Desarrollo De Un Módulo Que Implemente Las Funcionalidades Del Protocolo RTPS Para Ser Utilizado en Aplicaciones de Tiempo Real

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*Resumen*—El Proyecto de titulación comprende el desarrollo de un módulo que implementa funcionalidades del protocolo RTPS para aplicaciones distribuidas de tiempo real.

El módulo contempla una implementación básica del DDS, RTPS, y la interacción de los mismos, para el funcionamiento adecuado del middleware.

Primeramente se presenta el estado actual de los middleware de comunicaciones de tiempo real; realizando un breve estudio de cada tecnología incluyendo al middleware DDS[[1]](#footnote-1). Además se analiza las características y funcionalidades más específicas definidas en el estándar publicado por la OMG[[2]](#footnote-2) sobre DDS y RTPS.

Posteriormente se definen los requisitos necesarios para integrar el protocolo RTPS con el middleware DDS, realizando previamente un análisis de los **diferentes** paquetes RTPS[[3]](#footnote-3).

Se presenta un breve resumen del diseño que permite la interacción entre DDS y RTPS, el cual posteriormente es implementado.

Finalmente se presenta un ambiente de pruebas donde una implementación del protocolo es probada dentro de cuatro computadores que intercambian información.

# Introducción

En la actualidad los sistemas distribuidos de tiempo real se encuentran en una etapa de desarrollo donde se puede tomar varios caminos, es decir diferentes arquitecturas y tecnologías, de las cuales el protocolo de comunicación es parte vital en cada una de ellas, por lo que se requiere que al implementar la comunicación exista una correcta interacción entre el sistema distribuido y el protocolo de comunicación.

El presente proyecto se enfoca en diseñar, implementar y probar, el protocolo de comunicaciones RTPS, el cual es parte del middleware DDS.

# Marco Teórico

## Middleware de Comunicaciones

El Middleware es una capa intermedia de software, el cual se encarga de simplificar el manejo y la programación de aplicaciones, tratando de mantener la complejidad de redes y sistemas heterogéneos transparentes al usuario, por lo que se ha convertido en una herramienta esencial para el desarrollo de sistemas distribuidos.

Los Middleware de comunicaciones, son una abstracción de los detalles de bajo nivel relacionados con la distribución y la comunicación, el cual proporciona las bases para el desarrollo de Middlewares de alto nivel. Este maneja internamente los detalles del proceso de interconexión entre nodos que por lo general incluyen las siguientes características básicas:

* Direccionamiento o asignación de identificadores a entidades con la finalidad de indicar su ubicación.
* Marshalling[[4]](#footnote-4) o la transformación de los datos en una representación adecuada para la transmisión sobre la red.
* Envío o la asignación de cada solicitud a un recurso de ejecución para su procesamiento.
* Transporte o establecimiento de un enlace de comunicaciones para el intercambio de mensajes entre redes vía unicast o multicast.

En la Figura 1, se aprecia los servicios básicos que provee un Middleware.

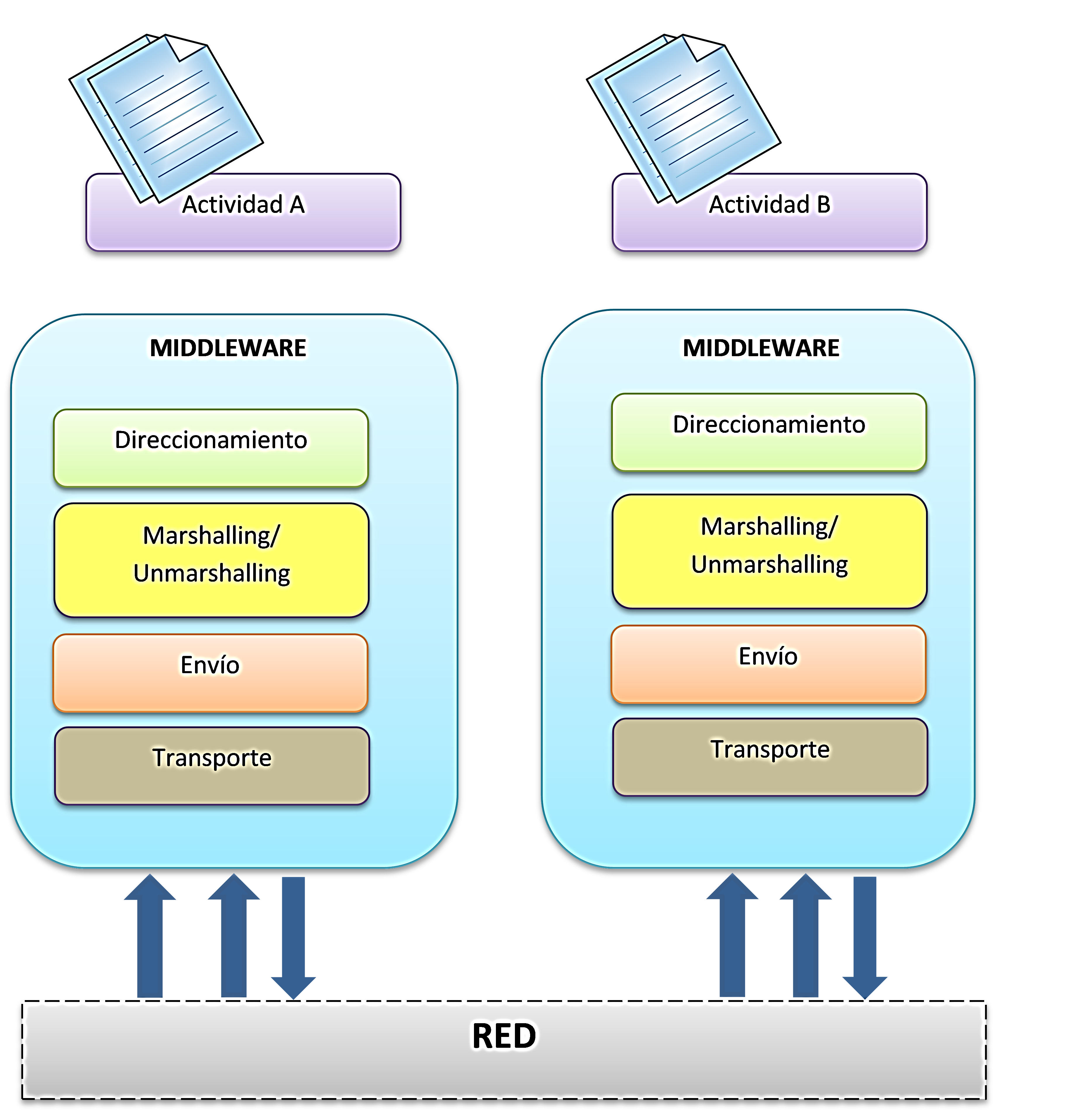


Figura 1. Servicios básicos provistos por el Middleware de distribución [1]

## Middlewares de Tiempo Real

Un sistema de tiempo real se define como un tipo especial de sistema cuya corrección lógica se basa tanto en la exactitud como también en la disminución de retardos en la información. En los sistemas de propósito general, el uso de la tecnología de Middlewares tiene como objetivo facilitar la programación de aplicaciones distribuidas. Con este fin, el Middleware proporciona una abstracción de alto nivel de los servicios ofrecidos por los sistemas operativos, sobre todo los relacionados con la comunicación.

Los desarrolladores son responsables de definir que parte de la aplicación puede ser accesible de forma remota, mientras el Middleware establece y gestiona transparentemente la comunicación entre los nodos del sistema distribuido. Además, los sistemas en tiempo real también se benefician de estas abstracciones de alto nivel.

### CORBA y RT-CORBA[[5]](#footnote-5)

CORBA [2] es un Middleware basado en el modelo de sistema distribuido DOM, el cual utiliza el paradigma Cliente-Servidor y cuya característica principal es facilitar la interoperabilidad entre aplicaciones heterogéneas[[6]](#footnote-6). Esta arquitectura está integrada por los siguientes componentes:

* Object Request Broker (ORB), representa el núcleo del Middleware y es responsable de coordinar la comunicación entre los nodos cliente y servidor.
* Interfaces del Sistema, estas consisten en un conjunto de interfaces agrupadas en función de su ámbito de aplicación.

A continuación se presenta en la Figura 1 una visión general de la arquitectura CORBA.

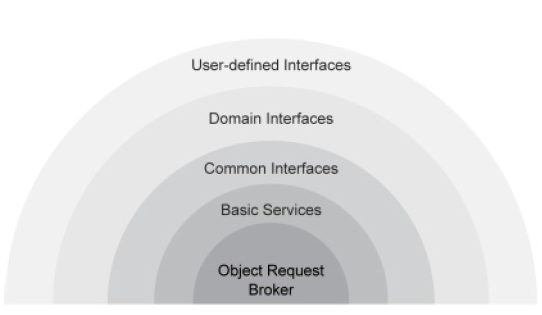


Figura 2. Arquitectura CORBA [1]

RT-CORBA nace a partir de las falencias de CORBA para tiempo real, las cuales se concentran en creación y destrucción de entidades en tiempo real, en los mecanismos de sincronización para controlar el acceso a recursos compartidos, y en los mecanismos para controlar el grado de concurrencia durante la ejecución de las llamadas remotas.

### The Ada Distributed System ANNEX

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* Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as “3.5-inch disk drive.”
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*a**b*    

Note that the equation is centered using a center tab stop. Be sure that the symbols in your equation have been defined before or immediately following the equation. Use “(1),” not “Eq. (1)” or “equation (1),” except at the beginning of a sentence: “Equation (1) is ...”

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* Do not confuse “imply” and “infer.”
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* There is no period after the “et” in the Latin abbreviation “et al.”
* The abbreviation “i.e.” means “that is,” and the abbreviation “e.g.” means “for example.”

An excellent style manual for science writers is [7].

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### Positioning Figures and Tables: Place figures and tables at the top and bottom of columns. Avoid placing them in the middle of columns. Large figures and tables may span across both columns. Figure captions should be below the figures; table heads should appear above the tables. Insert figures and tables after they are cited in the text. Use the abbreviation “Fig. 1,” even at the beginning of a sentence.

1. Table Styles

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1. Sample of a Table footnote. *(Table footnote)*
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##### Acknowledgment *(Heading 5)*

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g.” Avoid the stilted expression “one of us (R. B. G.) thanks ...”. Instead, try “R. B. G. thanks...”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

##### References

The template will number citations consecutively within brackets [1]. The sentence punctuation follows the bracket [2]. Refer simply to the reference number, as in [3]—do not use “Ref. [3]” or “reference [3]” except at the beginning of a sentence: “Reference [3] was the first ...”

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Unless there are six authors or more give all authors’ names; do not use “et al.”. Papers that have not been published, even if they have been submitted for publication, should be cited as “unpublished” [4]. Papers that have been accepted for publication should be cited as “in press” [5]. Capitalize only the first word in a paper title, except for proper nouns and element symbols.

For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

# Referencias

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| --- | --- |
| [1] | H. Pérez y J. J. Gutiérrez, «A survey on standards for real-time distribution middleware,» *ACM Computing Surveys,* vol. 46, nº 49, p. 39, Marzo 2014. |

1. G. Eason, B. Noble, and I.N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529-551, April 1955. (*references*)

We suggest that you use a text box to insert a graphic (which is ideally a 300 dpi resolution TIFF or EPS file with all fonts embedded) because this method is somewhat more stable than directly inserting a picture.

To have non-visible rules on your frame, use the MSWord “Format” pull-down menu, select Text Box > Colors and Lines to choose No Fill and No Line.

1. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68-73.
2. I.S. Jacobs and C.P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.
3. K. Elissa, “Title of paper if known,” unpublished.
4. R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.
5. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” IEEE Transl. J. Magn. Japan, vol. 2, pp. 740-741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].
6. M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.

1. DDS, Data Distributed System [↑](#footnote-ref-1)
2. OMG, Object Management Group [↑](#footnote-ref-2)
3. RTPS, Real-Time Publish-Suscribe Protocol [↑](#footnote-ref-3)
4. Marshalling, es un mecanismo ampliamente usado para transportar objetos a través de una red. [↑](#footnote-ref-4)
5. RT-CORBA, CORBA de Tiempo Real [↑](#footnote-ref-5)
6. Aplicaciones Heterogéneas, se refiere a las aplicaciones codificadas en diferentes lenguajes de programación, ejecución en diferentes plataformas y/o las implementaciones de Middlewares desarrolladas por diferentes empresas. [↑](#footnote-ref-6)