

## APPLICATION OF RFID TECHNOLOGY IN LIBRARIES

**MR. NEERAJ KUMAR SINGH**

Research Scholar

Dept. of Library & Information Science

Email: [neeraj.singh@pu.ac.in](mailto:neeraj.singh@pu.ac.in)

**PROF. PREETI MAHAJAN**

Dept. of Library & Information Science

Panjab University, Chandigarh-160014

Email: [ipreeti2001@yahoo.com](mailto:ipreeti2001@yahoo.com)

### ABSTRACT

*Circulation and shelving of the reading material in a library is quite a cumbersome work which takes most of the time of the library staff. RFID provides a solution to such a problem, by reducing the amount of time required to perform circulation operations. The paper covers the components and technical features of a modern RFID library system, its advantages and issues related to use of RFID in libraries. It also discusses the present status of RFID implantation in Indian libraries and give some suggestions for implementing RFID in libraries.*

**Keyword:** RFID, Radio Frequency Identification, use of RFID in libraries.

### 1.0 INTRODUCTION

RFID (Radio Frequency Identification) which is a combination of radio-frequency-based technology and microchip technology is being hailed as one of the most important application in every field including highway toll payments, automotive, packaging and handling, and retail industries, libraries, etc. The widespread use of RFID by Wal-Mart (the world's largest retailer) and the United States Department of Defense has made other companies and groups aware of the benefits of using RFID. According to Automatic Identification and Data Capture (AIDC),<sup>1</sup> "Radio Frequency identification is a technology that uses radio waves to transfer data between a reader and an electronic tag which is attached to a particular object. Typical uses are for object identification and tracking". According to Harrod's Librarians' Glossary and Reference Book,<sup>2</sup> "Radio Frequency Identification, an alternative to the Bar Code that uses tiny microchips in tags to hold and transmit detailed data about the item tagged. RFID has advantages over bar codes such as the ability to hold more data, the ability to change the stored data as processing occurs, it does not require line-of-sight to transfer data and is very effective in harsh environments where bar code labels may not work". RFID, thus is a generic term for technologies that use radio waves to automatically identify people or objects.

### 1.1 Components of RFID System

### **1.1.1 RFID Tag**

An RFID tag is a tiny radio device that is also referred to as transponder, smart tag, smart label, or radio barcode. There are two main components present in the RFID tag. Firstly, a small silicon chip or integrated circuit which contains a unique identification number (ID). Secondly, an antenna that sends and receives radio waves. The antenna consists of a flat, metallic conductive coil and the chip which is less than half a millimetre.<sup>3</sup>

### **1.1.2 Readers and Antenna**

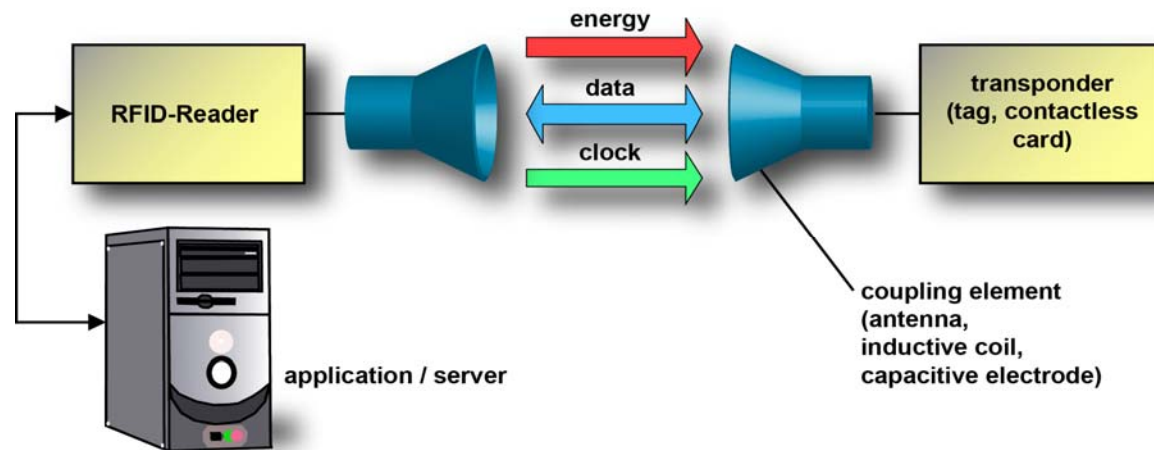
The second component in a basic RFID system is the interrogator or reader. Technically, reader units are transceivers (i.e., a combination of transmitter and receiver) and their usual role is to query a tag and receive data from it. RFID reader converts radio waves from RFID tags into a form that can be passed to middleware software. An RFID tag reader use antennas to communicate with the RFID chip. It can read information stored in the RFID tag and also update RFID tag with the new information. Hence, RFID reader accomplishes two tasks: it receives commands from the application software and communicates with tags.<sup>4</sup>

### **1.1.3 Middleware**

Both middleware and software applications are required in an RFID environment. Middleware manages the flow of information between the readers and the backend. In addition to extracting data from the RFID tags and managing data flow to the backend, middleware perform functions such as basic filtering and reader integration and control. RFID middleware assist with retrieving data from readers, filtering data feeds to application software, generating inventory movement notifications, monitoring tag and reader network performance, capturing history and analyzing tag-read events for application tuning and optimization.<sup>5</sup>

### **1.1.4 Server**

A server may be configured with an RFID system. It is a communication gateway among the various components. It receives the information from one or more readers and checks the information against its own database or exchanges information with the circulation database of the library integrated management system. The server typically includes a transaction database so that the reports can be produced.<sup>6</sup>



*Figure 1: Main components of every RFID system<sup>7</sup>*

## 2. APPLICATION OF RFID IN LIBRARIES

While there are over 500, 000 RFID systems installed in warehouses and retail establishments worldwide, these are relatively new in libraries. Singapore Public Library claims to be probably the first application of RFID technology fully deployed in a library environment in 1998. The use of RFID by libraries since then has grown dramatically. The adoption of RFID technology by libraries promises a solution that could make it possible to inventory hundreds of thousands of items in their collections in days instead of months. In addition, it allow patrons to check out and return library collection automatically at any time of the day. Besides speeding up checkouts, keeping collections in better order and alleviating repetitive strain injuries among librarians, RFID promises to provide a better control on theft, nonreturns and misfiling of a library's assets.<sup>8</sup>

### 2.1 Library RFID Components

An RFID system for library normally consists of RFID tags, a self check-out station, a self-return system/ book drop system, a staff work station, a tagging/programming station, security gate/s, a shelf scanner for inventory/digital library assistant, conveyor belts and sorting systems, etc.<sup>9</sup>

#### 2.1.1 RFID Tag

The tag is paper thin, flexible and approximately 2"x 2" in size which allows it to be placed inconspicuously on the inside cover of each book in a library's collection. It consists of an attached antenna and a tiny chip which stores vital bibliographic data including a unique ID number to identify each item.<sup>10</sup>

#### 2.1.2 Self check-out station

The Self Check-out station is a computer with a touch screen and a built-in RFID reader, software for personal identification, document handling and circulation. Considering the high levels of circulation per day, the staff is always over burdened with the issue and return of books. With the use of Self Check-out system, the patrons can checkout the documents themselves by following the touch screen menu without taking any assistance from library staff.<sup>11</sup>

### **2.1.3 Book-Drop (Return Station)**

The book drop system consists of book drop with screen and receipt printer. It allow patrons to automatically return the library documents. A reader installed in a book drop allows reading of the RFID tags as patron drops off the documents. It eliminates the labour-intensive steps of check-in and deactivation of the security protection by the library staff. It automatically checks- in the document, takes them off the patron's library account and reactivates the security function.<sup>12</sup>

### **2.1.4 Security gates**

Security gate/ EAS (Electronic Article Surveillance) is an anti-theft system used by libraries. It plays a crucial role in detecting unborrowed or improperly checked-out library document. Theft detection is an integral feature of the chip within the RFID tag which performs both the item identification and antitheft function.<sup>13</sup>

### **2.1.5 Automated sorting station**

Automated sorting station take books from the return station, checks them in, sorts and distributes the books to multiple bins or areas for re-shelving. Books are re-shelved by determining their shelving location in less time with less staff work. Libraries with large circulation eliminates the check-in and sorting of returned library documents by combining a sorter with one or more book drop readers. The sorters include conveyers to move materials from the book return(s) to the sorter.<sup>14</sup>

### **2.1.6 Staff work Station**

Staff work station is a staff assisted station which is used in a library for charging and discharging documents, programming of new documents, sorting of documents, etc. It consists of a reader and a PC. For doing programming/tagging of a new library document with the help of staff workstation, it is first put on the reader, the accession number of the document is read with the help of barcode scanner and then the data is downloaded from the library management system.<sup>15</sup>

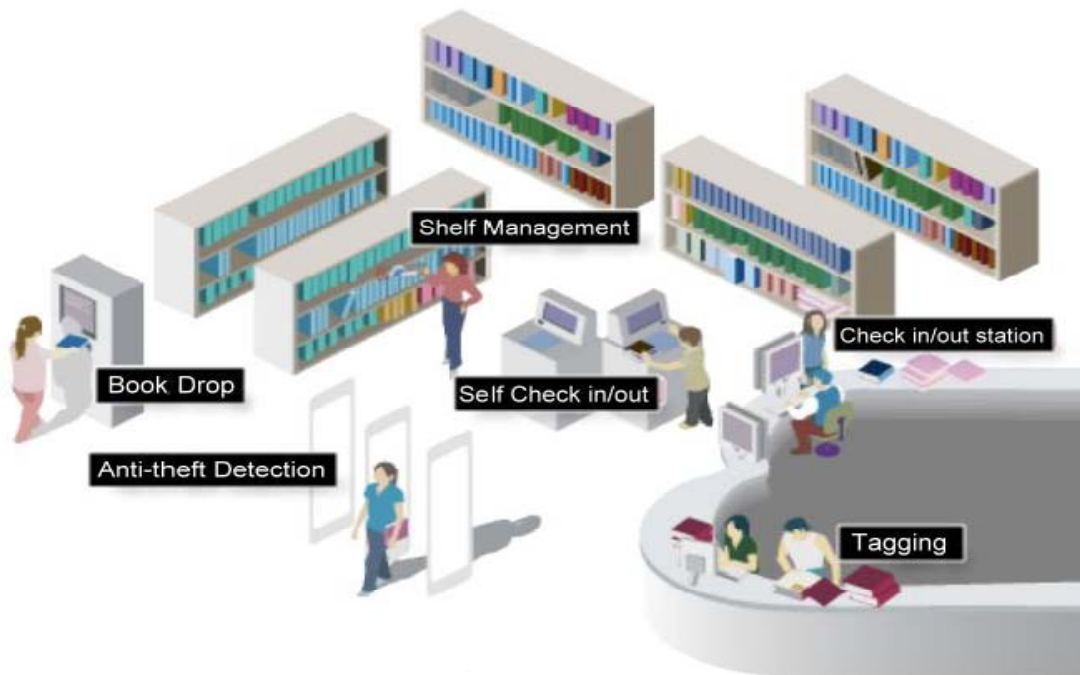
### **2.1.7 Inventory Control**

Inventory and shelf reading can be carried out with a portable reader. The reader transmits identification number to the server, which in turn sends it to library management software and response is returned in real time. Alternatively, information may be downloaded with library management software for inventory control. Shelf Management system makes it easier for the library staff to locate and identify the documents on the shelves.<sup>16</sup>

## **2.2 How RFID system works in the library**

The RFID technology works through flexible, paper-thin RFID tags, which can be placed inside the cover of each and every document. Complete information about each document is entered into the Library Management Software. Whenever a user brings a document for issue-return purpose, the RFID reader from the tag reads the information pertaining to that book and transmits the data into the software and document is issued in a few seconds without the

assistance of the library staff. As the user takes the document outside the library, the antenna placed at the exit gate automatically reads the information contained on the RFID tag to verify whether the document is properly issued or not. In case, it is not issued to the user as per library norms or it is being stolen from the library, the antenna senses it and gives an instant alert. Thus, it results in successful theft reduction of documents. RFID technology is not only being used for circulation purpose in the libraries, it is also used for stock taking purpose.<sup>17</sup>



*Figure 2: Library RFID Management Systems<sup>18</sup>*

### 2.3 Advantages of RFID in Libraries

Due to the low cost of the barcode technology, most of the libraries around the world are using it for circulation management. However, the main constraints related to barcode technology are that it always requires a line-of-sight, does not provide security of library collection, does not offer any benefit for collection management and is becoming very difficult for the libraries to satisfy the increasing demands of the users.<sup>19</sup> Hence, a need was felt to have a better technology that can improve the circulation management, inventory and security of library collections. Some of the advantages of RFID in libraries include issuing multiple books at a time; simplified self-charging/discharging; reduction in queue at circulation desk /counter; more hours of circulation; saving time of the library staff while issue/return of document; allow library staff to provide other users' centric service; reduction of staff at circulation desk ; increased issue/return of library documents; security of library collection, etc.

### 2.4 Issues related to use of RFID in libraries

#### 2.4.1 Privacy and RFID

Because of their nature, RFID tags can be vulnerable to unauthorised scanners reading the information stored on the tags. For this reason, most RFID tags used in the libraries contain a minimal amount of information, essentially the same information as stored on the barcode. But

even if the tag contains nothing more than a unique identifier (like a bar code), there are privacy concerns. Molner & Wagner (2010) have highlighted the potential threats of implementing RFID to patron privacy include unauthorised tags reading, writing, hotlisting, eavesdropping and tracking. Unauthorised tag reading occurs when the data between the reader and tag is unencrypted. This makes it easier for an unauthorised reader to read the data. Unauthorised tag writing occurs when an unauthorised reader inserts data onto the tag during the normal read-write process. For example, the unauthorised reader could illegally reset the security bit, allowing the user to walk out of the library with an unchecked-out book. Hotlisting is the process of illegally capturing data from the tag and matching it with specifically targeted item. Eventually the interloper could build up a database of tag codes and the title of the item associated with each tag. Tracking is the process of using the tag located in the book to keep track of the movements of an individual. In order for tracking to be effective, the individual being tracked must carry the tagged books and there must be unauthorised readers wherever the person travels.<sup>20</sup>

#### **2.4.2 Cost**

While there are many benefits of RFID, the cost of the same is high. For implementing RFID system in Indian libraries, the approximate cost of RFID system includes - RFID tags which varies from Rs. 11-22, Security gates which are in the range of Rs. 4,00000- 5,00000, Staff Work station which is in the range of Rs. 1,45,000-2,00000, Installation & Commissioning of RFID system which varies from Rs. 50,000- 1,00000, Application Software in the range of Rs. 2,00,000- 2,50,000, Server/Docking Station which may cost around Rs. 3,00000- Self Check Station in the range of Rs. 4,50,000- 5,00000, Book-Drop Kiosk in the range of Rs. 5,25,000-5,75,000, Portable RFID reader (Digital Library Assisnat) in the range of Rs. 2,25,000-2,50,000, etc.the cost is an important reason as to why the libraries are not adopting this technology.<sup>21</sup>

#### **2.4.3 Vulnerability to compromise**

It is possible to compromise an RFID system by wrapping the protected material in two to three layers of ordinary household foil to block the radio signal. Clearly, bringing household foil into a library using RFID would represent premeditated theft, just as bringing a magnet into a library using EM technology would be. It is also possible to compromise an RFID system by placing two items against one another so that one tag substantially overlays another thereby cancelling the signals. This requires knowledge of the technology and care in substantially aligning the tags.<sup>22</sup>

#### **2.4.4 Removal of exposed tags**

RFID tags cannot be concealed and are exposed for removal. If a library wishes, it can insert the RFID tags in the spines of all except thin books. However, not all RFID tags are flexible enough. A library can also imprint the RFID tag with its logo and make them appear to be bookplates, or it can put a printed cover label over each tag.<sup>23</sup>

#### **2.4.5 Exit sensor problems**

While the short-range readers used for circulation charge and discharge and inventorying may read the tags as much as 100 percent of the time, the performance of the exit sensors is more

problematic. They must read tags at up to twice the distance of other readers. The performance of exit sensors is better when the antennae on the tags are larger or when the exit lanes are 36 to 42 inches wide.<sup>24</sup>

#### **2.4.6 Standards**

There are no real agreed standards world-wide for RFID. Only set frequency bands and some guidelines are available with regards to RFID. Operational standards and regulations are different for each country.<sup>25</sup>

### **3. RFID USE IN INDIAN LIBRARIES**

Observing the usefulness and efficiency of RFID, libraries in the developing countries have also started implementing RFID for better circulation. Several libraries in India have implemented RFID technology which include: Dayanand Sagar College of Engineering (Bangalore), DESIDOC (New Delhi), Gautam Buddha University (Grater Noida), Indian Institute of Management (Lucknow), Indian Institute of Technology (Madras), Indian Institute of Technology (Kharagpur), Indian Institute of Science (Bangalore), Indian Law University (New Delhi), Indian Institute of Management (Shillong), National Institute of Technology (Rourkela), NASSDOC (New Delhi), National Center for Biological science (Bangalore), National Chemical Laboratory (Pune), National Institute of Technology (Surat), Parliament library (New Delhi), Punjab University (Chandigarh), Punjabi University (Patiala), Ram Manohar Lohiya Law University (Lucknow), University of Jammu (Jammu), University of Kashmir (Srinagar), University of Pune (Pune),etc. However, most of these libraries are either using some components of the RFID system or are using it only for circulation purpose. Infact, libraries in India are in the initial stages of RFID implementation.<sup>26</sup>

### **4. CONCLUSION**

Librarians are always known as early adopters of technology and they have started using RFID to provide more effective and efficient circulation services as well as for security of library collections. Although the use of RFID by libraries over the last few years has grown dramatically, yet the major barriers of RFID technology adoption by more libraries is its cost factor, non availability of standards and user privacy. As far as the cost constraints are concerned, once the libraries implement such a technology, it's benefits can be realized in terms of "Return On Investments" as it will speed up the circulation process and the staff can perform other user centric services. Regarding the non availability of standards, those libraries which are planning to implement RFID must use RFID tags that are ISO 28560 compliant in addition to ISO 15693, ISO 18000-3 and other global standards and protocols given by NISO. It is also very important that to protect user privacy, libraries should follow standard guidelines and store no personal information on RFID tags. Whether the libraries are using RFID technology today or not, they cannot avoid it as nowadays the book distributors have started selling books which are already tagged without any extra cost.

## REFERENCES:

1. Automatic Identification and Data Capture (AIDC). Retrieved from <http://www.aidc.org/>
2. Prytherch, R. (2005). Harrod's librarians' glossary and reference book: a directory of over 10,200 terms, organizations, projects and acronyms in the areas of information management, library science, publishing and archive management. Aldershot, Hants, England Burlington, VT: Ashgate.
3. Ward, M., Kranenburg, R.V., & Backhouse, G. (2006). RFID: Frequency, standards, adoption and innovation (JISC Technology and Standard Watch). Retrieved from [www.jisc.ac.uk/media/documents/techwatch/tsw0602.doc](http://www.jisc.ac.uk/media/documents/techwatch/tsw0602.doc)
4. Kolarovszki, P & Dúbravka, V. (2010). The simulation of production line and warehouse management based on RFID technology through 3d modelling and animation. Proceedings of the 10th International Conference "Reliability and Statistics in Transportation and Communication". Riga, Latvia, p. 426-432. Retrieved from [http://www.tsi.lv/sites/default/files/editor/science/Publikacii/RelStat\\_10/sess\\_9\\_kolarovszki\\_dubravka.pdf](http://www.tsi.lv/sites/default/files/editor/science/Publikacii/RelStat_10/sess_9_kolarovszki_dubravka.pdf)
5. Thornton, Frank (2006). RFID security. Rockland, MA, Syngress. Retrieved from <http://www.doko.vn/tai-lieu/rfid-security-1746299>.
6. Boss, R.W. (2011). RFID technology for libraries. Retrieved from <http://www.ala.org/pla/tools/technotes/rfidtechnology>
7. Finkenzeller, K. (2012). Introduction to RFID. Retrieved from <http://rfid-handbook.de/about-rfid.html>
8. Singh, J., Brar, N., & Fong, C. (2006). The State of RFID Applications in Libraries. *Information Technology and Libraries*, 25(1), 24-32. doi: 10.6017/ital.v25i1.3326.
9. Narayanan A., Sanjay Singh, & Somasekharan M. (2005). Implementing RFID in Library: Methodologies, Advantages and Disadvantages. Paper presented at the Conference on Recent Advances in Information Technology, IGCAR – Kalpakkam, July 14-15, Kalpakkam. Retrieved from <http://www.igcar.gov.in/igc2004/sird/readit2005.pdf#page=282>
10. Biblio Tech Review. (2001). RFID for libraries. Retrieved from <http://www.biblio-tech.com/html/rfid.html>
11. LibBest (2014). Library RFID System - Shelf Management. Retrieved from <http://www.rfid-library.com/shelf.html>
12. LibBest (2014). Library RFID System - Shelf Management. Retrieved from <http://www.rfid-library.com/drop.html>
13. Sarasvathy. P & Jagadish, M. V. (n.d.). Essential of RFID in library management - a view. Retrieved from <http://eprints.uni-mysore.ac.in/16129/1/essentialofrfidinlibrarymanagement-aview.pdf>
14. Vyas, S., Jetty, S., & Hopkinson, A. (2010). Emergence of best security system for libraries: RFID. Paper presented in the International conference on Emerging trends and technologies in Library and Information Science, New Delhi. Retrieved from [http://eprints.mdx.ac.uk/6051/2/RFID\\_SS.pdf](http://eprints.mdx.ac.uk/6051/2/RFID_SS.pdf)
15. Narayanan A., Sanjay Singh, & Somasekharan M. (2005). Implementing RFID in Library: Methodologies, Advantages and Disadvantages. Paper presented at the Conference on Recent Advances in Information Technology, IGCAR – Kalpakkam, July 14-15, Kalpakkam. Retrieved from <http://www.igcar.gov.in/igc2004/sird/readit2005.pdf#page=282>



16. Sandhu, G., & Ukwoma, S. (2012). Awaking Stock taking practice in academic libraries; The Radio Frequency Identification (RFID) technology. Paper presented at the Proceedings of the 12th annual conference on Nigerian Library Association @ 50: driving home the transformation agenda, Enugu, Nigeria. Retrieved from <http://roar.u el.ac.uk/1771/1/Awaking%20Stocktaking%20practices.pdf>
17. Vasishta, Seema (2009). Roadmap for RFID Implementation in Central library, PEC University of Technology. Paper presented in the International Conference on Academic Libraries, Delhi. Retrieved from [http://eprints.rclis.org/17693/1/ical-49\\_196\\_414\\_1\\_RV.pdf](http://eprints.rclis.org/17693/1/ical-49_196_414_1_RV.pdf)
18. LibBest (2014). System Architecture. Retrieved from <<http://www.rfid-library.com/>>
19. Ramzan. M. (2009). Status of information technology applications in Pakistani libraries. *Electronic Library*, 27(4), 573 – 587. doi: 10.1108/02640470910979543
20. Ayre, Lori Bowen (2006). RFID and libraries. In George M Eberhart (Ed.). *The whole Library handbook: current data professional advice and curiosa about libraries and library services* (pp. 452-456). Chicago: American Library Association.
21. Vasishta, Seema (2009). Roadmap for RFID Implementation in Central library, PEC University of Technology. Paper presented in the International Conference on Academic Libraries, Delhi. Retrieved from [http://eprints.rclis.org/17693/1/ical-49\\_196\\_414\\_1\\_RV.pdf](http://eprints.rclis.org/17693/1/ical-49_196_414_1_RV.pdf)
22. Boss, R.W. (2011). RFID technology for libraries. Retrieved from <http://www.ala.org/pla/tools/technotes/rfidtechnology>
23. Narayanan A., Sanjay Singh and Somasekharan M. (n.d.). Implementing RFID in library: methodologies, advantages and disadvantages. Retrieved from [http://www.libsys.co.in/download/implementing\\_rfid\\_in\\_Libraries.pdf](http://www.libsys.co.in/download/implementing_rfid_in_Libraries.pdf)
24. Boss, Richard W. (2004). RFID Technology for Libraries. American Library Association. Retrieved from <http://www.ala.org/PrinterTemplate.cfm?Section=technotes&Template=/ContentManagement/HTMLDisplay.cfm&ContentID=68138>
25. UK RFID Innoware (n.d.) RFID disadvantages. Retrieved from [http://ukrfid.innoware.co.uk/business\\_of\\_RFID/rfid\\_disadvantages](http://ukrfid.innoware.co.uk/business_of_RFID/rfid_disadvantages)
26. Anuragi, M. (2014). RFID technology for libraries: A n Indian scenario. *International Journal for Research in Applied Science and Engineering and Technology*. 2(11), 60-65. Retrieved from <http://www.ijraset.com/files/serve.php?FID=192>

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