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Closer to IPv6-only on WLCG

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It has now been over 12 years since the HEPiX-IPv6 working group began investigating the migration of WLCG towards IPv6 in 2011.
The effort of the working group can be split into three phases. In the first phase LHC software was analyzed in Ipv6 ready, ready with caveats and not ready at all. The aim "enable IPv6 access to all storage" (the second phase of the working group) was at the end of 2023 closely concluded with the dual-stack deployment of all Tier-1 and 95% dual-stack storage of the LHC Tier-2 centers as presented at ISGC2023. The next step towards IPv6 is that the WLCG management board agreed on a dual stack worker node and service deployment at all LHC Tier-1 and Tier-2 centers until the end of June 2024. Therefore another GGUS ticket campaign has been started. This presentation shows the challenges discovered as well as the status of the campaign and furthermore how much this step brought LHC forward towards an IPv6-only infrastructure.
In the last two weeks of February 2024 the next WLCG Data Challenge will run. The aim is that 25% of the data throughput expected of the high luminosity LHC Run starting in 2029 will be transferred between the Tier-0 (CERN) and all connected sites at a data rate, that has compared to todays standards an extremely high volume. One of the IPv6 initiatives is to identify specific link(s) and study their IPv4 and IPv6 traffic. Initially at least the LHCOPN link between CERN and DE-KIT will be inspected as well as further LHCOPN links other Tier-1s which will join this initiative. The first task is to evaluate the remaining use of IPv4 on the inspected links. For example preference for IPv6, which should be the norm with IPv6 Address Selection (RFC 6724), is not being honored due to "hidden" settings in applications and programming environments, or accidental misconfiguration. For example the Java preference for IPv4 caused most dCache traffic to be IPv4 until corrected. The next step will be to determine how to remove the remaining use of IPv4 traffic on the link to establish IPv6-only communication over the LHCOPN links between these site(s) in the future.
This will prepare for the ultimate goal of removing IPv4 from the WLCG infrastructure, to simplify operations, streamline security management, and remove NAT inefficiencies. All this is required to make sure that there is no critical traffic left using IPv4 and that the last and third phase of the WG can be brought forward going in LHC to IPv6 only.
The migration of the German Tier-1 towards IPv6 has developed further. The additional transferred communication towards IPv6 of the worker nodes will be shown as well as an overview of the required configuration steps.
LHC is moving towards IPv6-only and has reached the point where already a large majority of the traffic is IPv6. The step to go to IPv6-only has yet to come, however, the duration of this process cannot be determined. Other research communities can learn much from LHC migration towards IPv6, but the recommendation is definitely to every new program "start from the beginning with IPv6 only".

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