网络安全态势感知所依赖的原始测量数据可以来源于不同型号、不同实现技术、不同开发与生产者的网络运行管理系统、网络安全管理系统、主机管理系统和应用管理系统,这些系统产生异构的运行监测数据和日志数据,需要采用流式数据处理方式在不同的时间窗口内完成融合处理任务.目前,这方面的研究明显是不够的,现有的大数据分析技术虽然可以提供一定的支持与借鉴,但这些方法对态势觉察的适用性还需要有针对性的研究.

(2) 不完全信息条件下的活动辨识

这个问题是指在测量系统存在漏报、误报以及信息缺失的前提下,如何尽可能准确地辨识出网络中存在的活动.这类研究可以认为是源自网络入侵检测领域,但在网络安全态势感知的范畴中被赋予了更为广泛的含义.互联网的流量具有重尾的特性,传统的研究往往关注流量行为的典型部分和主要部分,例如像流量分类,但在态势觉察中,不仅这些部分需要关注,小流量的零星行为也需要专注,例如 APT 检测的需要,而且不完全信息条件下这类活动的辨识更为困难.因此,这个领域需要更为精细的测量数据关联性分析方法.

(3) 网络活动的语义计算

从目前的实践看,网络攻击的意图识别基本上是手工完成的,即需要依靠人工经验的判断.鉴于人的能力约束和相关人力资源的不足,这种人工实现方式给网络安全态势感知的大规模应用带来极大的限制.因此,很有必要研究网络活动特征提取和意图识别的机器处理方法,以提高网络安全态势感知系统的自治能力.尽管网络入侵防范系统 IPS 领域的工作可以提供一定的基础,但从实现不同时间粒度的网络安全态势感知以满足从毫秒级攻击自动响应到 APT 检测的不同需要的角度看,都是远远不够的.

(4) 网络态势的可视化

网络安全态势感知所处理的海量异构测量数据及其处理结果需要有合适的表示方式来加以表达和应用,可视化技术是一个公认的可行支持.HSARPA 在它的战略研究计划中也提到需要研究可扩展的可视化方法来支持态势感知数据的使用,包括带准确地理定位的可视化方法、支持 Drill-down 的可视化分析方法以及适合不同用户使用和表达不同内容的可视化技术.

(5) 网络安全态势感知的协同

网络空间安全需要全球合作,至少在国家的层面要求合作的网络安全态势感知系统之间具有协同能力,就像 HSARPA 规划中所要求的那样.如果参照网络入侵检测领域的相关研究,对于合作机制的要求至少包括配置互操作性(即合作各方具有信息交换能力),需要有类似 SNMP 和 IPFIX 这样的标准协议;共享信息的语法互操作性,需要有类似 IDMEF 的标准数据结构;以及语义互操作性,例如描述网络安全态势的标准测度及其取值,这在网络入侵检测领域还是空白.此外,由于合作各方可能存在信息访问限制,如何实现信息共享与隐私保护的平衡把握,是需要研究的问题.

(6) 更为完善的态势投射方法

目前的态势投射方法基本都是静态的,不能适应网络安全态势感知的过程需要,因此需要研究相应的动态态势投射方法,例如基于非合作不完全信息动态博弈理论设计附带预警能力的态势投射方法.

6 结 论

网络安全态势感知包括网络安全态势觉察、网络安全态势理解和网络安全态势投射这 3 个层面,是一个完整的认知过程.它不仅仅是将网络中的安全要素进行简单的汇总和叠加,而是根据不同的用户需求,以一系列具有理论支撑的模型为支持,找出这些安全要素之间的内在关系,实时地分析网络的安全状况.

网络安全态势感知是网络安全领域的研究热点,尽管已经得到较长时间的关注,但仍未形成完整的体系和明确一致的目标.在现有的网络安全态势感知的研究中,将其视为网络安全事件应用大数据处理和可视化技术的汇总结果的观点和将其视为基于网络安全事件融合计算的网络安全状态量化表达的观点,都没有完整地反映其目标和任务;将其视为网络安全监测实现形式的观点则不够准确.为此,本文对网络安全态势感知概念进行重新定义,试图给出一个更为完整、清晰的描述,以期抛砖引玉.

目前,网络安全态势感知的研究是一个正处于发展中的课题,大部分研究都集中在重构攻击活动方面,基本都是网络入侵检测领域研究的延伸,已有很好的基础但也有很多问题需要研究和解决.另一方面,包括网络测量、网络流量行为学、网络管理技术、大数据处理技术、流式数据处理技术、可视化技术在内的其他相关领域的发展也为网络安全态势感知的研究提供了积极的支持.尽管网络安全态势感知的研究仍处于初级阶段,但是,随着各种相关技术和研究的不断完善,网络安全态势感知技术将走向成熟和实用,为保障网络的安全起到越来越重要的作用.

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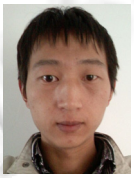

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