

The Cyber-Attacks and Digital Economy in India during 2004 - 2015

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Abstract

This article focuses on the study of the cyber-attacks and digital economy in India during 2004 – 2015 in order to 1) to find out the types and patterns of all cyber-attacks in India during 2004 – 2015, 2) to investigate the relationship between GDP of India and the cyber-attacks in India during 2004 – 2015, and 3) to compare the cyber-attacks between India and Thailand during 2012 – 2015 due to the availability of data. Frequency, percentage, mean, standard deviation, and Pearson's Product-Moment Correlation are the statistics employed for data analysis. The level of significance was set at .05.

The results were as follows: 1) There were 310,146 attacks, or approximately 25,846 attacks per year during 2004 to 2015 in India, 2) In aspect of techniques of the attacks, there were big four in India during 2004 – 2015: abusive content, information security, intrusions, malicious code, 3) In overall, there has been an upward trend of cyber-attacks in India since 2004 – 2014, except in 2015 due to the implementation of “Digital India” program. In categorical level, two absolute different trends – upward and downward trends occurred in India. The upward trend focuses on all crowd – oriented cyber-attacks of information gathering, information security, malicious code, and others whereas the downward trend focused on individual-oriented cyber-attacks such as abusive content, intrusions, and fraud, 4) there were quite high positive relationship between GDP of India and the cyber-attacks in India during 2004 – 2015 in the overall level at the .01, and categorical level, fraud, information gathering, and malicious code had high positive relationships with GDP of India at the .01, and with intrusions and other at .05; and 5) In overall, the amount of cyber-attacks of Thailand (Z score = 6.47) was higher than India (Z score = 5.18). In categorical level, Thailand had more serious cyber-attacks than India with approximately 1.48 S.D. in malicious code and approximately 0.76 S.D. in intrusions.

Keywords: *Cyber-attacks, digital economy, India, 2004 – 2015*

1. Introduction

According to her long plan, India Vision 2020, India has changed herself to be a developed country in the year of 2020 by transforming from product-based economy to digital economy since 1993, in which her Vision about Technology in India Vision 2020 was set by Technology Information, Forecasting and Assessment Council (TIFAC). In addition, the emerging of “Digital India” program since 2014 in order to prepare India’s readiness for digital economy will accelerate the growth of Indian digital economy in India for supporting 462,124,989 Internet Users, 34.83% of total population, on July 2016. (Kalam & Rajan, 1998; CMAI, 2014; Blasi et al., 2015; Department of Electronics and Information Technology, Ministry of Electronics and Information Technology, Government of India, 2015; Internet Live Stats, 2016.) However, the transformation towards new economy has a big cost of more innovative and sophisticated cyber-attacks which directly compromises CIA triangle of information security of India and Confidentiality-Integrity-Availability. These attacks decelerates the growth of digital economy (Whitman & Mattord, 2003; Whitman & Mattord, 2008; Whitman & Mattord, 2012; Gnanasambandam et al., 2012; Durand & Vergne, 2013; Boyle & Panko, 2015; Tapscott, 2015; Deloitte, 2015; Nedeltchev, Gopalratnam, & Tirumala, 2015) For India, according to data since 2004 of Indian Computer Emergency Response Team (CERT-In, 2016), there are 310,146 attacks, or approximately 25,846 attacks per years.

According to the above-mentioned concern, this article has three focuses on India in order to get the basic information about cyber-attacks in India and the lessons for the implementation of digital economy of Thailand as follows: 1) to find out the types and patterns of all cyber-attacks in India during 2004-2015, 2) to investigate the relationship between GDP of India and the cyber-attacks in India during 2004-2015, and 3) compare the cyber-attacks between India and Thailand during 2012-2015 due to the availability of Thai data.

2. Digital India

The Digital India has been adopted by Prime Minister Narendra Modi since 2014. It is an umbrella program, run by Department of Electronics and Information Technology (DeitY) for many government Ministries and Departments under a single vision of the Government of India in order to prepare and promote “citizen empowerment and inclusion” and “digital economy / knowledge economy” in India. It has lots of consultations from many entities such as government, industry, civil society and citizens. It also employs the “myGov” (<http://mygov.in/>) – a digital platform by DeitY – for facilitating, collaborating and participating the program. In general, the program centered on 3 key areas – info-structure for every citizen, public services on demand, promotion of digital literacy and IT access of every citizen. In addition, there are nine strategies / pillars in this program: broadband highways, universal access to mobile connectivity, public internet access program, e-Governance reforming government through technology, e-Kranti or electronic delivery of services, information for all, electronics manufacturing, IT for jobs and early harvest programs. Each of these strategies is run across multiple ministries and departments (Department of Electronics and Information Technology, Ministry of Electronics and Information Technology, Government of India, 2015; Deloitte, 2015).

3. Type of Information Attacks

Cyber-attacks are any acts by threat agents for compromising the security of victims’ devices for the interest of attackers (Whitman & Mattord, 2003; Whitman & Mattord, 2008; Whitman & Mattord, 2012). There are various classification of information attacks (Whitman & Mattord, 2003; Whitman & Mattord, 2008; Whitman & Mattord, 2012; Oz, 2009; Brown, C.V. et al., 2014; Marakas & O’Brien, 2014; Valacich & Schneider, 2014; Boyle & Panko, 2015; Laudon & Laudon, 2016; European Computer Security Incident Response Team Network, 2003).

In this paper, eCSIRT’s taxonomy will be employed for data analysis because it is the standardized framework which covers all above-mentioned classifications. In addition, it is very convenient for comparing with cyber-attacks in Thailand, which employs this classification for national cyber-security (Gohwong, 2016a).

European Computer Security Incident Response Team Network (eCSIRT) employs the WP4 Clearinghouse Policy - Release 1.2, the common framework for information security – classified by Jimmy Arvidsson in 2003, as follows: abusive content (spam, harassment, child/sexual/ciolence), malicious code (virus, worm, Trojan, spyware, Dialer), information gathering (scanning, sniffing, social engineering), intrusion attempts (exploiting of known vulnerabilities, login attempts, new attack signature), intrusions (privileged account compromise, unprivileged account compromise, application compromise), availability (DoS, DDoS, Sabotage), information security (unauthorized access to information, unauthorized modification of information), fraud (unauthorized use of resources, copyright, masquerade), and otherall incidents which don't fit in one of the previous categories (European Computer Security Incident Response Team Network, 2003).

4. Methodology

This study is a quantitative research. The data for analysis were 1) the cyber-attacks data during 2004 – 2015 from Indian Computer Emergency Response Team (CERT-In, 2016) for analyzing the types and patterns of all cyber-attacks in India during 2004 – 2015, 2) the cyber-attacks data during 2012 – 2015 from MICT of Thailand (MICT of Thailand, 2016) for comparing India and Thailand, and 3) GDP data from World Bank (World Bank, 2016) for finding out the relationship between GDP of India and the cyber-attacks in India during 2004-2015. The statistics employed in this study are frequency, percentage, mean, standard deviation, Pearson's Product-Moment Correlation. The level of significance is set at .05.

5. Findings

5.1 Types and patterns of all cyber-attacks in India during 2004 – 2015

All cyber-attacks in India during 2004 – 2015 are shown in Table 1 and Figure1.

Table 1 Types and patterns of all cyber-attacks in India during 2004-2015 (N = 12)

| eCSIRT's classification | India | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | Total |
|-------------------------|-------|-----------|------------|------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|---------------|--------------|---------------|
| Abusive content | 1 | 0 | 0 | 0 | 0 | 305 | 285 | 981 | 2480 | 8150 | 54677 | 85659 | 0 | 152537 |
| Information security | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25037 | 26244 | 51281 |
| Intrusions | 3 | 0 | 0 | 0 | 0 | 835 | 6548 | 6344 | 4394 | 4591 | 5265 | 7286 | 961 | 36224 |
| Malicious code | 4 | 5 | 95 | 19 | 358 | 408 | 596 | 1817 | 2765 | 3149 | 4160 | 4307 | 9830 | 27509 |
| Other | 5 | 4 | 18 | 17 | 264 | 148 | 160 | 188 | 1240 | 2417 | 3484 | 3610 | 8213 | 19763 |
| Information | 6 | 11 | 40 | 177 | 223 | 265 | 303 | 477 | 1748 | 2866 | 3239 | 3317 | 3673 | 16339 |
| Fraud | 7 | 3 | 101 | 339 | 392 | 604 | 374 | 508 | 674 | 887 | 955 | 1122 | 534 | 6493 |
| Availability | N/A | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Intrusion Attempts | N/A | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | 23 | 254 | 552 | 1237 | 2565 | 8266 | 10315 | 13301 | 22060 | 71780 | 130338 | 49455 | 310146 |

Note. 1 = Spam, 2 = Website Defacements, 3 = Website Compromise (Website Intrusion) and Malware Propagation, 4 = Virus / Malicious Code, 5 = Others, 6 = Network Scanning/Probing, 7 = Phishing

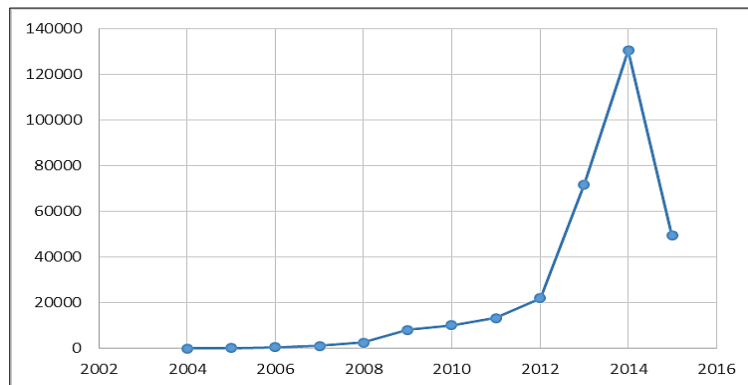


Figure 1 Amount of overall cyber-attacks in India during 2004-2015

The findings were found as follows:

- 1) There are 310,146 attacks, or approximately 25,846 attacks per year in India during 2004 – 2015.
- 2) According to Figure 1, in overall, there has been an upward trend of cyber-attacks in India since 2004 – 2014. After that, due to the implementation of “Digital India” program on infrastructure, online governmental services, and IT literacy since 2014, it becomes the downward trend in which 62.1% decreased from 2014.
- 3) In categorical level, there are two absolute different trends according to techniques of cyber-attacks – upward and downward trends. The upward trend in pattern I, shown in figures 5 – 8, comprises all crowd – oriented cyber-attacks as follows: information gathering (network scanning / probing), information security (website defacements), malicious code (virus), and other attacks such as email spoofing (2004-2006) whereas the downward trend in pattern II, shown in figures 1 – 4, focuses on individual-oriented cyber-attacks such as abusive content (spam), intrusions (website compromise / website intrusion and malware propagation) and fraud (phishing).

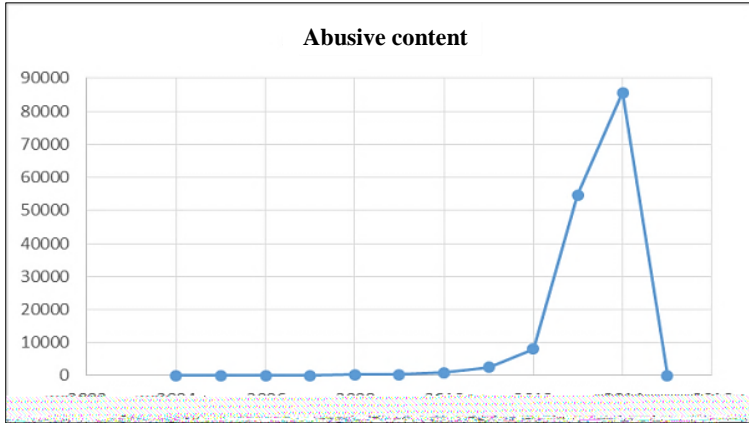


Figure 2 Abusive content in India during 2004-2015

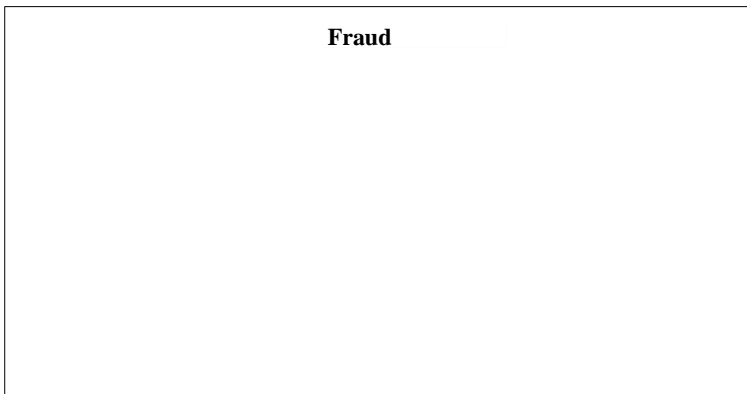


Figure 3 Fraud in India during 2004-2015

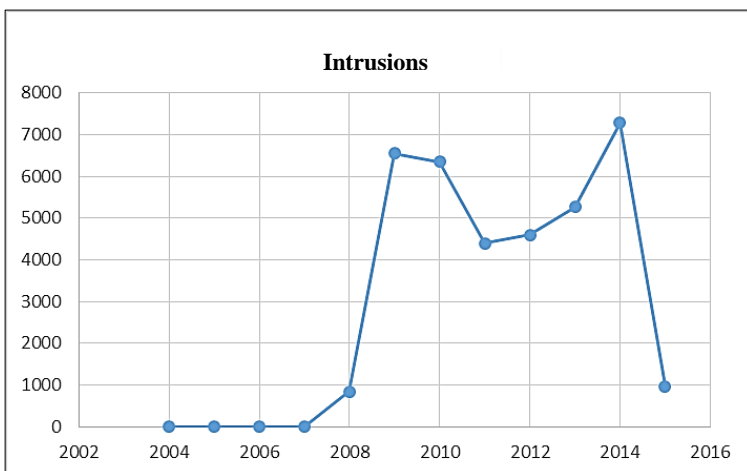


Figure 4 Intrusions in India during 2004-2015

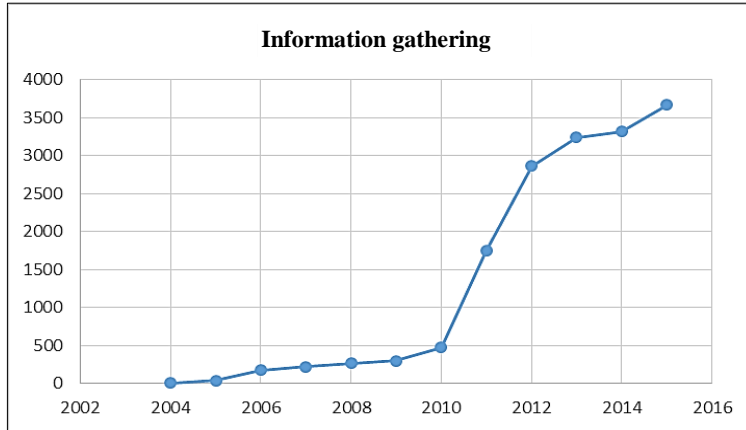


Figure 5 Information gathering in India during 2004-2015

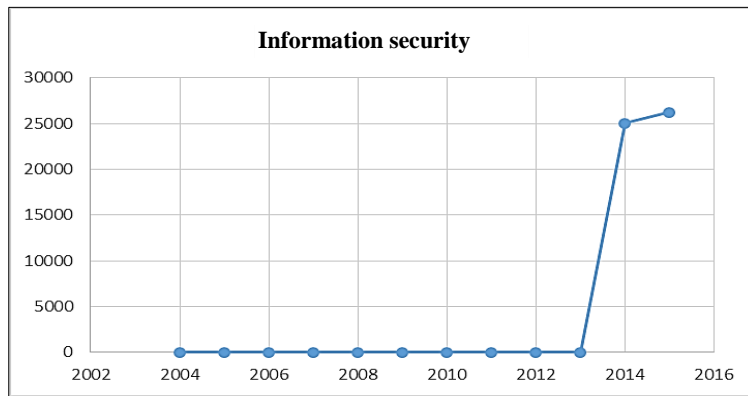


Figure 6 Information security in India during 2004-2015

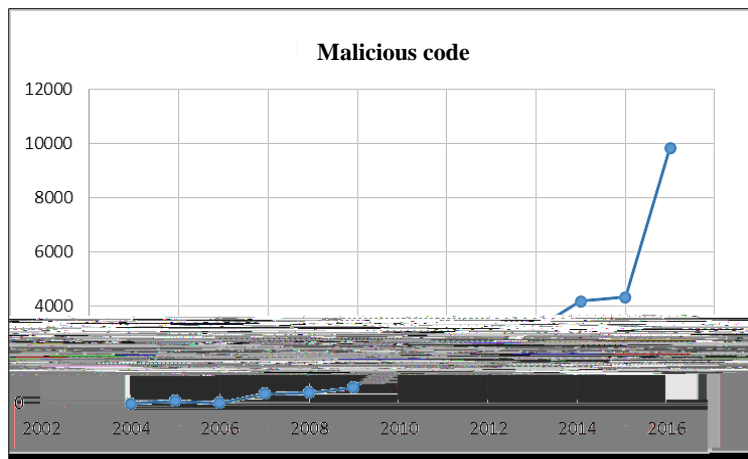


Figure 7 Malicious code in India during 2004-2015

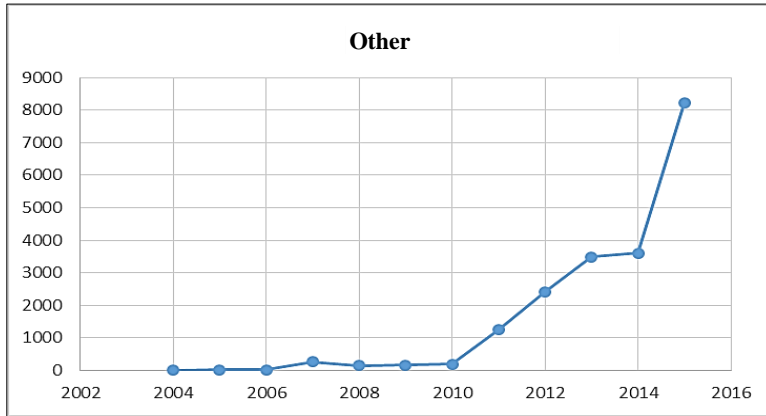


Figure 8 Other attacks in India during 2004-2015

- 4) In aspect of techniques of the attacks, there are big four in India during 2004-2015 (see Table 2): abusive content, information security, intrusions, and malicious code. The big four cyber-attacks can be categorized into two groups: crowd-oriented cyber-attacks (information security and malicious code) and individual-oriented cyber-attacks (abusive content and intrusions). The first group has in the upward trend though its number of attacks is less than the latter group. In contrast to the first one, the latter one has downward trend though abusive content which is the highest and intrusions is in the third place. However, spam as one technique in abusive content is the highest cyber-attacks with almost 50% in India.

Table 2 Overall of cyber-attacks in India during 2004-2015 (N= 12)

| eCSIRT's classification | India | Total | Mean |
|-------------------------|--|----------------------------|-----------------|
| Abusive content | Spam | 152537 (49.18) | 12711.42 |
| Information security | Website Defacements | 51281 (16.53) | 4273.42 |
| Intrusions | Website Compromise (Website Intrusion) and Malware Propagation | 36224 (11.68) | 3018.67 |
| Malicious code | Virus / Malicious Code | 27509 (8.87) | 2292.42 |
| Other | Others | 19763 (6.37) | 1646.92 |
| Information gathering | Network Scanning/Probing | 16339 (5.27) | 1361.58 |
| Fraud | Phishing | 6493 (2.09) | 541.08 |
| Availability | N/A | 0 (0.00) | 0 |
| Intrusion Attempts | N/A | 0 (0.00) | 0 |
| Total | | 310146 (100.00) | 25845.50 |

The association between GDP of India and the cyber-attacks in India during 2004-2015 is shown in Table 3.

Table 3 The association between GDP of India and the cyber-attacks in India during 2004-2015 (N = 12)

| Cyber-attacks in India During 2004 – 2015 | GDP (current US\$) | |
|--|--------------------|-------------|
| | r | P |
| Abusive content | .490 | .11 |
| Fraud | .842 | .00** |
| Information gathering | .844 | .00** |
| Information security | .538 | .07 |
| Intrusions | .691 | .01* |
| Malicious code | .777 | .00** |
| Other | .698 | .01* |
| Total | .666 | .02* |

* Significant at the .05 level, ** Significant at the .01 level

There are quite high positive relationship between GDP of India and the cyber-attacks in India during 2004-2015 in the overall level at the .01, and categorical level, fraud, information gathering, and malicious code have high positive relationships with GDP of India at the .01, and with intrusions and other at .05.

5.2 Comparison between India and Thailand

The key purpose of this paper is to give an important lesson for Thailand; therefore, comparison of cyber-attacks between India and Thailand is a must. However, due to the availability of data, comparison of cyber-attacks between India and Thailand was conducted only during 2012-2015. In addition, Z-score, shown in Table 4, was employed in this study for standardizing cyber-attacks data from two different sources, which had different amount, data collection methods and mean (Rowntree, 2000; Rumsey, 2011).

Table 4 Z-score of cyber-attacks between India and Thailand during 2012-2015

| Z-score of cyber-attacks during 2012 - 2015 | India | Thailand |
|---|-------------|-------------|
| Abusive content | 2.51 | -0.79 |
| Availability | -0.65 | -0.79 |
| Fraud | -0.57 | 1.44 |
| Information gathering | -0.37 | -0.74 |
| Information security | 0.44 | -0.80 |
| Intrusions | -0.26 | 0.76 |
| Intrusion Attempts | -0.65 | 0.23 |
| Malicious code | -0.19 | 1.48 |
| Other | -0.27 | -0.80 |
| Total | 5.18 | 6.47 |

Table 5 Types and patterns of all cyber-attacks in Thailand during 2012-2015 (N= 4)

| eCSIRT's classification | Thailand |
|-------------------------|---------------------------------|
| Malicious code | 3439 (31.51) |
| Fraud | 3376 (30.93) |
| Intrusions | 2358 (21.60) |
| Intrusion Attempts | 1559 (14.28) |
| Information gathering | 99 (0.91) |
| Abusive content | 32 (0.29) |
| Availability | 26 (0.24) |
| Other | 19 (0.17) |
| Information security | 7 (0.06) |
| Total | 10915 (100.00) |

Table 6 GDP between India and Thailand during 2012-2015

| Year | India | Thailand |
|------|------------|------------|
| 2012 | \$1,444.27 | \$5,859.92 |
| 2013 | \$1,456.20 | \$6,171.26 |
| 2014 | \$1,576.82 | \$5,941.84 |
| 2015 | \$1,581.59 | \$5,814.86 |

Note. GDP per capita (current US\$)

Source: World Bank, 2016a, 2016b

According to the data from Tables 4, 5 and 6, in overall, the amount of cyber-attacks in Thailand (Z score = 6.47), with greater GDP per capita than India, was higher than India (Z score = 5.18). In categorical level, Thailand had more serious malicious code and intrusions – two top cyber-attacks of both countries –than India with approximately 1.48 S.D. in malicious code and approximately 0.76 S.D. in intrusions.

6. Discussion

Findings about cyber-attacks in India during 2004-2015

- 1) The finding about 310,146 attacks, or approximately 25,846 attacks per year in India during 2004-2015 reveals one fact that the more access to Internet under digital economy since 1996, the less information security (Whitman & Mattord, 2012).
- 2) In overall, there has been an upward trend of cyber-attacks in India since 2004-2014, except in 2015 due to the implementation of “Digital India” program, especially the third area – promotion of digital literacy and IT access of every citizen (universal digital literacy) by universal access to

digital resources, all documents such as certificates and entitlements on cloud, digital resources / services in Indian languages, “myGov” as a key collaborative digital platform for participating the program. People with good IIT knowledge do not easily become the victims of cyber-criminals.

- 3) In categorical level, two absolute different trends – upward and downward trends occur in India. The upward trend focuses on all crowd – oriented cyber-attacks as follows: information gathering, information security, malicious code, and other whereas the downward trend focuses on individual-oriented cyber-attacks such as abusive content, intrusions, and fraud. These attacks of the upward trend focuses on property rights and intellectual property, online anonymity, network security (Himma & Tavani, 2008; Quinn, 2012; Quinn, 2015; Laudon & Laudon, 2016).
- 4) For the investigation of association between GDP of India and the cyber-attacks in India during 2004-2015, there are quite high positive relationship between GDP of India and the cyber-attacks in India during 2004-2015 in the overall level at the .01, and categorical level, fraud, information gathering, and malicious code have high positive relationships with GDP of India at the .01, and with intrusions and other at .05. This findings support the previous findings in 6.1.1 that the more access to Internet under digital economy, the less information security, and in 6.1.2 that almost of cyber-attacks are attacks towards masses of people with high positive relationship such as information gathering ($r = .844$), malicious code ($r = 0.777$), other ($r = 0.698$), except fraud ($r = 0.842$) and intrusions ($r = 0.691$). It shows an interesting trend in India that the state of the art and trend of cyber destruction in India focuses on mass deterioration.

In overall, an important lesson for Thailand from the previous findings is that India (Z score = 5.18) with lower value of GDP per capita faced cyber-attacks less than Thailand (Z score = 6.47) because she had higher gap of digital “haves” and digital “have-nots” than Thailand. This kind of problem about access to ICT equipment with Internet is digital divide, measured by ICT Development Index (IDI). This standard tool, which full score is 10, has 11 indicators in three groups – access, use and skills. For instance, in 2015, her IDI score 2.69 whereas Thailand was 5.36 (ITU, 2015). If IT is considered as a language, people in the country with good IT literacy who can both use, read and write or code the programs do not easily become the victims in digital setting. In addition, some people often have opportunistic behaviors by committing cyber-crimes from their good knowledge on digital language. In other words, the more IDI score, the more people with high IT literacy. That is why India with low IDI score mostly had cyber-attacks in information gathering (network scanning / probing), information security (website defacements), malicious code (virus), and other attacks such as email spoofing (2004-2006) – which are the crowd-oriented cyber-attacks – because it is quite convenient for attackers to do this kind of cyber-attacks against their victims who have low IT literacy about network security. On the other hand, Thailand with medium IDI score mostly faced the problems from individual-oriented cyber-attacks such as intrusions (website compromise / website intrusion, malware propagation), intrusion attempts, and fraud (phishing) because the attackers must employ more sophisticated techniques against the networks of their victims who have fair IT literacy.

In categorical level, Thailand had more serious malicious code and intrusions – two top cyber-attacks of both countries – than India with approximately 1.48 S.D. in malicious code and approximately 0.76 S.D. in intrusions. The possible reason is that most of top Thai universities according to the top-100 Asia-Pacific universities of Webometrics, the leading E-university ranking, put great emphasis on infrastructure / IT infrastructure in their undergraduate-level curriculum of management information systems such as coding which is necessary for malicious code and intrusions. It is noteworthy that there was not any university of India in the list (Webometrics, 2015; Gohwong, 2016b).

7. Conclusion

This article focuses on the study of the cyber-attacks and digital economy in India during 2004-2015, by using data from Indian Computer Emergency Response Team (CERT-In) in order to (1) find out the types and patterns of all cyber-attacks in India during 2004-2015, (2) investigate relationship between GDP of India and the cyber-attacks in India during 2004-2015, and (3) compare the cyber-attacks between

India and Thailand during 2012-2015. The findings give an important lesson for Thailand, which just fully join the digital economy in 2014 that the more access to Internet under digital economy, the less information security. In addition, it is not easy to find the balance between access and information security, especially in digital economy (Whitman & Mattord, 2012; Tapscott, 2015; Gohwong, 2016).

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