Physical Network Analysis

More than "just another overlay"

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Supporting the MCPP is the primary purpose of the PNA, whether in the joint or combined environment. *(Photo by Cpl Skyler Treverrow.)*

It is time for the Marine Corps intelligence enterprise to catch up to what logistics planners already expect of it: to know how to provide a consistent, relevant, and doctrinally-sound physical network analysis (PNA) in support of their Marine Corps Planning Process (MCPP) requirements. Ask a Marine Corps logistics planner about PNA, and you will hear of its utility, its importance to the planning process, and maybe some examples of good PNA observed in the past. What you will struggle to find is a common understanding of exactly *what* PNA is and *how* or *who* conducts it. The importance of conducting PNA has permeated the logistics community ahead of a doctrinal trail. The issue currently lacks a common understanding of PNA, its relationship to the MCPP, and its relationship to the intelligence preparation of the battlespace (IPB) process. Descriptions of PNA currently only exist in an appendix of the MAGTF Staff Training Program's "A Logistics Planner's Guide," *Pamphlet 4-0.2*, (June 2011) and a brief section of *MCTP 3-21.2, Aviation Logistics,* (May 2016) and do not adequately codify how to conduct PNA. The Marine Corps Intelligence, Surveillance, and Reconnaissance Enterprise (MCISR-E) should conduct PNA as a systems analysis approach to defining the operating environment (OE) in support of the LCE's MCPP.

What Is PNA?

According to *MCTP 3-20A*, PNA "links the intelligence preparation of the battlespace process, logistic analysis, and commander's intent to develop an aviation logistics concept of support." More than simply linking the intelligence effort with some logistics analysis, PNA should develop a working model of the pertinent aspects of the physical network which supports the unit's accomplishment of its mission. The current state of PNA mostly covers encyclopedic data regarding airfields, ports, roads, and other logistics-centric aspects of the operational environment but not a means to organize this data. At the same time, logistics planners draft estimates of supportability based off basic network flow models. In these models, logistics planners establish nodes of distribution (combat service support areas) and connect these nodes via sustainment arcs (between node to node) and supply arcs (between node and supported unit). The limiting factors on these models are the friendly force's capability and capacity. These basic network flow models closely represent the doctrinal templates the intelligence community utilizes when it evaluates an adversary's formations and how they would organize to fight without the restrictions of terrain or weather. When the intelligence section applies a doctrinal template to the current operational environment, taking into account restricted terrain, mobility corridors, and weather effects, they produce a situational template. Analysts should utilize encyclopedic data to build a model

of the operational environment upon which logistics planners synchronize their basic network flow model to the real-world capabilities and capacities. This produces a situational template and is the essence of PNA—a systems model of the physical operational environment relevant to the requirements of logistics planners.

Wait, Isn't PNA the Same Thing as IPB?

As identified in the *MCRP 2-10B.1, Intelligence Preparation of the Battlespace,* (November 2014), the G-2/S-2 leads the staff effort that is the IPB process. PNA is part of the intelligence section's contribution to the IPB. PNA should be a continuous, evolving process along with the IPB it supports, not just a static product or overlay. The model of the operational environment generated by the PNA process evolves and updates as the mission changes. Concurrently, other elements of the staff submit estimates of supportability within the umbrella of IPB. The communications section conducts analysis to determine retransmission site requirements. The operations section provides and validates the area of operations and area of influence. The public affairs section provides a communications strategy, including an assessment of populations and useful means of communicating to them. All of this among other contributions PNA contributes to the four steps of IPB and overall understanding of the operational environment.

A similar aspect of PNA and IPB is that they are both living processes that are continuously updated as information becomes available or the operational environment changes. PNA is inherently tied to the mission and the unit being supported. The friendly force has unique information requirements that change over time. PNA provides the reality to bound friendly force capabilities and limitations by modeling the relevant aspects of the operational environment. The vast volume of information available makes it impossible to simply conduct PNA in a given geographic area without an understanding of the mission and means by which the logistics entity will accomplish the mission. PNA must evolve concurrently within the MCPP, supporting each of its steps.

We have to link intelligence efforts with logistics analysis so that PNA can develop a model to best support the unit's ability to accomplishment its mission. *(Photo by LCpl Preston McDonald.)*

How Does PNA Support MCPP?

Support to MCPP is the central function of PNA. The initial PNA model is designed to support framing of the problem. Considering the operational environment, certain logistics nodes will essentially self-identify as a starting point for key areas of any distribution network operating in that area. At this point of the MCPP, rough time/distance analysis suffices to understand the beginning of limitations of the operational environment. The emphasis on this model is that it is an initial starting point to understanding the operational environment. It must change as MCPP progresses and the requirements and operational environment are better understood.

As the planners frame the problem and understand what needs to be completed to accomplish the mission, the intelligence section refines their PNA to support the development of courses of action (COAs). At this point, the model takes shape—some nodes may drop off and some may be added. Also, the relevant connecting arcs are applied to the model, whether they are air-, sea- or land-based arcs. This step is the most important contribution of PNA to the MCPP—support to developing COAs that are feasible. The mitigating factors usually considered by logistics planners are self-generated: How many lift assets do we have? What is their readiness? How many containers do we have? The output when they generate a COA is a basic network flow model, which determines the throughput capacity between different logistics nodes in terms of pounds or gallons or 20-foot equivalent units per day. PNA will identify other restrictions in the operational environment, which will not allow the basic network flow model to operate at 100 percent. The effects of the weather and terrain may restrict air corridors, limit which bridges are available, or otherwise increase the time/distance required to connect nodes together. The largest port in the world might not be useful if a road or rail network does not exist with sufficient capacity to move material away from the port. This model and its effects on the COA are further refined during the COA war game step.

PNA supports the COA war game by identifying the resiliency of the modeled distribution network under stress. Each COA identifies how it will utilize the available means of distribution in the operational environment to accomplish the objective, and the PNA applies stressors to that network to locate weak

points. Red cell actions during the war game that solely reflect the actions of an enemy force aren't sufficient. The LCE must maneuver against consumption. PNA will identify risk to mission accomplishment not otherwise considered: What are the effects of daily traffic patterns on the road networks? What happens to the network if a key bridge is destroyed? What happens to the distribution capacity if aircraft are grounded for a period of time because of weather? How far can the GCE advance before the LCE can no longer sustain them in the current distribution model? These considerations create decision points, supporting event template development in turn. How and where should additional combat service support areas be established? At the end of the war game, the planners should have an understanding of how each COA utilizes the physical network available and what risks to mission are incurred by doing so.

At the completion of the war game, the PNA can act as one of the decision criterion for the commander: which COA does the physical network better support? This step of MCPP provides the best rationale for why PNA is not just an overlay but rather a living model. Facts and figures do not accurately portray how they work together or aid in the understanding of throughput capacity over time. Only an accurate model connecting these otherwise disparate elements will demonstrate cumulative capability and capacity over time. The feasibility and sustainability of each COA is determined (at least in part) by the ability of the physical network to support it.

Once the commander selects the COA, the planners and staff sections shift to developing the order. PNA forms the bedrock of the intelligence staff estimate. Friendly, enemy, and neutral forces utilize the same physical network. Ongoing operations affect that network and changes in its capability or capacity will in turn present a risk to mission accomplishment. At the time of the order being written, not all information will be known about the physical network. The intelligence section considers the physical network in its intelligence requirements development and collection plan. Over time, the understanding of the operational environment shifts as operations occur, collectors collect, and the plan develops. These incorporations further refine the model to reflect closer to the real world what matters to logistics planners.

Why should we conduct PNA?

PNA identifies decision points for the commander. PNA is more than an overlay added to a modified, combined obstacle overlay as part of the IPB process; it is a systematic method to develop a model, which defines the operational environment in terms relevant to the LCE mission and commander. If the PNA identifies a major logistics node outside of the assigned area of operations, it drives a request to shift a boundary or to conduct cross-boundary coordination. The destruction of certain bridges on sustainment or supply arcs drives the LCE to surge assets to other nodes, conduct route reconnaissance, or shift to a branch or sequel of the base plan. PNA identifies the ability of the network to support the supply arc to the supported unit. PNA identifies the decision point at which the GCE has advanced enough to be out of range of the supply node, thus driving the establishment of a forward combat service support area. PNA identifies the choke points within the distribution network to drive plans for mitigation. Whether it is a small apron at an airfield, a lack of heavy equipment to offload aircraft, limited storage capacity at a port facility, a bridge weight limitation, or a small tunnel on a key route, the physical network analysis identifies where the limiting factor will occur in the physical network.

Intelligence pertaining to terrain, trafficability, the enemy situation, and weather are as important to the LCE as it is to other MAGTF elements. *(Photo by Sgt Kassie McDole.)*

So What Now?

MCRP 2-10B.1 publication currently contains two appendices that cover unique intelligence production tools for MCPP and functional analysis. As a foundational publication for how information pertaining to the operational environment is consolidated and analyzed to support the commander and staff, the *MCRP 2-10B.1* needs to contain PNA. Another appendix to the publication provides a venue for the PNA process to be fully explained within context of both IPB and MCPP. Publication in doctrine also enables PNA to be taught at formal learning centers throughout the Service. PNA is a unique approach for a unique requirement—it needs to be codified to be utilized properly across the MAGTF.

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