made a *technically and commercially sound reality*

BACKUP SLIDES:

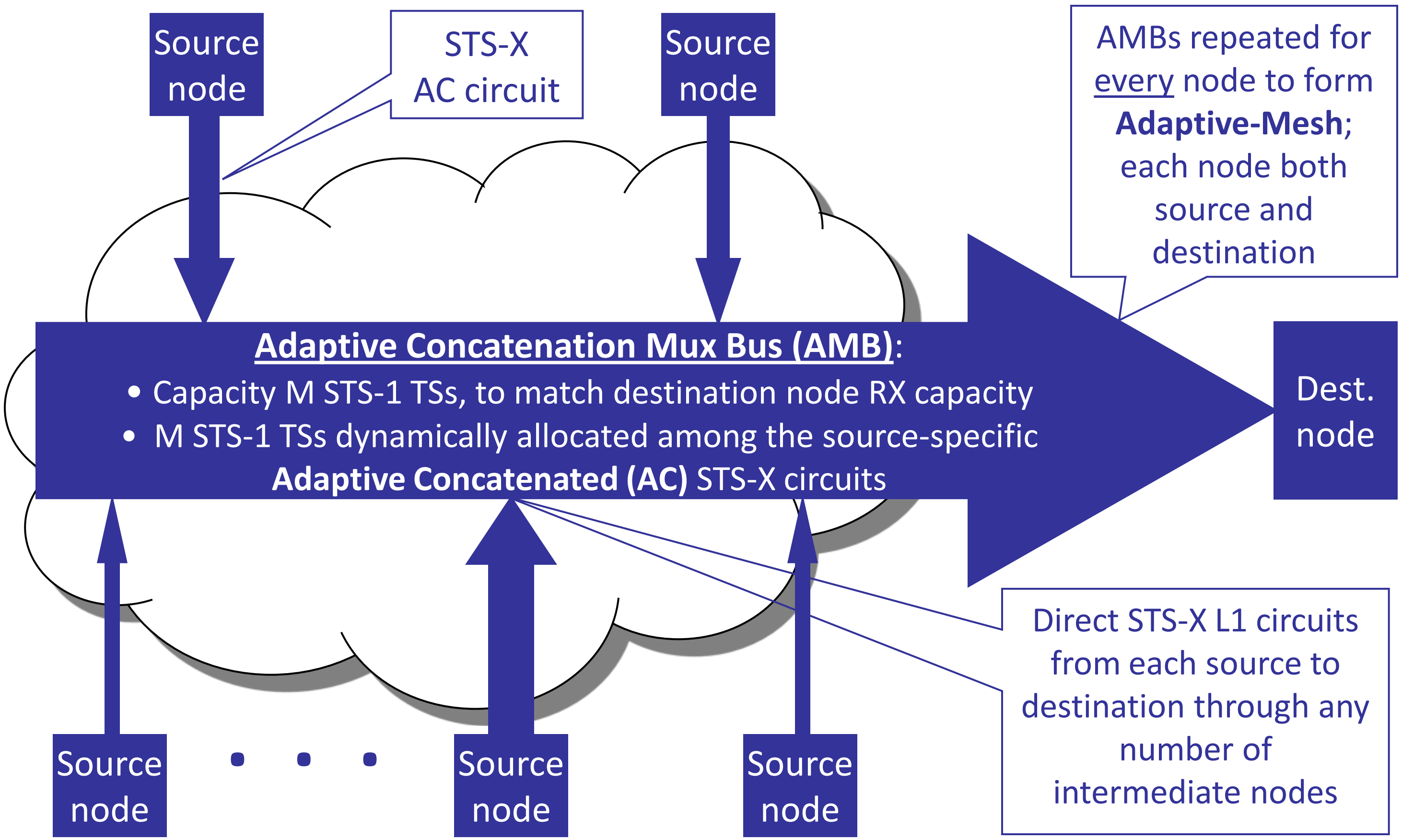
Adaptive-Concatenation Mux Bus -- the basic construct for Adaptive-Mesh grid networks

# AUTOMATIC NETWORK OPTIMIZATION

- Adaptive-Concatenation of STS-X timeslots for always-optimized mesh connectivity:
  - ✓ L1 capacity allocation optimization according to traffic load variations
  - ✓ realtime-dynamic
  - ✓ automatic
  - ✓ transparent
  - ✓ overhead-free


- Demonstrably achieves:
  - ✓ maximized bandwidth efficiency
  - ✓ QoS of direct circuit:

    minimized delay, jitter, packet loss free transport
  - ✓ architecturally minimized packet processing requirements via *dynamic L1 by-pass*




**Adaptive bandwidth L1:**

✓ Maximized bandwidth utilization

AND

✓ Premium QoS based on actual L1 circuit transport:
- Minimized jitter and delay
- Packet loss free transmission

- Allocation of timeslots among the AMB sources optimized for every new STS row based on byte inflows from the sources to the destination of the AMB:
  - 72000 optimization cycles/second; capacity allocation unit ~ the size of min. length L2 packet
  - ⇨ Continuously optimized L1 bandwidth allocation on individual packet / STS-1 row timeslot basis
- AMBs continuously maximize network traffic throughput, within the constraints of their destination (customer) node RX capacities (e.g. STS-192 AMB for 10Gbps destination RX port):
  - ⇨ AMBs consume minimum network capacity sufficient to maximize utilization of network egress interfaces

⇨ **Maximized difference between revenue (throughput) and cost (capacity); maximized network profitability.**

OPTIMUM COMMUNICATIONS

www.ocsipholding.com